

LUXEMBOURG AS A KNOWLEDGE CAPITAL AND TESTING GROUND FOR THE CIRCULAR ECONOMY

NATIONAL ROADMAP TO POSITIVE IMPACTS

Tradition, Transition, Transformation

December 18, 2014

Colophon

Title

LUXEMBOURG AS A KNOWLEDGE CAPITAL AND TESTING GROUND FOR THE CIRCULAR ECONOMY.

National Roadmap for Positive Impacts. Tradition, Transition, Transformation.

Prepared for

Ministry of the Economy
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in association with **Returnity Partners**

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STUDY HIGHLIGHTS

The circular economy is more than a potential model for Luxembourg; it is an economic imperative.

Terms of Reference in Brief

Describe the pros and cons of why and how Luxembourg uses and might use materials productivity and quality in the circular economy to raise employment, competitiveness and savings, and improve environmental impacts.

The Diversity Imperative

The circular economy is more than a potential model for Luxembourg; it is an economic imperative.

At a December 11, 2014 Cluster Forum, the dynamic achievements of Luxembourg's Innovation Clusters were presented, and in describing those the Secretary of State for the Economy as well as Cluster Presidents and Managers made one thing exceptionally clear; it is a priority for Luxembourg to diversify its economy. The circular economy was described as one way to support that diversification.

In that context it is no accident that the Ministry of the Economy requested the present study to focus on describing how to use materials in the circular economy to diversify Luxembourg's economy so it is still more resilient.

BREAKING NEWS – A NEW OPPORTUNITY FOR LUXEMBOURG ?

In the week the present study was being submitted, European Commission President Jean-Claude Juncker and Vice President Vice-President Frans Timmermans announced the EU legislative package on the Circular Economy was being withdrawn and would be re-tabled in 6 months.

Is it good news or bad news for the Circular Economy? According to Mr. Timmermans;

“We want to make sure the Circular Economy is approached in a circular way and not just half a way.”

Source Circular Economy package to be ditched and re-tabled. Euractive.com 17/12/14

While the outcome is unclear at the time of writing, one thing remains certain; the circular economy as described in the present study is an economic mechanism to achieve positive economic, social and environmental impacts. It is not a sustainability mechanism to create extra costs. Companies who use the positive impacts approach as a basis for their business already achieved considerable success.

In that way, the re-tabling of Circular Economy legislation presents an unexpected opportunity for Luxembourg, which takes over the EU Presidency later in 2015. The opportunity is to focus legislation on creating positive impacts, which are already driving circularity successes. By emphasising positive impacts instead of reducing negative impacts, Luxembourg might guide a new EC package to successful passage and implementation.

The main messages

Circularity is already an economic imperative for Luxembourg and is being used to generate employment and stay competitive. Businesses use it but don't call it the circular economy. As a result the positive impacts are under-stated.

The potential in Luxembourg is great for value creation at the scale of;

- *Systems & Services.* Supplier communities, logistics, ICT, buildings.
- *Products.* Automotive, construction, food, glass, household goods, metal.
- *Components.* Re-using, remanufacturing & recycling.
- *Materials.* Paper, metal, polymers, biochemicals, biomass, secondary raw materials & composites.
- *Additives & Ingredients.* For composites, glass, metals, polymers, & wood.

Government leadership with a low-cost enabling platform will be a catalyst for the private sector to seize opportunities offered by the circular economy to generate positive impacts and add value through innovation.

Business Opportunities Identified

Already-operating and candidates for scaling up;

- Increase local product sales with buy-local co-branding.
- Valorise secondary materials for cost savings & EU compliance.
- Raise metal manufacturing margins with Greater Region suppliers community.
- Preserve & generate jobs with improved materials sourcing in Greater Region.
- Partnering manufacturers with Tarkett for additives quality & materials sourcing.
- Replicate building savings by City of Venlo using goal-setting & residual value.
- Improve construction packaging savings with reusable containers.
- Savings from improving quality and separation of high quality office paper.
- Savings from substitutions to conform with new EU regulations on HFCs.
- Recover high value additives from specialty glass.
- Modular conveyor systems for logistics operating savings.
- B2B is the main potential except for local B2C grocery retailing.

Business Opportunities Identified

Short road to implement from existing platforms;

- Quality assurance & savings on duplication with national coordination.
- Use spare capacity for reverse logistics with the post office.
- Capture value from truck repairs through legal enabling mechanisms.
- Develop a new consulting business with standards for secondary raw materials.
- Sharing & re-use websites for e.g. equipment, vehicles, & excavation residues.

Mid-term perspectives with big win potential;

- Evaluate converting excavation waste dumps into recreation areas.
- Quantify positive impacts with an improved LCA tool.
- Develop reversible biobased composites with Greater Region R&D project.

Government Actions

Leadership on enabling platforms and light-house actions;

- Working Group to start stakeholder task forces & track existing actions.
- National quality co-branding with pilot.
- Education modules & hands-on skills-for-circularity training.
- R&D positive criteria for materials & legislation. Investment matchmaking.
- Initiate Light-House Actions e.g.
 - Facilitate Greater Region actions on materials banking.
 - Quality & valorisation standard & compliance for secondary raw materials.
 - Logistics. Facilitate Paper, Post Office, Repairing.
 - Circular buildings; defined, modular, healthy, savings, added value.

Potential CE Initiating Actions to Align with Existing Activities

December 2014 - March 2015

Working group created from the present study steering committee to;

- Analyse the study in-depth & get feedback from steering committee members.
- Organise consultation with 45+ study interviewees to get feedback and recruit implementers & initiators to be on stakeholder task forces.
- Do stakeholder goal-setting & find capable coordinators for quick-win pilot projects.
- Identify CE leadership group candidates to catalyze government & business.
- Start organising a practical stakeholder workshop to celebrate & accelerate where Luxembourg is already doing the right thing the right way.
- Identify upcoming events & what to announce where & when e.g. Participate in and integrate February finance symposium results.
- Generate a compelling narrative based on stakeholder selection of priorities.

Introduction

The circular economy is more than a potential model for Luxembourg; it is an economic imperative.

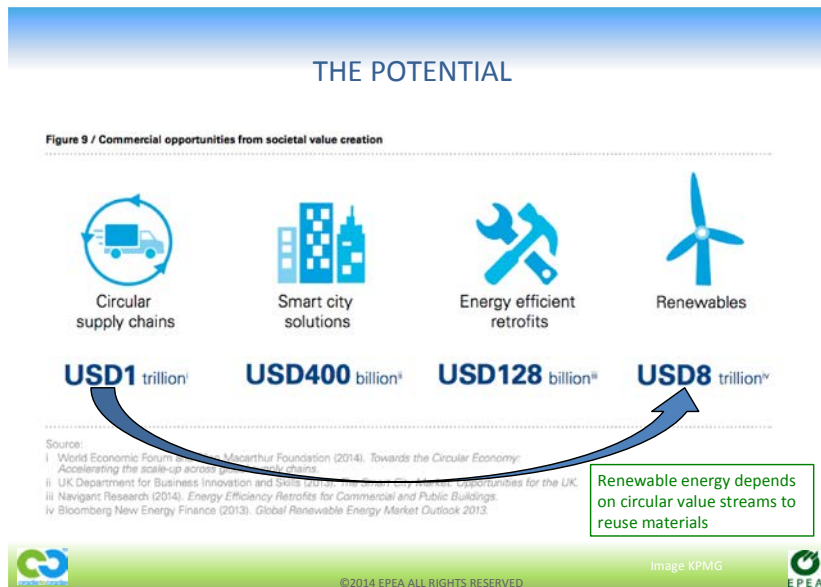
Due to its history of exhausting resources then finding substitutes, Luxembourg is already a testing ground for circularity methods. For example its steel, aluminium, glass, and other industries are experts at re-using secondary raw materials. The re-use of those materials is core to their economic survival. It is a competitive necessity to sharpen their capacities in those areas.

Because Luxembourg's exemplary European society is based on equity, cultural tolerance, economic stability, responsive government and manageable size, the country is a powerful proving ground for circularity. Its heritage of quality and its service-based economy allow leveraging of skills to take advantage of the embedded growth potential. The likely benefits for Luxembourg are considerable. The starting position is excellent. The capabilities and motivation seem to be in place. It is now only a question of providing a nucleus and initial catalyst to accelerate the transition towards a circular economy at scale. The Grand Duchy of Luxembourg and the Ministry of the Economy in particular have powerful roles to play as catalysts for circularity.

In the present situation where knowledge of circular economy potential is low but know-how for supporting technology and services is high, the government has a special brief opportunity to seize the initiative by delivering powerful messages about circularity through initiating and coordinating actions, as well as supporting those with a solid foundation of education, training and national co-branding.

By leveraging those mechanisms the government will provide the enabling framework for its stakeholders to implement a circular economy with innovative lighthouse initiatives.

The Size of the Prize



Highlights Figure I: Total value creation potential relating to circularity. Source image KPMG

How big is the economic prize for circularity?

Estimates vary, but most agree it is large. The estimation of 1 Trillion USD on the left is from a report for the World Economic Forum by Ellen MacArthur Foundation and McKinsey with participation by EPEA. Another 8 Trillion USD estimated from renewable energy is calculated by Bloomberg New Energy. The arrow connecting those results from studies (Gordon et al) suggesting strategic materials supplies for renewables might be problematic, and substitution of those materials on its own might not be sufficient to meet intermediate demand. A restorative paradigm integrating high quality materials with innovative substitution is a main mechanism to avoid shortages. The mechanism is working today. For example logistics equipment companies like Vanderlande Industries and Luxembourg-based companies like Tontarelli, Ecoparc Windhof and Tarkett are generating materials and energy savings for shareholders and customers.

Big Wins from circularity are in materials recovery and materials for renewable energy, with total size of the prize; 9 Trillion USD. How much of that might Luxembourg gain? Up to €3 Trillion in assets resides in Luxembourg financial institutions. Might those funds be invested for circularity?

Estimating Circularity Benefits for Luxembourg

Circularity supports 7,000 – 15,000 jobs as well as more than €1 billion annually in economic activities in Luxembourg primarily in manufacturing but also in buildings, retailing and other areas. Companies using circular service concepts and other mechanisms include some of the largest manufacturers; ArcelorMittal, Eurofoil, Guardian Industries, Norsk, Tarkett, Tontarelli, building developments like Ecoparc Windhof and building equipment leasing and sharing like Floop2 and Loxam, as well as retailers Oikopolis, Pall Center and Cactus. Automotive suppliers have a returnable packaging network for components while Luxembourg leads Europe in automotive leasing and is starting car sharing.

Compared to most of Europe, Luxembourg, the Greater Region & Benelux enjoy a proportionately large share of circularity-designed products, services and systems. According to information compiled as Annexes for the present study, more than 100 products certified for circularity cycles are being offered by local outlets in the Greater Region and at least 15 circular supplier communities are applying service concepts in the Benelux and Germany. Those products and services are driving millions of tonnes of circular materials flows. The proportionately large share of circular activities in the Benelux derives from two complementary catalysts; a survival imperative created by dependence on secondary raw materials, and frontrunner activities utilising the cradle-to-cradle innovation approach.

However, presently statistics are often unavailable or not presented in the right framework to accurately estimate the economic and jobs aspects of circularity in Luxembourg. The following figures and tables provide qualitative and quantitative estimates of the existing and potential benefits based on best available information, summarising types of circularity benefits and potential gains for diverse economic sectors in Luxembourg in accordance with the main focuses of the study; *describe how to improve competitiveness, employment, savings, and environmental impacts.*

Highlights Table I: Benefits & potential gains in the circular economy for Luxembourg

Economic Activity	Competitiveness	Job Preservation & Creation	Savings / value creation	Improving Environmental Impacts
<p>Primary & secondary manufacturing</p> <p>Steel, Aluminium, Specialty glass, polymers.</p>	<p>Steel, Aluminium, Specialty glass manufacturing rely on secondary raw materials to stay competitive. e.g. ArcelorMittal, Eurofoil, Guardian.</p> <p>Offering performance based contracting options and service concepts improves customer lock in and value capture due to quality gains.</p>	<p>Ensuring stable volume flows controlled by Luxembourg entities.</p> <p>Improved separation, potentially improved volumes through supplier communities.</p> <p>Offering additional performance based services.</p>	<p>Matching scrap quality with output quality improves margins. Examples ArcelorMittal, Norsk, Eurofoil.</p> <p>Improve re-use and recycling yield.</p> <p>Improve operating, maintenance savings. Example Vanderlande Industries.</p>	<p>Secondary raw materials content saves up to 90% of energy & emissions compared to primary extraction. Examples ArcelorMittal, Norsk, Eurofoil.</p>
<p>Architecture, Engineering, Construction</p>	<p>Staying competitive with Designs for prefabrication and modularization, improved construction techniques.</p> <p>Creating buildings that are more attractive for customers because they are healthier and more cost effective to occupy.</p>	<p>New policies & standards requiring architects, engineers, construction companies to be responsible for REACH compliance.</p> <p>Systems for Improved separation & reuse of residues, on-site recycling, deconstructing instead of demolishing.</p> <p>Improving market share coverage within Greater Region.</p>	<p>Reducing waste management costs & improving residual value through innovative designs & product use.</p> <p>Example; Venlo City Hall.</p>	<p>Reducing emissions from transporting & landfilling waste.</p> <p>Reclaiming excavation waste sites as useable areas.</p> <p>Eliminating incineration.</p>
<p>Professional trades</p>	<p>As prefabrication, modularity & deconstruction enter markets, trades need related skills to stay competitive.</p>	<p>Maintain quality leadership and offset higher labour costs with higher resource productivity.</p> <p>New skills for refurbishment, disassembly, redesigning.</p>	<p>Refurbishment, repair, disassembly generate savings for customers and extend usage period of current stock.</p>	<p>Contributing to materials recovery & revalorization supports positive environmental impacts. Delays externalities of new production.</p>

Economic Activity	Competitiveness	Job Preservation & Creation	Savings / value creation	Improving Environmental Impacts
Finance	Investments in systems with greater residual value, known materials & improved functionality are more reliable.	Protecting against surprises from REACH non-compliance on investments. Across the spectrum. Table 10.21 in the main study describes <i>Where Finance and Circularity Meet</i> .	Buildings and systems, which have high residual value instead of demolition liabilities are more cost effective. Example; Venlo City Hall.	Investments into defined circular activities have overall positive impacts which vary by project. Example; Improved ROI for Desso & Tarkett shareholders.
Real Estate	Level the playing field as owners won't be able to dump excavation waste offsite and build with undefined materials in the future.	Competitive cost-effective renovation of older buildings. Gaining expertise in building healthy mixed use developments with greater marketing value. Leasing office interiors.	Assets gain value and have lower maintenance costs if designed for total life cycle costing, higher reuse rate offset re-investment needs. Example Park2020.	Buildings have the greatest environmental impacts so improvements have substantial positive impacts. Example Ecoparc Windhof.
Reverse Logistics	Improving efficiencies of existing assets and building re-commerce platforms ahead of competition.	Keeping up with competitors who offer an extra reverse logistics service to your customers. Using spare capacity of physical assets for reverse logistics. Build out new services, i.e. including separation and re-configuration of shipments.	Energy savings, materials savings from reusing existing assets. Improved load factors by re-balancing flows.	Energy savings, materials savings. Reduced emissions due to higher load factor, i.e. fewer trips.
Retailing	Meeting demands of customers for local products, achieve higher margins on local products.	Keeping customers with a local quality label and maintain sales presence. Attracting more customers with a local quality label and create job in upstream product handling (e.g. packaging).	Improve yield and margin on locally sourced products leveraging higher quality and proximity. Examples Oikopolis, Pall Center.	Locally produced, marketed & consumed food is environmentally friendlier. Example Rosport.

Economic Activity	Competitiveness	Job Preservation & Creation	Savings / value creation	Improving Environmental Impacts
Small farms	Staying in business in the face of high costs by quality differentiation	Stay profitable with locally grown label & retailer communities Improve sales through customer communities, increase share of biological agriculture with higher share of labour than mass-production agriculture	Integrating energy production with nutrient recycling generates savings if done effectively. Example; Palaterra.	Locally produced, marketed & consumed food is environmentally friendlier. Improve quality of local soils Example Oikopolis
R&D	Improving functionality, residual value, eliminating fossil fuel use.	Maintaining competitiveness in materials R&D Near-shoring with High-tech has large job creation potential. Creating new materials designed for reversibility and high residual value.	Savings form improved materials quality. Examples Tarkett, Desso, Steelcase. Speeding disassembly through automation.	Potential for very large positive impacts from new materials and sources.
Industrial design	Improving functionality of materials	Improved risk management by avoiding REACH violations. Designs for disassembly to improve residual value, additional work required to re-design products and processes for circular economy (FabLab, GoodYear tires)	Systems designed for offline maintenance, disassembly, less weight and energy use generate savings. Example. Vanderlande Industries.	Systems with easily recoverable materials generate large environmental savings by avoiding primary extraction.
Waste management	Waste management companies compete against each other for business and customers are demanding improvements. Example Pall Center.	Use regional customer supplier networks to prevent loss of business to distant traders. Specialty technologies e.g. food grade upcycling for polymers, recovering rare elements from waste.	Reducing transport, separation & processing costs. Examples; SDK, Ecoparc Windhof.	Replacing incineration with recycling generates large environmental savings.

Economic Activity	Competitiveness	Job Preservation & Creation	Savings / value creation	Improving Environmental Impacts
Accounting & legal	Keeping ahead of the competition on accounting for internalization of external costs; one of the most significant factors for business today.	<p>Improve risk management.</p> <p>New Balance Sheet for measuring economic value of positive impacts</p> <p>New types of contracts for materials banking & leasing, high demand for improved reporting and auditing</p>	Industries wanting to know how much they are saving require economic indicators and KPI verification.	Increased transparency on leakage and improve measurement allows avoidance/re-capture of emissions and externalities
ICT	ICT providers are competing to provide services for cataloguing materials in products & buildings, integrating renewables with lighting systems.	<p>As tax benefits disappear, offer safe haven for data against agency snooping.</p> <p>Developing sharing websites & backbone architecture.</p> <p>Reverse logistics data management.</p>	<p>ICT generates cost-savings by supporting reverse logistics, valorisation of materials, validating data for KPIs.</p> <p>Example; Equipment sharing websites.</p>	By improving use of existing assets, environmental costs are reduced.

Note: The above table is not repeated in the main body of the study.

Defining Circularity

The study found high motivation to learn about circularity, a high level of competence about some tools used for circularity, but a low level of knowledge about the circularity framework. .

To account for those, the following section provides a basic introduction more extensive than normally in a study summary.

Context. EU and EC approaches to the circular economy

On December 16, 2014, the President and Vice-President of the European Commission announced the EC was withdrawing its Circular Economy legislative package and re-tabling it in 2015. The new development represents an unexpected opportunity for Luxembourg to co-develop a positively defined approach to the circular economy in preparation for its EU Presidency.

On its Environment website, the European Commission describes the circular economy package. However, given the withdrawal of the package by the EC, the following information is only a baseline for further preparation by Luxembourg rather than a framework for action;

The circular economy package (package withdrawn Dec 16, 2014)

'The European Commission adopted the [Communication "Towards a circular economy: a zero waste programme for Europe"](#) and [annex](#) to establish a common and coherent EU framework to promote the circular economy. Turning Europe into a more circular economy means:

- *boosting recycling and preventing the loss of valuable materials;*
- *creating jobs and economic growth;*
- *showing how new business models, eco-design and industrial symbiosis can move us towards zero-waste;*
- *reducing greenhouse emissions and environmental impacts.*

As part of the circular economy package, the Commission also adopted a [legislative proposal to review recycling and other waste-related targets in the EU](#) and [annex](#). Achieving the new waste targets would create 180 000 new jobs, while making Europe more competitive and reducing demand for costly scarce resources.'

(Source <http://ec.europa.eu/environment/circular-economy/>)

As a basis for Luxembourg to prepare actions on the circular economy, the EU and EC communications and studies as well as new political developments are reviewed here briefly;

- The published EC interpretation of the circular economy on its website is still anchored in the environment Directorate General rather than in the economic and financial affairs DG. As a result, the CE initiative comes from the environmental perspective despite significant emphasis on economic incentives, and despite significant support for CE approaches in the business community.
- The potential for using the circular economy to generate *Positive Impacts* is described in an August 2014 EC Scoping Study of the circular economy. See chapter 3.2.2 of the present study.
- *However, those positive impacts are not emphasized as much in the EU communication on the circular economy.* For example the term ‘positive impact’ is used only once in the framework publication.

A review of circular economy literature and practice suggests that the potential for generating and capturing value through positive impacts offers wider benefits for Luxembourg than just reducing waste. The potential for positive impacts is explored here, in the context of new developments at the EU, and the wider recommendations of the EC Scoping study.

The historical context of circularity

The term ‘circular economy’ is published in scholarly literature since the 1950s to describe e.g. the positive economic potential of nutrient recycling for integrated agriculture and aquaculture in China. On the other hand, in Germany the term ‘Circular Economy’ or ‘Kreislaufwirtschaft’ is used in waste legislation since the 1990s, so it has a different meaning in Europe’s largest economy than in China or as presently used by circularity proponents.

In Europe at least 18 NGOs and consultancies focus mainly on circular economy and each has its own version of circularity. Among the 9 Benelux-based organisations, all except one were created in the past 5 years. Those examples show why the term ‘Circular Economy’ is still a work in progress.

Defining circularity in the context of the present study

As the core topic of the study is to assess the starting position and potential of a circular economy for Luxembourg, it is important to describe what is understood by the term, as it is still evolving and is subject to different interpretations and focuses. In order to know what is involved in circularity quality assurance, a basic knowledge of the circular economy is a first step.

For the present study focusing on materials, the circular economy is defined as follows, which is less of an all-encompassing definition and more in conformity with the boundaries set for the study;

Circular Economy

The restorative use of materials and products in renewably powered cycles where everything is a resource for something else, generating positive economic, social and ecological impacts through improved quality and resource productivity.

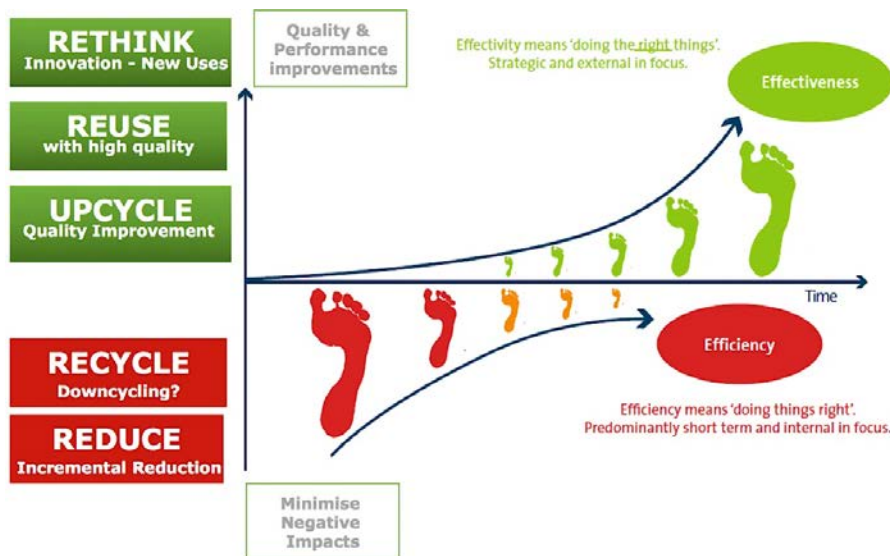
A common notion connected to that definition is the decoupling of economic activity from linear material throughput by replacing the linear 'take-make-waste' paradigm with high-quality material, component and product reuse cycles in a holistic and service-oriented framework.

Scale

- On a descending scale and although definitions of the following terms vary, the circular economy occurs at the level of;
 - Systems & services ranging from taxation to logistics, buildings, agricultural topsoils and emissions re-use,
 - Processes ranging from manufacturing to biodigestion and deconstruction,
 - Products and components ranging from automobiles and paper clips to circuit boards and connectors,
 - Materials ranging from composites to wool,
 - Additives, chemicals and elements ranging from gallium to chlorophyll.
- In Luxembourg examples of circularity are found at each of those levels

Quality and positive impacts

Environmental regulatory approaches focus on *reducing negative impacts*. Circularity focuses on *improving quality* and *generating positive impacts*. The following diagram illustrates the pathway from less negative to more positive.



Highlights Figure II: The road from less negative to more positive. Source EPEA.

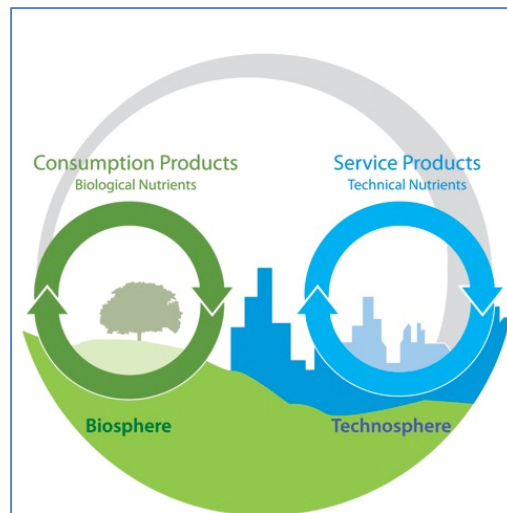
For example,

- The red-coloured section focuses on reducing negative impacts. Under most regulations using the reduction approach a sustainable floor covering has to minimise resource use and emissions.
- However in the green-coloured section, positive impacts are a value-added feature. For example a circularity floor covering *maximises resource re-use* and *actively cleans the air*.

The Benelux is a frontrunner in creating those types of positive impacts. Products certified for circularity cycles have improved the quality of billions of Euros worth of products for Benelux companies like DSM, Desso, Vanderlande Industries, Mosa, and others.

Those frontrunners make products, systems and buildings that do good things and have high residual value. Designing things that are actively positive for the environment, practical and healthy for users, and profitable for manufacturers is an art and a science. Benelux companies are achieving it.

Technosphere and Biosphere



Highlights Figure III: Basis for materials flows in the circular economy (Source EPEA)

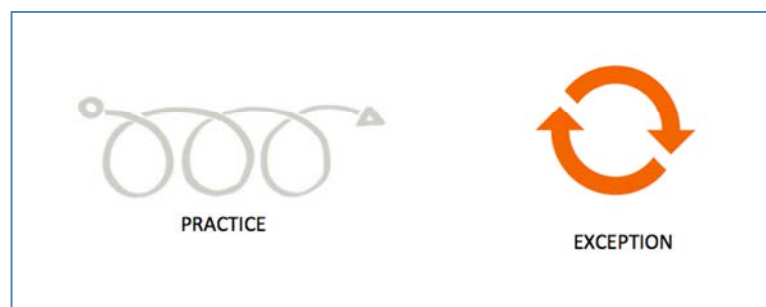
The Technosphere and Biosphere cycles, also referred to as technical and biological cycles, are a scientific and economic foundation for circular ingredients, materials, components, products and systems.

- Figure III describes a broadly acknowledged basis for materials flows in the circular economy; the **Biosphere** where products are designed to be *consumed* then dispersed into the environment, and the **Technosphere** where products are designed to perform a *service* and be kept in technical cycles. The methodology was published in 1992 by Braungart et al and is described more completely in peer-reviewed publications like the Journal of Cleaner Production (Cradle-to-cradle design: creating healthy emissions, 2006).
- Materials in the circular economy are defined by their use in those cycles, rather than if they are biological or non-biological materials. For example, a non-biological element like magnesium is used in the Biosphere as a nutritional supplement, and in the Technosphere as a coating or alloy component. Its toxicity levels and functionalities are significantly different for the Biosphere than they are for Technosphere. In the Biosphere it is designed to be consumed by people and in the Technosphere it is designed to be used and reused. The use defines the materials.
- For products designed for the Technosphere, the circular set-up allows economic arbitrage potential by preserving the embedded material, labour

and capital costs longer in the system. Extending usage periods by maintaining products, components and materials in the inner loops, using them in cascaded value chains and avoiding dilution of quality of feedstock achieves positive economic returns compared to linear take-make-dispose value chains. The resulting increase in resource productivity accelerates decoupling of economic growth from primary raw materials intake.

Systems are central to circularity

- In the circular economy, systems and services concepts are modelled on the Biosphere and Technosphere for sourcing, manufacturing, distributing, using, collecting, repairing, remanufacturing, recovering, recycling, and regenerating materials, components and products.
- Businesses operating in the Benelux designing products and systems on that basis are doing well, for example: architectural tiles (Mosa), floor coverings (Desso & Tarkett), furniture (Steelcase, Ahrend, Herman Miller), lighting (BB-Lightconcepts & Philips), logistics (Vanderlande Industries), paper (Steinbeis), printing (Gugler), and textiles materials (DSM). For those companies, the thousands of substances that give their products functionality are usually not kept in closed loops. Under circularity they are often designed to be released into the environment, or recovered for other processes & products. In this way, *everything is a resource for something else*.
- For example, a USB memory stick rarely becomes a memory stick again. Instead its materials are recovered and used for other purposes. As well, phosphate migrates from soil to plants to products and back again in a wide-ranging cascade. Those spheres and cascades provide innovation opportunities for businesses due to the diversity of potential customers for their products.



Highlights Figure IV: Continuous and closed material flows.

- *Circular supplier communities.* In order to connect those systems across value streams, circular supplier communities link customers with suppliers in new ways in multi-stakeholder platforms by supporting innovation and economy of scale. Those communities exist for everything from textiles to buildings and paper. For example, the largest circular supplier community to date is the Carlsberg Circular Community involving customers & suppliers with combined revenues exceeding €30 billion. The community was started in 2013 to optimise packaging ingredients and packaging returns systems used in dozens of countries for the leading packaging streams including paper, glass, cardboard, metal and plastics.



Highlights Figure V: Illustration describes some Carlsberg circular community participants Source Carlsberg

The role of additives in circularity systems and services

Systems and services are based on products. Products are based on components. Components are based on materials, and materials get their functionality from thousands of additives.

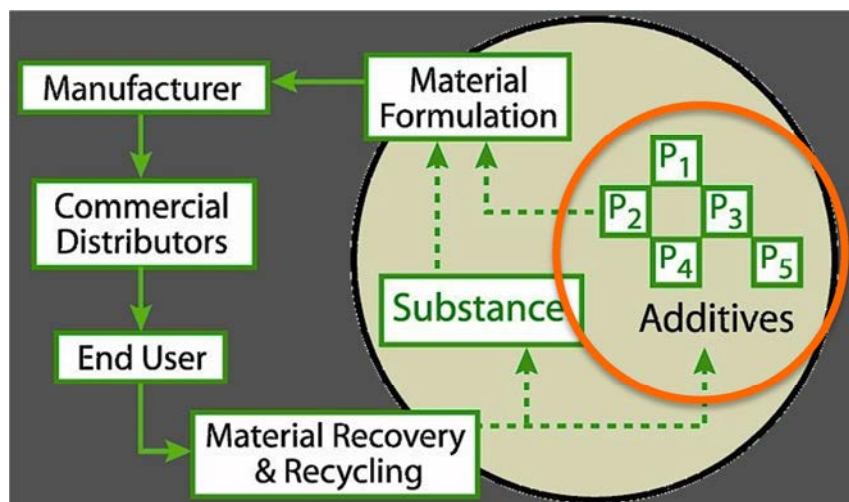
Why are additives so significant for Luxembourg? The leading materials on the EU Critical Raw Materials list are additives rather than bulk materials. Among the 14 most critical raw materials identified by the EU as critical, about 95% are used as additives to give materials functionality; *Antimony, Beryllium, Cobalt, Fluorspar, Gallium, Germanium, Graphite, Indium, Magnesium, Niobium, Platinum Group Metals, Rare earths, Tantalum and Tungsten.* (Source http://ec.europa.eu/enterprise/policies/raw-materials/critical/index_en.htm)

Products like automotive components, floor coverings and speciality glass, manufactured in Luxembourg rely on additives to be functional. Additives are also essential for remanufacturing, repairing and recycling.

Designing additives for safe use & re-use in circular systems is paramount for those systems to work effectively. How to be sure additives are safe and effective as well as available for use in circular systems?

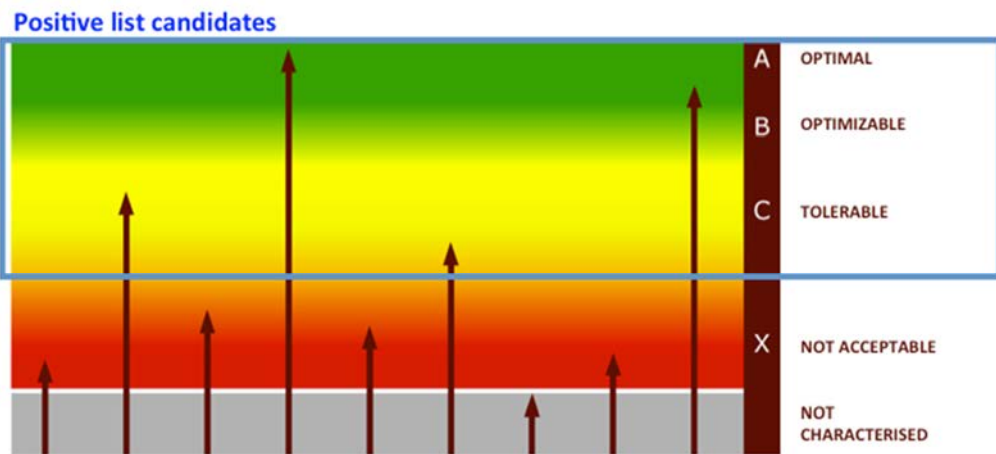
Positively defined additives

Usually, bulk substances like plastics, glass, or metals are easy to evaluate. It is additives that pose the challenge. For example, in Luxembourg's flooring industry large quantities of chemical substances are used in production, from processing of polymers to dyeing the fibers to the final touch of the finished article. In the textiles industry more generally, approximately ten percent of the 2,400 textile-related substances identified in a recent EC analysis are considered to be of potential concern for human health (Source <https://osha.europa.eu/en/news/se-chemicals-in-textiles>). The good news is that hundreds of chemicals, ingredients and materials already are suitable for uses in the circular economy. The still better news is that Luxembourg with The Greater Region has competencies for integrating positively defined additives into products, and this is already done through innovative companies like Tarkett with their R&D centers in Luxembourg. Those companies use circularity powered by cradle to cradle methods to take a new approach to additives; Considering the extensive list of chemicals that are bad for us, it makes more economic and health sense to focus on the ones that are good for us.



Highlights Figure VI: It's the additives that matter. Materials cycle describing how additives determine functionality. Source EPEA.

The following diagram describes the process for assessing positive potential of additives used in materials for products. Ingredients in the upper zones make a Positive List. The EU is starting to use positive lists in its legislation.



Highlights Figure VII: Illustration of assessing ingredients for positive potential.
Source EPEA.

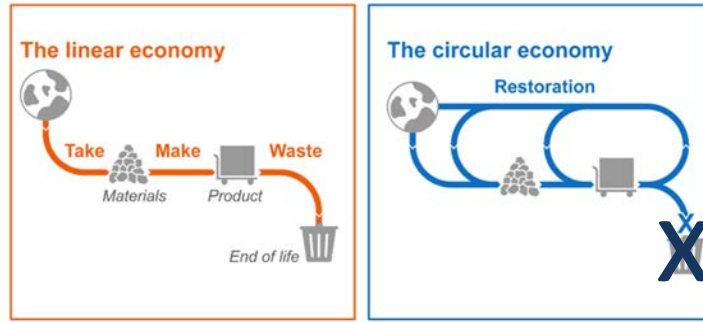
Managing complexity

Due to the complexities of systems, services, products, materials and additives, the main challenge of describing the circular economy is being clear without being simplistic. The basic concept is easy but implementation is challenging because it integrates science with economics.

The challenge is managing complexity.

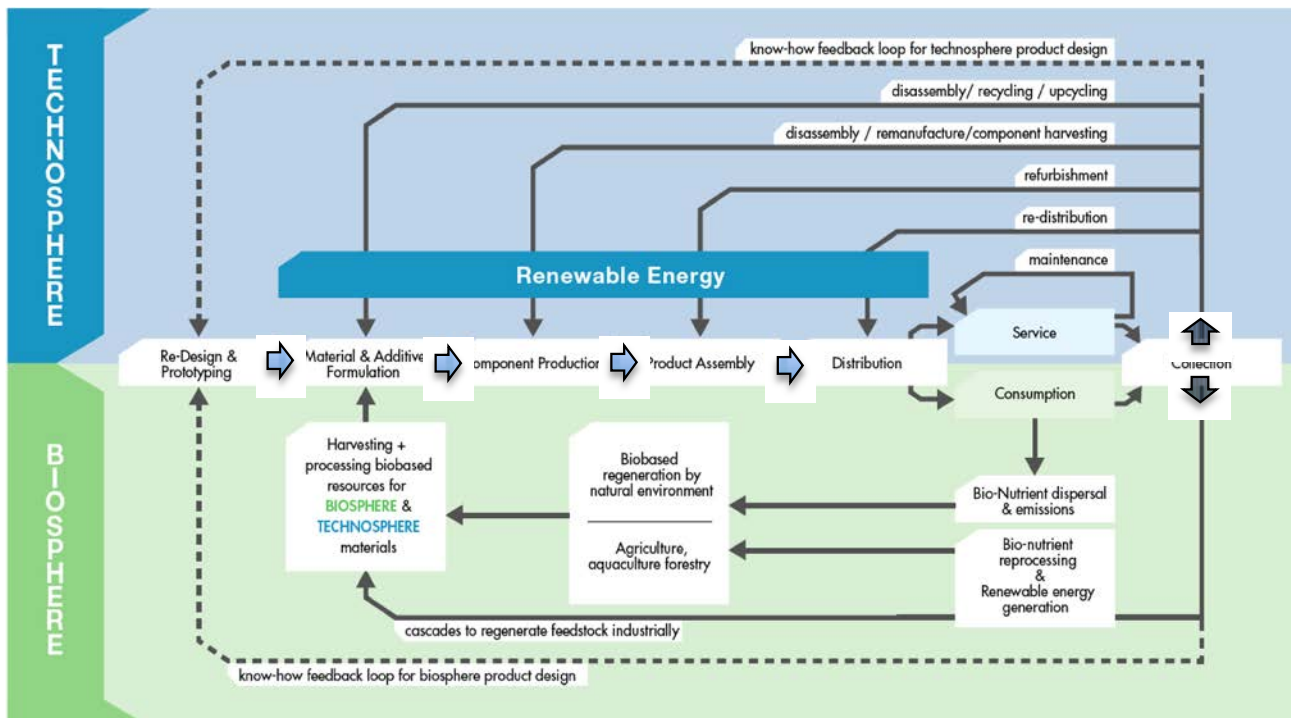
The illustration on the following page describes circularity in simplest terms. The diagram after that describes a framework for managing the more challenging technical flows which comprise a circular economy.

In simplest terms...



Highlights Figure VIII: Diagram Desso.

In economic and scientific terms...



Highlights Figure IX: Circular economy material flows powered by Cradle to Cradle (Source C2CBizz Guide to C2C-Inspired Business Sites. Diagram EPA & Returnity Partners)

The diagram describes the following features, which are significant for Luxembourg's economy;

- *Value capture is possible across the cycles*, including design, prototyping, formulation, manufacturing, assembly, distribution, collection, repair, remanufacturing, disassembly, recycling, reprocessing, regeneration, and re-use. Luxembourg has know-how for most parts of the cycle.
- Designing and prototyping of materials, components and products are value propositions for the circular economy. Designing and prototyping are also strengths of Luxembourg companies, especially R&D divisions.
- *Designing and prototyping are improved when know-how from the back-end is used to optimise circularity at the front end*. Luxembourg companies at the back-end like Superdreckskescht (SDK) and Valorlux have the know-how to support designers and prototypers at the front end.
- *Additives, coatings and trace ingredients* determine the functionality of materials and products. Companies like Tarkett are pioneering new approaches to healthier additives and coatings in Luxembourg.
- *Bio-based resources* are utilized to manufacture materials for the Biosphere and Technosphere. The Technosphere opens a door to new markets for Luxembourg's biobased materials R&D.
- *Dispersion of bionutrients* into the environment supports new feedstock for the circular economy. Designing for dispersion is a competitive advantage. Luxembourg's bio-based materials initiative will gain markets from designing materials in that way for the Biosphere.
- *Renewable energy* is generated by and used to manufacture Technosphere products. It is a tool for companies to capture the 8 Trillion USD projected from renewables as described in the chapter entitled Why Do It?

The Present Situation in Luxembourg

Luxembourg is still predominantly a linear economy. It is running out of local stocks of construction materials like stones for drainage, aggregate for roads, and perhaps sand for high quality concrete. Those scarcities are warning signs.

The opportunity is to adapt successful circularity models to improve materials security by improving resource productivity. The good news is that many of those models exist in and near Luxembourg, as summarized in the following pages.

As well, according to the findings of the present study, and as described in Table 2.1 of the Context chapter, more than 20 commercial planning and research activities are happening across Luxembourg with the potential to accelerate and benefit from circularity. Those activities span diverse sectors and players, making a compelling case for national alignment.

Existing platforms in Luxembourg, the Greater Region and Benelux

- Luxembourg has already a range of circular-oriented mechanisms including steel renting and take-back by ArcelorMittal, automotive leasing by various companies, intellectual property for car sharing through e.g. ArrivalStar, equipment sharing & leasing through Floop2 & Loxam, redesigning flooring materials for circularity through Tarkett, supporting regional biodiversity with a bee biodiverse campaign, reverse logistics management at Amazon and Kuehne & Nagel, R&D on biobased materials, and robotics for disassembly through the CRPs. Circular-oriented customer supplier community networks are operating in and near the Greater Region for; retailing through Oikopolis, Cactus and Pall Center, facilities management through W-Solve, logistics technologies through Vanderlande Industries, paper with Steinbeis, textiles with I-Collect and Climatex, steel with ArcelorMittal, aluminium with Eurofoil and Norsk, specialty glass with Guardian Industries, and others.
- Diverse products designed or certified for circular Biosphere and Technosphere cycles are available for purchase or lease in Luxembourg, the Greater Region or the Benelux and are inventoried for the present study. For example some buildings like Ecoparc Windhof, Venlo City Hall and Park2020 contain dozens of construction products and systems designed for circularity.

Those platforms still require optimisation, but they are a good place to start for launching education and training as well as test marketing of circular B2B and B2C products and systems.

Circular economy knowledge & capacities in Luxembourg today

Knowledge & motivation. Among the 45+ individuals interviewed, and according to their own perceptions of the situation in Luxembourg, there is a generally high motivation to learn about the circular economy but currently only few practitioners are familiar with the concept or have practical experience from applying circular practices. The combination presents a special opportunity and risk; the opportunity to set the right direction, and the risk of missing a competitive potential if nothing is done to craft the approach while it is fresh.

- *The financial industry* is motivated to learn about the circular economy and wants to know the details of implications for each type of business activity. An October 2014 workshop with selected finance industry representatives was well attended and generated a range of questions, which are summarized in the study (Results from circular economy finance workshop) to the present study. Due to this the government has a special and brief window of opportunity to fulfil that information demand to take a frontrunner position on circularity.
- *The construction and manufacturing industries* understand the potential quickly and embrace the concept. For them the question is how to find the right partners along the value chains and to pool enough critical volume to develop profitable business models. The government can be an important catalyst to bring the relevant stakeholders together.

Capacity.

- Luxembourg has the beginnings of an educational and training capacity due especially to commercial experience of companies like Tarkett & Ecoparc Windhof applying cradle-to-cradle (C2C) in buildings and manufacturing. See Defining the circular economy for C2C relevance.
- Among those with some knowledge of the circular economy there is a concern Luxembourg can't do much because it is too small to have the whole cycle in its borders. However, the study found Luxembourg has circularity mechanisms in manufacturing, agriculture, construction, finance, retailing, and education. In R&D, Luxembourg and the Greater Region have diverse capacities for circularity research.
- Measuring Environmental Impacts. Luxembourg companies are already improving their environmental impacts with circular mechanisms but the

tools to accurately measure some of those improvements and reductions are missing.

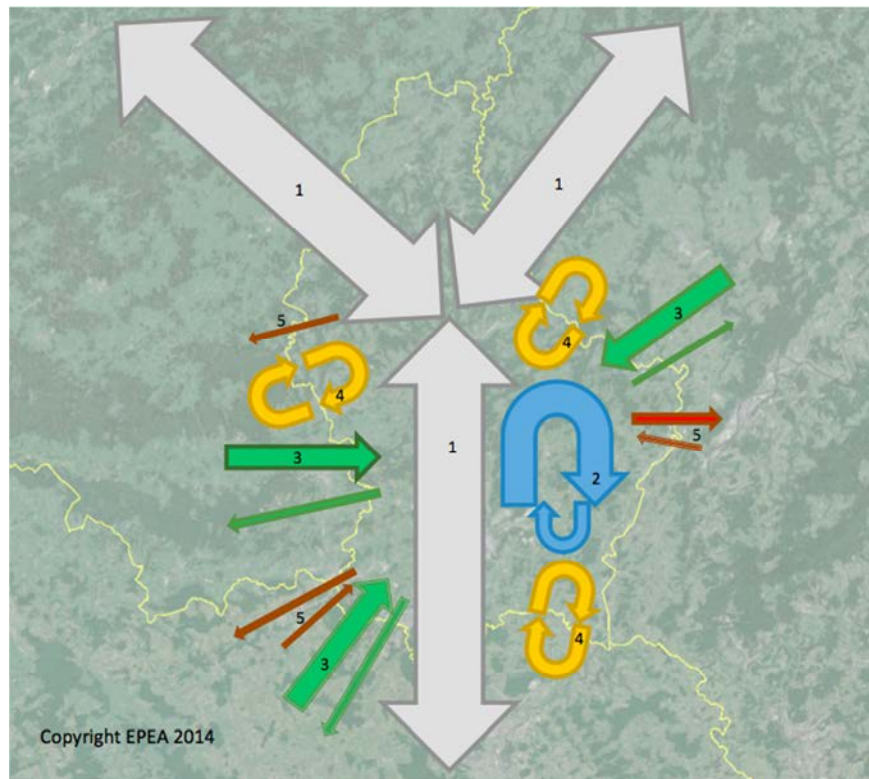
In conclusion Luxembourg enjoys the presence of a number of relevant, circular economy approaches, which can be a robust platform for further growth. While awareness of the opportunity is low, motivation and potential reward to act is high. Now it is important to select and further drive initiatives, which play to the strength of Luxembourg's S.W.O.T profile discussed later.

Materials flows & materials assets

As in financial accounting, there are materials flows and materials assets.

Among the largest human-generated materials flows in Luxembourg are;

- *Logistics*. 50 million tonnes per year transported through hubs.
- *Excavation, inert waste*. ~10 million tonnes per year. In the CE it might also be considered an asset.
- *CO₂ emissions* ~6.2 - 10 million tonnes per year but skewed by 'tank tourism'.
- *Fossil Fuel combustion*. ~3.9 million tonnes per year.
- *Steel & Aluminium from recycled sources* ~2.1 million tonnes per year.
- *Waste exports* 800,000 tonnes per year.
- *Incineration* 120,000 tonnes per year.



Highlights Figure X: Material flows in and out of Luxembourg.

Number + Colour codes;

- 1 GREY **Freight:** 50 million tonnes transiting through Luxembourg hubs. (Luxembourg Logistics Cluster 2013)
- 2 BLUE **Inert waste** incl. excavation 10.5 million tonnes (EEA, 2010)
- 3 GREEN **Fuel:** Imports ~3.9 million tonnes (IEA 2013)
- 4 YELLOW **Steel and Aluminium:** import/export 2. million tonnes (Arcelor Mittal & EPEA)
- 5 RED **Waste:** 823,000 tonnes exported (Statec 2013)

Exclusions;

- 6.2 -10 million tonnes CO2 emissions (IEA).
- Freight transiting through Lux which does not pass through hubs.
- Wastewater, manure, Forestry products.

[Flows to individual countries are illustrative only.]

Materials assets in the infrastructure

There is no reliable estimate on the size of Luxembourg's materials bank represented by buildings, logistics infrastructure, and power generating and transmission infrastructure, but it is certainly in the hundreds of millions of tonnes representing tens of billions of Euros.

Due to fragmentation of the assets, there seems to be no systematic evaluation of the present or residual value of that materials bank.

As materials security becomes more of an issue, it might be productive for the government to develop a reliable way of estimating the total value of Luxembourg's private and public sector materials assets.

How to determine impacts?

Quantities alone do not determine impacts of materials. Although no scientific assessment was found which compares these flows in Luxembourg, and while differing Life Cycle Assessments will result in differing ranking, the same list adjusted for negative environmental impacts like e.g. materials quality/integrity, reducing dependence on externalities, might look quite different.

Criteria for ranking impacts are shown in the main body of the study, but in general terms those considerations include factors described in the following Table II;

Highlights Table II: Considerations for evaluating impacts of materials flows in Luxembourg

Material Flow	Positives	Negatives
Incineration 120,000 tonnes	<ul style="list-style-type: none"> • Marginal energy recovery 5 – 10% of embedded energy • Potential for repurposing 	<ul style="list-style-type: none"> • Most embedded energy is lost • Materials integrity destroyed • Slag & ash contain contaminated mixed content hard to separate • Recycling investment discouraged • Toxic emissions
Fossil Fuel combustion. ~3.7 million tonnes.	<ul style="list-style-type: none"> • Revenues for government • Technical potential for CO₂ recovery from points sources • Energy for society 	<ul style="list-style-type: none"> • CO₂ & Toxic emissions • Non renewable • Requires military infrastructure to secure oil reserves
CO₂ emissions ~6.2 -10 million tonnes but skewed by 'tank tourism'.	<ul style="list-style-type: none"> • Potential for point source re-use 	<ul style="list-style-type: none"> • Climate change risks
Logistics. Transporting 50 million tonnes through hubs.	<ul style="list-style-type: none"> • Large revenues • Large reverse logistics potential • Potential large materials banking infrastructure 	<ul style="list-style-type: none"> • Traffic noise • Land degradation • Large CO₂ emissions
Excavating and transporting, excavation & inert waste. ~10 million tonnes.	<ul style="list-style-type: none"> • Potentially materials asset. • Landscape & recreation potential • Re-use potential on sites 	<ul style="list-style-type: none"> • Large fossil fuel emissions from extraction & transport • Landslides • Land use • Costs
Waste exports 800,000 tonnes destined for valorisation or incineration.	<ul style="list-style-type: none"> • Revalorisation 	<ul style="list-style-type: none"> • Incineration (see incineration previously) • Transport costs & emissions
Steel & Aluminium from recycled sources ~2.1 million tonnes.	<ul style="list-style-type: none"> • Revenues • Saves emissions from primary extraction • CO₂ reuse potential • Practical products • Materials banking potential 	<ul style="list-style-type: none"> • Still has emissions.

Statistics and calculating ecological footprint

While some positive and negatives from that table are obvious and do not require extensive analysis to determine the right or wrong thing to do, still there is no statistical inventory classifying materials flows in those ways, and so there is only a rough basis for evaluating the potential.

For example, extensive studies are done on ecological footprint impacts of some of those materials. A 2010 study by CRP Henri Tudor identified imports and exports having the most impacts on carbon footprinting.

However, the question is; how might those footprint calculations be affected if, for example, purchase of renewable energy by ArcelorMittal electric arc furnaces, or the net energy savings of reprocessing scrap were considered? In a circular economy calculation, the figures might look quite different, but at the moment it is not known how different because the statistics are not gathered or calculated in ways that might allow the calculation. Because Life Cycle Assessment (LCA) is not designed to evaluate the positive potential connected with those materials flows it is also challenging to do a comparative assessment of benefits. In Chapter 8.6 of the present study on LCA the potential to solve the problem is described.

Table 23: Imported products impacting the Footprint of the carbon uptake land category most

Name	EFi	Impact on the total EFi
	[gha]	[%]
Iron & steel scrap	2,669,963	24%
Blooms, billets, slabs, etc. of iron or steel	724,211	6%
Products of polymerization and copolymerization	603,691	5%
Aluminum and aluminum alloys, unwrought	431,159	4%
Machinery and mechanical appliances, nes	412,021	4%
Plates etc. of iron or steel uncoated	367,511	3%
Prods of condensation, poly-condensation & poly-addition	345,885	3%
Builder's woodwork & prefab. Buildings of wood	277,358	2%
Medium plates etc. of iron or steel, 3 4.75mm	248,164	2%
Articles of artificial plastic materials, nes	218,518	2%
Chemical products and preparations, nes.	218,201	2%
Wood simply shaped or worked, nes	212,040	2%
Materials of rubber	179,137	2%
Sum	6,907,859	61%
Total EFi	11,302,544	

Highlights Figure XI: Calculation of leading carbon footprint impacts for imports in Luxembourg. In the tables 'Efi' is Ecological Footprint Imports and 'Efe' is Ecological Footprint Exports. (Source The Ecological Footprint of Luxembourg Technical Report CRP Henri Tudor 2010)

Table 24: Exported products impacting the Footprint in the carbon uptake land category most

Name	EFe	Impact on the total EFe
	[gha]	[%]
Angles etc. of iron or steel, 80 mm or more	1,643,767	17%
Aluminum and aluminum alloys, unwrought	1,180,016	12%
Other coated iron or steel plates	765,116	8%
Products of polymerization and copolymerization	490,565	5%
Rubber tires & tubes for vehicles and aircraft	489,825	5%
Bars and rods of iron or steel, ex wire rod	443,680	5%
Wire rod of iron or steel	364,403	4%
Aluminum and aluminum alloys, worked	355,067	4%
Iron & steel scrap	303,939	3%
Articles of artificial plastic materials, nes	296,700	3%
Fabrics, woven, of synthetic fibers	235,430	2%
Prods of condensation, poly-condensation & poly-addition	222,002	2%
Chemical products and preparations, nes	213,816	2%
Paper and paperboard in rolls or sheets nes	193,091	2%
Sum	7,197,415	73%
Total EFe	9,854,422	

Highlights Figure XII: Calculation of leading carbon footprint impacts for exports in Luxembourg. In the tables 'Efi' is Ecological Footprint Imports and 'Efe' is Ecological Footprint Exports. (Source The Ecological Footprint of Luxembourg Technical Report CRP Henri Tudor 2010)

S.W.O.T. Summary

In performing the S.W.O.T. analysis the present study accounted for S.W.O.Ts done by the Haut Comité as well as by surveys of Luxembourg's economy and environment in global competitiveness reports (e.g. Report on Global Environmental Competitiveness of Luxembourg). As well, S.W.O.Ts by the 2014 EC scoping study on the circular economy, and the U.K. All-Party Parliamentary study on remanufacturing, were considered.

A traditional S.W.O.T analysis structure is not the most practical for Luxembourg because with circularity often weaknesses are also strengths and threats are opportunities. In the main body of the study S.W.O.T was organized by topic to describe challenges and solutions along thematic observations.

However, for the purposes of the summary, here are highlights according to a traditional S.W.O.T structure;

Strengths:

- Excellent geographic location and multi-cultural capabilities with an already extremely high share of transit volume and business relationships.
- Excellent R&D and piloting capabilities across wide spectrum of CE-relevant topics (from material intensive applications (i.e. construction, agriculture, heavy industry) to high-end service provisioning.
- Diversified economy encapsulated in a focused geographic location with strong personal and professional ties to effect cross-sectorial change with a government with clear commitment to guide economic development according to strategic objectives.

Weaknesses:

- Little awareness about CE-opportunity in business community. Potential for confusion about circularity theory and practice.
- For some fractions sub-scale volumes (e.g. for own re-valorization activities) and limited value chain coverage (i.e. only R&D or logistics handling, but no own core manufacturing activities).
- Lack of economic indicators, statistics and LCA scoping parameters to measure progress.

Opportunities

- Become the pre-eminent initiator, orchestrator and enabler of CE-activities by combining design, material flow/logistics and enabling competencies (i.e. financing, planning).

- Become an important CE showroom and test-lab for CE-applications (i.e. CE-construction, CE-consumer product test lab, ...).
- Define CE innovation and R&D frontier by aligning already existing initiatives at Luxembourg level with CE as core vision (i.e. Luxinnovation clusters).
- Identify competent partners with aligned incentives & diverse capabilities in specific value streams, jurisdictions and regional boundaries.

Threats:

- Substantial risk of misunderstanding CE science based on popular misconceptions about materials and cycles, which in turn might lead to misallocated investments.
- Traditional forces blocking innovation and systems redesign (e.g. investments locked up in linear processes with little appetite to sacrifice return of investment, when moving to competing CE-set-ups, e.g. automotive sector's customer base).
- Potential lack of quick tangible results in some CE areas as Luxembourg's opportunity-rich environment could yield mega-trend opportunities which take more time to develop (e.g. biotechnology for aging population, big data investments,...)
- Inability to start circularity initiatives;
 - Perceived absence of decision-makers
 - Materials not designed for healthy use or high residual value.
 - Overlapping jurisdictions on waste and water especially in agriculture.
 - Licensing requirements for companies to handle secondary raw materials.

→ Overall, the CE fits extremely well to Luxembourg's S.W.O.T profile because it will favour locally available sub-systems and play to the specific strengths of Luxembourg. So, a fantastic opportunity.

Barriers and how to overcome them

Earlier studies on the circular economy identified barriers to circularity at EU, regulatory and other levels, and proposed solutions. Rather than re-invent the wheel, the present study points to where those studies are relevant for Luxembourg.

The Near-Term Potential Summarized

If Warren Buffett owns it we must be doing something right.

MBDC CEO Ken Alston referring to Warren Buffett's ownership of Shaw Industries which pioneered circularity designs for carpets (Source C2CBizz event Antwerp Nov. 20, 2014).

Acceleration of circular economic practices in Luxembourg at scale is estimated with the potential to generate €300 million to €1 billion EUR annual net-material cost savings and more than 2.200 jobs especially for young unemployed in the next years, if robustly applied in the construction, automotive, manufacturing, financial, logistics, R&D, and administrative sectors.

Improved material productivity as well as innovation to obtain those savings will strengthen Luxembourg's resilience and support new employment *especially in the high-unemployed youth category where the government has established priorities.*

In order to capitalise on those potentials, it is advantageous to craft a Mission, Strategy and Objectives with measurable Goals and Milestones supported by quick and mid-term wins.

Special note. Refer to the main text of the study in order to appreciate the preconditions and scope of work to achieve those gains. For example, a precondition is that the Ministry as well as frontrunner companies and R&D institutes in Luxembourg adopt circularity as a development approach, and implement circularity education, training, supplier communities and other enabling tools in order to capture savings and realise added value. These are often low-cost mechanisms but nonetheless pivotal for achieving gains.

Indicative rough estimate of potential job creation*

ROUGH ESTIMATE

In number of employees (salaries)

INDICATIVE SENSITIVITY ANALYSIS

Activity	CE-share %	Main lever for job creation				Local value coverage %	Potential %	Total	Comment
		Savings Total	Growth of activity %	Growth labor intensity %	Add additional activities %				
Financial / real estate / renting (J + K)	44,108	5 2,205	10	3	2	2	17	375	More component harvesting, redesign
Wholesale / retail / transport/ communication (G - I)	41,854	5 2,093	10	-	5	-	15	314	Increase offerings of CE-based services (e.g. leasing)
Public administration	40,602	2 812	-	-	3	-	3	24	Build out CE-based programs
Construction	38,796	5 1,940	25	3	2	-	32	621	More separation, material recycling
Manufacturing industries	32,117	10 3,212	3	2	5	-	10	321	Add re-manufacturing capabilities
Health and social services	29,253	0 -	-	-	-	-	0	-	-
Scientific, research, technical	27,609	5 1,380	10	-	-	2	10	138	Increase research around CE topics
Transport and logistics	26,330	5 1,317	10	-	2	2	14	184	Increase in reverse logistics
Administrative services	22,603	5 1,130	5	-	5	-	12	136	Reverse supply chain management
Hotels and restaurants	15,935	0 -	-	-	-	-	0	-	-
IT and communication services	15,752	5 788	5	3	-	-	8	63	Redistribution, repair services
Other services	5,450	0 -	-	-	-	-	0	-	-
Household productions undifferentiated	5,252	0 -	-	-	-	-	0	-	-
Education and training	3,127	2 63	10	-	-	-	10	6	Build out CE-based trainings
Real estate	2,063	5 103	10	-	-	-	10	10	Increase in revalorization of building components
Arts and entertainment	1,716	0 -	-	-	-	-	0	-	-
Not classified	1,593	0 -	-	-	-	-	0	-	-
Water distribution and management	1,470	50 735	10	-	3	-	13	96	Increase sludge processing, nutrient extraction
Agriculture	1,399	10 140	30	2	-	-	32	45	Grow bio-based share of total agriculture
Energy generation and distribution	1,193	10 119	10	-	-	-	10	12	More alternative energy installations
Extra-territorial activities	538	0 -	-	-	-	-	0	-	-
Extracting industries	282	0 -	-	-	-	-	0	-	-
Total	359,042	16,036					2,345		

* Not exhaustive, based on signature activities, 3 year projection
Source: Rapport annuel 2012 agence pour le développement de l'emploi

Highlights Figure XIII: Estimate of potential job creation in 3 years if national programme implemented

As expected the opportunity for job creation is highest in those labour intensive and manufacturing based industries and construction. This is fully in line with the findings derived in the sectorial deep dives discussed in this study.

Moreover as these jobs will require more artisans than white collar professionals, it also highlights the opportunity for growing and establishing CE-activities to address the structural needs of the local labour and employment market.

Overview on material input and potential cost savings

INDICATIVE ESTIMATE

Use and supply

FOR DISCUSSION

2012 in base prices

Activity/sector	Use in EUR millions			Savings in %		Net material cost savings in EUR millions			
	Output	Industry imports	Total	Transition	Advanced	Output Industries		Total	
						Transition	Advanced	Transition	Advanced
Manufacture of computer, electronic and optical products (26_28)	1,320	2,334	3,654	13	21	172	277	475	767
Manufacture of transport equipment (29_30)	141	3,492	3,633	13	21	18	30	472	763
Manufacture of furniture; other manufacturing (31_32)	88	487	575	13	21	11	18	75	121
Total	1,549	6,313	7,862			201	325	1,022	1,651

Source: Statec Luxembourg, ESA95 Questionnaire 1500 – Supply table at basic prices, including a transformation into purchaser's prices (2012), relative savings from Ellen Mac Arthur Foundation – Towards the circular economy report I (2012)

Highlights Figure XIV: Estimate of potential savings in 3 years if national programme implemented

It is important to note, that this potential quantifies the size of the overall opportunity but does not account directly for the potential of Luxembourg to fully capture it, as Luxembourg frequently only covers a relatively small portion of the associated value streams in the respective industries (frequently in activities upstream (e.g. design) and down-stream of the main manufacturing activities (esp. distribution)). For this reason the potential is likely to represent an upper limit (for the contribution from these specific activities).

Added potential for economic gains

While the above estimates solely focus on the manufacturing part of the economy there are two more sectors, construction & services, which stand to provide sources for further economic growth leveraging CE-practices. As for these a solid bottom-up validated estimate on potential net-material savings is not available (esp. for construction) or not meaningful (esp. for services).

However, based on anecdotal information provided in interviews with the steel, aluminium, specialty glass, plastics and flooring industries in Luxembourg, there is a near-universal agreement that margins will be improved by improving the quality of secondary raw materials feedstock, and in some cases it was estimated by interviewees that the improvements might make the difference between profit and loss. As well, similar estimations are possible for the construction industry and these are described in section 4.3.2 in Chapter on Raising Industry Competitiveness.

Potential Visionary Mission for Luxembourg

Luxembourg aspires to be **A Knowledge Capital and Testing Ground for the Circular Economy**, to generate positive impacts, diversify its economy further, and improve the quality of life for citizens, partners and visitors.

Luxembourg will achieve the Mission by creating **Circular Economy Services** to improve productivity and resource quality across diverse sectors, for example, construction, education, finance, ICT, logistics, manufacturing, retailing, training, and R&D.

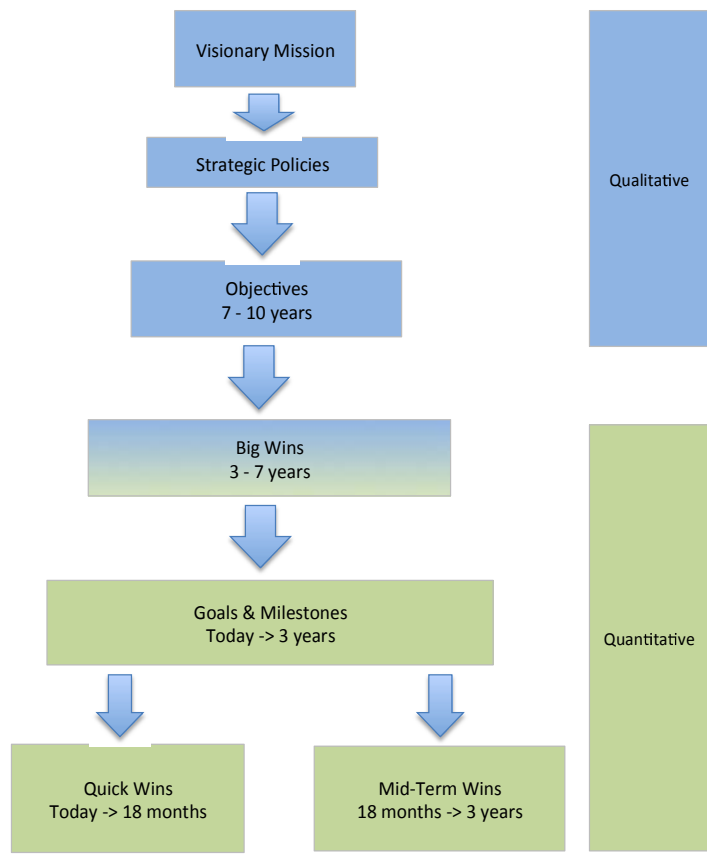
Luxembourg will implement the Mission with measurable objectives, goals and quick wins to accelerate employment, improve competitiveness and increase value creation.

In order to implement circularity, a Roadmap was requested in the study terms of reference. However, it is EPEA's experience that implementing circularity at a national level across diverse sectors, calls for more than a single roadmap. It involves diverse roadmaps developed with diverse stakeholders.

- The framework for Circularity Roadmaps is organised as follows and described in Figure XV on the following page;
 - Mission, Strategic Thrusts and Objectives. These are qualitative.
 - Big Wins, Goals, Milestones, Mid-term Wins and Quick Wins. These are quantitative.
- The Roadmap framework on the next page describes a systematic process for achieving the overall Mission.
- The framework is accompanied by Strategic Policies, which the government might use to support the circularity transition.

Special Note

Normally, roadmaps are developed through a goal-setting process, which EPEA co-develops with stakeholders. In this case, the Ministry requested EPEA to describe what the roadmaps might look like. It is emphasised strongly that in order to reach final roadmaps, a goal-setting process be undertaken for each of the described Objectives.



Highlights Figure XV: Roadmap structure

The following Highlights Table III comprises 7-10 year Objectives, 3 – 7 year Big Wins, and immediate-to-3-year Short-to-Mid-term Wins arising from the present study. The Objectives are divided into two main sections; enabling framework & services, and economic implementation projects.

Highlights Table III: Objectives, big wins & low cost quick wins

Overall Objectives supported by strategic thrusts 7 – 10 Years	Potential Big Wins on the road to Objectives 3 - 7 years	Potential Low-Cost Quick Wins & Mid-Term Wins 1 – 3 years
CIRCULARITY ENABLERS		
<p>National Objective Implement a <i>National Circularity Roadmap for Resource Quality & Productivity</i>.</p>	<p><i>Implement enabling mechanisms, which empower diverse stakeholders to implement the circular economy by raising competitiveness, accelerating job creation, saving costs and improving environmental impacts.</i></p>	<p>Establish a <i>National Circularity Initiative for Resource Quality & Productivity (NCC)</i></p> <p>Announce <i>Circularity Training Initiative</i> for the EU Presidency.</p> <p>Announce <i>National Quality Co-Brand for Circularity</i> to improve sales and support existing Luxembourg quality labels.</p>
<p>Education & Training Luxembourg with the Greater Region will be Europe’s leading education & training hub for creating new jobs and improving competitiveness using circularity skills and technologies.</p>	<p><i>Luxembourg creates thousands of new jobs for youth through remanufacturing, repairing, disassembly, deconstruction & logistics.</i></p>	<p><i>Circularity Training Initiative</i> for hands-on training of unemployed youth for circularity skills.</p>
<p>Marketing & Messaging National quality co-brand for circularity-inspired products & services by leveraging existing Luxembourg labels to increase sales & competitiveness of products.</p>	<p><i>Luxembourg increases sales of local agricultural products and manufactured goods by integrating a national quality co-brand with circularity.</i></p>	<p><i>National Quality Co-Brand for Circularity</i> to complement existing Luxembourg labeling, piloted with local grocery retailers & growers, supported by a government ‘buy local’ campaign.</p>
<p>Economic Indicators Luxembourg is recognized as an authority for quality assurance and measurement of present and potential value of circular materials.</p>	<p><i>Luxembourg creates a new industry for circular economy quality assurance and measurement by pioneering a New Balance Sheet for Circularity</i></p>	<p>Announce plan to establish a <i>New Balance Sheet for Circularity</i> To start, announce Pilot for Measuring Positive Impacts by adapting LCA</p> <p>Announce a <i>National Materials Banking Valorization Inventory</i> for materials in Luxembourg’s infrastructures.</p>
<p>Regulation Luxembourg be a leading partner with the EU to establish regulation and incentives for safely and equitably implementing circularity, with a focus on supporting R&D incentives and removing licensing barriers.</p>	<p><i>Luxembourg is a consulting services hub for advising governments & companies on circularity legislation, regulation, & incentives.</i></p>	<p>Optimize & embed already-developed <i>CE positive criteria</i> into new legislation, regulation and investment guidelines.</p> <p>To conform with new EU regulations announce a CO₂ <i>Phase-In programme for replacing Hydrochlorofluorocarbons HFCs</i> with economical & energy-saving closed loop CO₂ systems.</p>

Overall Objectives supported by strategic thrusts 7 – 10 Years	Potential Big Wins on the road to Objectives 3 - 7 years	Potential Low-Cost Quick Wins & Mid-Term Wins 1 – 3 years
ECONOMIC SECTORS		
<p>Manufacturing Luxembourg with the Greater Region will be a European R&D frontrunner for recovering & using secondary raw materials for primary manufacturing to support its existing industries.</p> <p>Luxembourg will be the technology frontrunner in IT, robotics and additive manufacturing for near-shoring circularity.</p>	<p><i>Luxembourg & Greater Region achieve substantive resource security and improve margins by 10% with smart specialization in secondary raw materials.</i></p> <p><i>Luxembourg integrates high-technologies to be a significant participant in the repatriation of millions of near-shoring jobs to Europe, i.e. bringing jobs back to where the markets are.</i></p>	<p>Accelerate <i>Circular Supplier Communities</i> for improving secondary raw materials productivity & quality.</p> <p>Upcycle scrap & cullet trading into a <i>Materials Banking</i> service to improve margins for Luxembourg's manufacturers.</p> <p>Initiate <i>Positively Defined Materials</i> with manufacturers, anchored by years of successful R&D at Tarkett in Luxembourg.</p>
<p>Construction National materials management for circularity in construction & building management fully operational. The plan to be developed in the near-term.</p>	<p><i>Luxembourg and the Greater Region save hundreds of millions in costs annually and increase the real value of the new & renovated building stock amounting to billions of Euros in gains, by converting demolition liabilities into bankable materials assets.</i></p>	<p>Announce <i>National Materials Management Plan</i> for construction headlined by <i>Upcycling Construction Residues</i> to reduce excavation and construction waste 30% by re-using it.</p> <p>Pilot a <i>Circularity Light-house</i> in Luxembourg with 100% defined materials to improve residual value.</p>
<p>Investment, Banking, Insurance Luxembourg will be the leading financial center for circularity investment & banking, including new mechanisms for integrating Greater Region R&D with industry and finance, & best practices</p>	<p><i>Luxembourg becomes the Trillion-Euro circularity banking hub for revenue-generating banking services, investment, materials leasing, and insurance.</i></p>	<p>Quality-Assured <i>Circular Matchmaking</i> with Greater Region R&D innovators.</p> <p>Pilot <i>Secondary Raw Materials Valorization Service</i> with municipal governments and builders, vetted by the financial community.</p>
<p>Logistics Luxembourg will be a European reverse logistics hub, leveraging its existing assets to provide new services.</p>	<p><i>Increase the share of logistics revenues for reverse network activities and re-distribution in the Greater Region.</i></p>	<p><i>Circular Logistics Service</i> with La Poste</p> <p>Investigate feasibility of <i>Circular Vehicle Repairing & Leasing</i>.</p>
<p>R&D Luxembourg with the Greater Region and supported by the investment industry will be an R&D frontrunner for introducing positively defined chemicals, composites, nanomaterials and biomaterials to existing and new industries.</p>	<p><i>Luxembourg and the Greater Region lead near-shoring of industry with 3D and automated circular manufacturing to repatriate millions of jobs .</i></p> <p><i>Luxembourg is the IP capital for licensing circular materials, generating billions of Euros in licensing fees.</i></p>	<p>Pilot 3DRD; <i>3D & Robotic De-construction Initiative</i> based on existing R&D.</p> <p>Announce The New BBC. Biobased Biocompatible Composites</p>

Highlights Table IV: Secondary objectives*

*These items are described as potentially secondary due to considerations described under Methodology in the study. However, it is emphasized that the Ministry and the Stakeholders will ultimately determine priorities. The table is provisional only.

Category	Objective
ENABLING MECHANISMS	
ICT & advanced technology systems	Luxembourg will be the technology frontrunner in ICT, robotics and additive manufacturing for circularity.
ECONOMIC SECTORS	
Agriculture	Establish a national circular agriculture programme focused on improving local marketability of Luxembourg agricultural products and restoring soil quality with advanced methods.
Automotive	Investigate the feasibility of circular supplier communities through pilot projects based on increasing secondary raw materials use, remanufacturing, tracking systems for returnable packaging.
Water	Luxembourg will be a circularity leader in value-added water recycling to meet and exceed its EU water quality goals.

Strategic Policies to Achieve the Mission and Objectives

Ultimately materials re-use might drive the Greater Region.

Laurent Federspiel
Head of Department, Technology & Business
Development Luxinnovation

Circularity for materials might be Luxembourg's answer to the EU's demands for smart specialization by regions.

CE study interviewee

Companies achieved cost savings of more than 40% easily by re-thinking their value streams in a circular set-up

Valorlux interview

There is a universe of potential opening up. However, we have never looked systematically yet to capture these opportunities.

FabLab interview

When we think Circular Economy we don't think just end-of-use but also the quality during use.

Anne-Christine Ayed, Vice-President, Tarkett

Resource productivity supported by materials quality and systems efficiencies is taking its place alongside energy transformation as a priority for Europe to achieve a dual mission of well-being and economic prosperity. The circular economy supported by cradle-to-cradle methods is a defined and practical framework for achieving it.

A Core Strategy for Integrating Circularity into Government Policies

In the circular economy, materials, components and products are used to develop new services, as well as sales. The strategic thrust is to leverage Luxembourg's service-oriented capacities to optimise and scale up those knowledge assets.

Luxembourg has the opportunity to use materials quality as an innovation platform for resource productivity and security. For example, materials know-how is a platform for partnering with the Greater Region in a Smart Specialization strategy to establish Luxembourg as A Knowledge Capital and Testing Ground for the Circular Economy

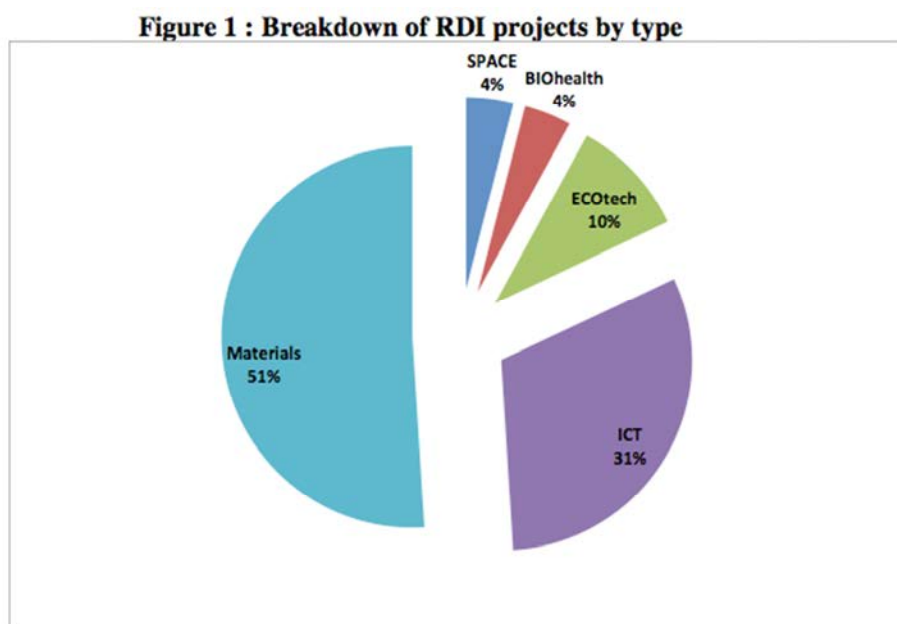
Luxembourg is superbly positioned to claim leadership as a Knowledge Capital and Testing Ground for the Circular Economy, to accelerate job creation, improve competitiveness and increase cost savings while reducing environmental impacts. Luxembourg and the Greater Region enjoy a powerful starting base as they already use circularity for thousands of jobs and billions of Euros worth of materials, products, & services. Companies are using those platforms to achieve prosperity.

To support Luxembourg to achieve the status of Knowledge Capital and Testing Ground for the Circular Economy, the following section is divided into Sectorial, Regional and Enabling strategies.

Why focus on materials resources as a strategy?

Materials are the designated focus for the present study, but factors other than the terms of reference justify materials quality as a circular economy focus for Luxembourg.

For example, the following diagram taken from the *2014 National plan for smart, sustainable and inclusive growth Luxembourg 2020* illustrates the current breakdown of public R&D funding to companies in Luxembourg;



Source: Ministry of the Economy (February 2014)

Highlights Figure XVI: Funding proportions for Luxembourg R&D

As well, effective use of materials and resources is one of the 3 themes relevant to the Europe 2020 strategy selected for the INTERREG North-West Europe trans-national programme with a FEDER budget of €396 million, and is also the focus of an EU Interreg project INTERMAT involving the Greater Region.

Secondary raw materials are core to the survival of some of Luxembourg's leading primary industries. It is a competitive priority to sharpen and scale up Luxembourg's capacities for reusing secondary raw materials.

As well, in the circular economy materials and products are used to provide services, and services are the greatest strength of Luxembourg's economy.

Sectorial Strategies

Use materials & resource productivity to improve competitiveness & employment

Potential CE Big Wins for Luxembourg cut across traditional, transitional and transformational sectors, but each requires training;

- Traditional sectors; Reverse logistics, Construction methods, Retailing agricultural products. Support traditional industries by optimising scrap and cullet streams.
- Transitional approaches. Adapt approaches for capturing new value streams with reverse logistics, designs for disassembly, phosphate capture. Develop positively defined biobased ingredients and materials.
- Transformational approaches. Near-shoring with transformative technologies like ICT-based 3D additive manufacturing and systematic introduction of performance-based usage models

Circularity has the potential to support resources of the past, present and future. Luxembourg will benefit from solutions for each;

- *The past*; Upgrading waste management technologies to better deal with brownfields, excavation waste, old PVC, old concrete, demolishing old buildings etc.
- *The present*; upgrading industrial sourcing and recycling of secondary raw materials for steel, specialty glass, aluminium, plastics, reusable packaging.
- *The future*; composites, bio-carbon fibres, nanomaterials, biobased materials, new ways of assembling and disassembling e.g. additive manufacturing and robotic/human interaction for disassembly.

B2B vs. B2C. Gains are largely but not entirely in the B2B rather than B2C segments; for example, primary & secondary manufacturing, agriculture, construction, finance. Exceptions include B2C retailing and ICT for sharing websites.

Luxembourg's consumers have shown a willingness to pay premium for local products and to be supporting re-use models (e.g. re-usable bags introduced by Valorlux and local retailers like Cactus), once presented with a circular economy choice.

Improve resource productivity in selected sectors with customer supplier communities.

Scale up Customer Supplier Communities in construction, recycling, and retailing to improve value and quality. Profitable examples are working today in & near Luxembourg and are available to be scaled up.

One of the most effective marketplace mechanisms for achieving buy-in to circularity is customer supplier communities. These re-align the traditional customer supplier relationship to amplify win-win scenarios.

Customer/supplier communities are core mechanisms for achieving materials quality. Those exist across a range of activities in Luxembourg including;

- for steel & aluminium between manufacturers & scrap dealers,
- for paper between customers and collectors,
- for retailing between agricultural producers, wholesalers & retailers,
- for flooring between materials designers and marketers.

The challenge is to optimise and scale up.

Support mixed use in the Plan Sectorial

The government recently completed a long-awaited Plan Sectorial for development across Luxembourg. Builders and developers as well as MDDI expressed universal agreement about the importance of promoting mixed-use developments which integrate business, residential, institutional, and commercial to replace the single-use strategies which in past resulted in substantial commuting. A move to creative, socially responsible increased density including healthy materials and buildings is also seen as a way to avoid further generation of excavation waste by going slightly up instead of down, while improving affordability which in turn encourages diversity required for circularity.

Optimise procurement

Customer supplier communities are closely connected to procurement. Procurement cuts across every government and large company department so seems a natural way to accelerate competitiveness, but practice shows there

are barriers to overcome. Central purchasing rules, anti-competition, confusion over circular vs. sustainable, traditionalism and other factors have to be overcome. Especially perceived conflict between supplier communities and anti-competition legislation is a priority to address. Procurement quick wins might be in the non-publicly listed private sector where the rules are less stringent. However there might be exception with government owned companies. As well customer/supplier communities are central for educating purchasers & suppliers in the public and publicly traded sectors.

Regional Strategy

The Greater Region as a circular community for R&D & education on materials quality & resource productivity

- Unify efforts of the Greater Region around the EU Smart Specialisation programme by establishing a 'Materials Quality' Specialty.
- In the strategic field of technology R&D the Greater Region is already a strong partner with Luxembourg, due to Luxembourg's traditional leveraging of regional resources to compensate for its size and limited accreditations. Leveraging those partnerships is central.
- An example is the IntermatGR consortium of universities working on materials research. The following is excerpted from a description by Luxinnovation;
- The Luxembourg Materials Cluster set up a cross-border Cluster based on materials in the Greater Region, "INTERMAT". The establishment of the Cluster is financed through an INTERREG project with a duration of 18 months. The project aims at fostering knowledge exchange, identifying synergies between partners and creating a Materials Competence Centre. This company-focused project provides:
 - Companies and especially SMEs with access to existing competences in the Greater Region through joint networking events, such as lab days, meetings and seminars, creativity sessions and open innovation networks.
 - One-stop-shop services to create a common platform for the exchange of know-how and expertise as well as for transnational problem solving.
 - In fact, materials are a common topic in the five regions involved in this project: Luxembourg, Wallonia, Saarland, Lorraine and Rhineland-Palatinate. All regions share a common industrial past and common excellence in materials research. Previous INTERREG initiatives have already created close links between academics in the region.

- A range of Greater Region programmes and institutes specializing in materials and especially in bringing those materials from the lab to the marketplace are dynamically active in the Greater Region, for example the Leibniz Institute for New Materials <http://www.inm-gmbh.de/en/>. The network started through Intermat might be expanded to those groups.
- Other potential focus areas for materials R&D co-operation include;
 - biobased additives and composites designed for circular cycles,
 - designs for disassembly,
 - robotics,
 - 3D additive manufacturing,
 - Life Cycle Assessment,
 - Joint progress in revalorization processing (e.g. concrete recycling)
- In Germany a few standout activities deserve mention; Moorbach energy landscape for off-grid solutions, and Palaterra, a company and methodology with a new kind of topsoil manufacturing with potential to restore Luxembourg's agricultural soils.
- In selected areas such as textiles and reverse metallurgy, regions like Wallonia announced plans to become circular economy regions, although progress to date has been delayed by regional elections. Luxembourg will gain from studying this cluster as it develops and possibly participating.
- Circularity statistics on the Greater Region as an entity are difficult to find. Information has to be gathered from individual Greater Region members. The newly-created Greater Region EcoInnovation Cluster Umweltcluster Grossregion will be a valuable mechanism for that.

Benelux strategy. The Valley at Schiphol Trade Park as a model for Luxembourg to track.

To underline the value of integrating R&D with practical pilots and enabling tools, a new circular economy hub in The Netherlands might be a model for the Ministry of the Economy as well as other Ministries and businesses in Luxembourg to track, especially regarding tax, free trade zone potential and R&D incentives. Initiated by Delta Developments who developed the C2C-inspired Park 2020 in the Netherlands, and supported by the Schiphol Airport Development Corporation (SADC), *The Valley* at the Schiphol Trade Park plans to bring circularity to a new level by creating 'materials farms', knowledge hubs and scientific networks with a range of circular economy businesses and services. It will be the largest circularity development to date, encompassing an area larger than one square kilometer next to one of Europe's busiest airports.

The Valley is being co-developed with a range of local and international stakeholders, including various universities, the World Economic Forum and the Ellen MacArthur Foundation, making it one of the largest economic circular economy activities in The Benelux.

As a starting project, the group did an inventory of the diverse residue flows around Amsterdam to identify local opportunities for upcycling it to resources and matching it with potential re-users. These fractions will be used as a basis for materials communities as described further in the present study.



Enabling Strategies

Do a few things well but empower diverse stakeholders with education & training

The study considered how Luxembourg might focus on doing a few things well but still support diverse stakeholders in its economy.

The potential solution is for the government to lead on selected priorities while empowering stakeholders with educational and training platforms to innovate on their own.

Leadership on selected priorities includes primarily supporting lighthouse initiatives for example;

- Hands-on education & training,
- Pilot projects for upcycling & classifying secondary raw materials,
- National quality co-brand circularity pilots
- Pilot transforming supplier chains into circular supplier communities

Improve competitiveness & employment with education & training about circularity

- The National plan for smart, sustainable and inclusive growth Luxembourg 2020 recommends;

Step up efforts to reduce youth unemployment by improving the design and monitoring of active labour market policies. Strengthen general and vocational education to better match young people's skills with labour demand, in particular for people with migrant background. Take resolute action to increase the participation rate of older workers, including by improving their employability through lifelong learning.

- The potentials for circularity education and training for employment are;
 - *Preserving jobs* by continuing to optimise security of supply of secondary raw materials for primary and secondary industries, as well as retraining personnel for circularity.
 - *New job potential in Luxembourg.* Traditional sectors like construction, logistics, finance, retailing, but as well for transformative technologies like 3D additive manufacturing. While 3D might be seen as a job killer risk it is

actually generating new employment from manufacturing of the machines, software and feedstock, as well as releasing creativity potential for product designers. The further 3D potential for near-shoring jobs presents a significant potential for Luxembourg.

- *New job potential in the Greater Region & beyond.* Luxembourg-based companies have the opportunity to create new jobs and competitive advantages outside Luxembourg especially for ICT, finance, logistics.
- The tools are;
 - *Hands-on training.* Those potentials might each be met with an aggressive hands-on training programme and facility. There is a potential for job preservation as well as job creation among high-unemployment groups in Luxembourg due to forecasted demands for physical disassembly and reverse logistics. To take advantage of those opportunities, hands-on training is required. The infrastructure to deliver training already exists through e.g. Chambre des Metiers, FabLab, Futurelab, Innovation clusters, IFSB & Luxbuild2020, Learning Factory, the CRPs, University of Luxembourg, as well as companies like ArcelorMittal, Cimalux, Goodyear, Pall Center, and Tarkett to mention a few. The opportunity and challenge is to align and unify those efforts around hands-on training for circularity.
 - *Circular Supplier communities* to accelerate competitiveness and education. Supplier communities are a redesign of the traditional supplier chain. Usually lowest-cost is the only driver and this often leads to lowest or unknown quality along the supply chain. By integrating cost and quality according to transparent objectives, suppliers become partners with customers in the journey to circularity. The results with projects like e.g. Ecoparc Windhof in Luxembourg include more competitive attractive buildings and workplaces which also include collective savings by eliminating redundancies.

Integrate circularity science with economics

There are knowledge gaps on the science of circularity. Those gaps represent a competitive opportunity for Luxembourg;

- *Designing.* Designs of materials, components and products have large impacts on circularity economics. Efforts to optimise recycling without optimising materials or products generate unnecessary costs. It is more cost-effective to design materials, products and revalorisation systems together.
- *Positively designed ingredients.* Materials functionality and added value come from thousands of commonly used ingredients, additives, and coatings. Most environmental regulations focus on reducing toxicity of

those ingredients, but a distinction of circularity is to define them positively. The competitive potential is for Luxembourg and Greater Region R&D groups to collaborate on *developing positive lists* of chemicals for products.

- *Biomaterials* are one of the largest potentials for the Technosphere especially for biobased chemicals as feedstock. Luxembourg & the Greater Region have powerful R&D capacities to develop biochemicals and biomaterials for the Technosphere to increase the decoupling effect by employing biological resources in the Technosphere to achieve usage periods exceeding the regeneration periods required for the present methods of growing biomass feedstock.

Aim for quality, then focus on quantity

Circularity is first about quality and embedded value. Luxembourg has the potential to use quality to its competitive advantage to be *A Knowledge Capital and Testing Ground for The Circular Economy*. The capacities, which give it the potential, are; economic & cultural diversity, stability, service orientation, high education and income level, materials research, flexible governance and geopolitical location.

Materials quality is a framework for Luxembourg and the Greater Region to meet the goals of the EU smart specialization policy and improve resource productivity for Luxembourg's secondary-raw-materials-dependent industries. The circular economy aims to increase effectiveness of systems (doing the right things) and it is thus typically more potent than the classical sustainability debate, which focuses on efficiency gains (doing things right). The question is where to start; with the installed base or with new designs? Those are each good starting points and mutually supportive, if they share a perspective on achieving higher quality standards/levels. Those perspectives include;

- *Resource effectiveness based on quality of materials recovery and economies of scale*. The value capture lies with efficiencies in the existing system by recovering materials, which are part of the established asset base.
- *Resource re-use based on quality of materials*. The fastest road to value capture is to improve the quality and residual value of materials by remaking the way they are made.

Those schools of thought are potentially complementary, but only if quality is the overall driver. In that context, Highlights Table III shows the potential quality Objectives for Luxembourg.

Promote positive impacts

A new way of doing businesses requires answers to previously unasked questions to take full advantage of the future opportunities and being able to mitigate the risks of disruptive innovation. While the shift is focusing to improve productivity of finite, physical resources, the innovation will need to span from design including material formulation, business model innovation (towards a performance based economy), reverse network capabilities to establishing enablers and platforms to foster collaboration. Current environmental regimes are not up to the challenge because they are based on regulations for reducing negative impacts and are not incentive-based. The circular economy is focused on improving positive impacts. The approach is catalyzing a new set of policies, incentives and regulations aimed at positive impacts. An example is the new set of EU product criteria based on 'positive lists' instead of 'banned lists'. Luxembourg has the capacity to lead development of those enabling mechanisms by adopting policies based on positive impacts.

Promote stakeholder engagement

The ultimate focuses for circularity in Luxembourg are determined by stakeholders as a next step from the present study. The study started the consultation process by performing 45+ interviews to learn perception of stakeholders, then used those perceptions to provide a range of potential circularity objectives. Especially the study focused on where it might be feasible to get buy-in for the following ambition levels;

- Supporting incremental traditional improvements where it makes economic or cultural sense.
- Using transition as a manageable bridge from the present to the future.
- Transforming technologies & systems to stay competitive.

Customer supplier communities also play a pivotal role in leveraging stakeholder engagement.

Leverage Luxembourg's presidency for circularity

Utilise the upcoming EU-Presidency to claim the Circularity space and harness the associated energy to move towards implementation quickly. For example;

- The withdrawal and re-tabling of circular economy legislative package by the EC presents an unexpected opening for Luxembourg to drive a positive agenda in contrast to a regulation-driven agenda. See *Breaking News*

section at the beginning of the Highlights section of the present study. For example introduce positive criteria for circular economy legislation.

- Announce Luxembourg's intention to focus on circularity at the highest level of government, industry & academia.
- Announce the intention to establish a quality standard for secondary raw materials.

By so doing the government will claim the territory and generate public excitement and commitment for next Presidencies like The Netherlands to follow through on.

Motivate Luxembourg's leadership through participation

Involve business, academic and government leaders in a high level mechanism to coordinate the diverse circularity-related initiatives already going on. See following section.

Potential Role for the Government of Luxembourg

Government is a big potential enabler in Luxembourg for CE, and one advantage Luxembourg has over other countries is, that its tradition for business-minded policies and its ability to align stakeholders across sectors allows to move quickly to respond to shifts in marketplace conditions

As described at the beginning of the summary, the study identified a pivotal leadership role for the Ministry of the Economy and national government to play in clarifying, optimising and scaling up the circular economy;

The government has a special brief opportunity to seize the initiative through initiating and coordinating actions, supported by powerful messages about circularity through education, training and national co-branding. By leveraging those mechanisms the government will provide the enabling framework for its stakeholders to power the circular economy with innovative lighthouse initiatives.

Potential Implementation Structure

A Framework for Circularity Actions

A National Circularity Initiative (NCI) for Resource Quality & Productivity coordinated by a results-oriented circularity working group for implementation.

The NCI is exemplified by the many initiatives described in the Roadmap of the present study, including for example a National Co-branding Label for Circularity to further distinguish the existing Luxembourg brand, improve sales of Luxembourg products & services, and inspire national participation. The co-brand is itself a type of quality assurance to build understanding of the circular economy.

Working Group Composition. The initial working group is intended as a practical activist and catalyst for circularity instead of a committee catch-all for every ministry and industry association.

Coordinate work through the Innovation Clusters

Innovation is at the core of circularity. Participation and leadership by the Ministry of the Economy via the Innovation Clusters and initially the Ecoinnovation Cluster seems a practical place to base the programme described here, especially because the Innovation Clusters already integrate stakeholders from the private and public sectors, so there is no need to re-invent this structure.

The working group for the NCI might play a function additional to aligning circularity activities; It might allow the government to more closely integrate parallel initiatives. The diversity and number of activities occurring in 2014 is remarkable and displays a proactive attitude but also a potential for duplication.

Getting Started. Circular Economy Working Group & Pathway to Pilot Projects

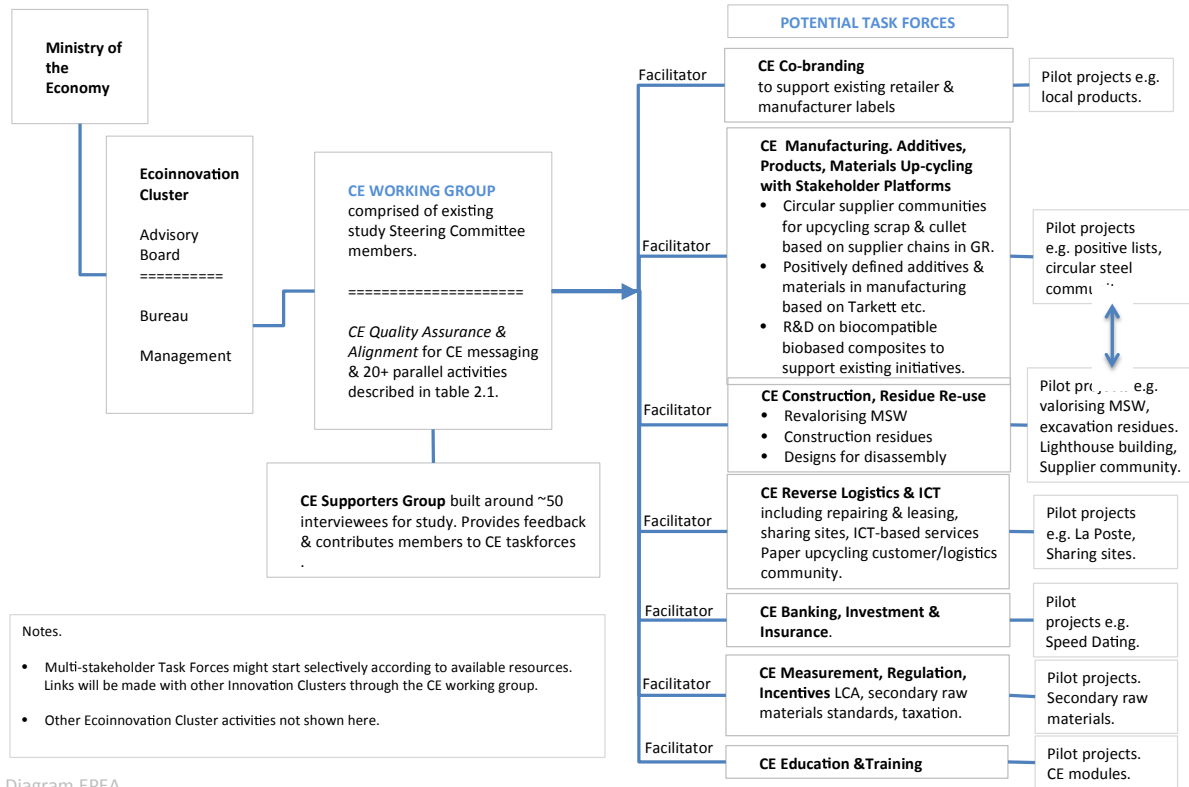


Diagram EPEA

Highlights Figure XVII: Organogram for National Circularity Initiative and associated stakeholder platforms. (Lines indicate communication rather than authority.) For more information on structure & functions refer to Quick Win #1 under Roadmap chapter.

