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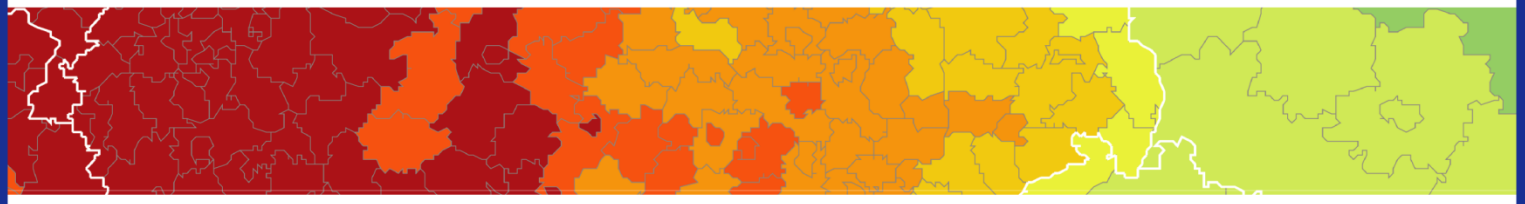

CIRCTER – Circular Economy and Territorial Consequences

Applied Research

Final Report

Annex 6

Individual case study reports

Version 09/05/2019

Final Report

This applied research activity is conducted within the framework of the ESPON 2020 Cooperation Programme, partly financed by the European Regional Development Fund.

The ESPON EGTC is the Single Beneficiary of the ESPON 2020 Cooperation Programme. The Single Operation within the programme is implemented by the ESPON EGTC and co-financed by the European Regional Development Fund, the EU Member States and the Partner States, Iceland, Liechtenstein, Norway and Switzerland.

This delivery does not necessarily reflect the opinion of the members of the ESPON 2020 Monitoring Committee.

Authors

- The Circular Economy Strategy of Scotland - Jan-Philipp Kramer, Bärbel Birnstengel, Mirjam Buck, Richard Simpson, Adriana Cruz, Prognos (Germany)
- The WCYCLE Strategy of Maribor - Marion Courtois, Philippe Micheaux Naudet, ACR+ (Belgium)
- The Circular Economy in the region of Brussels - Ruslan Zhechkov, Asel Doranova, Nathan Kably, Technopolis (Belgium)
- The Circular Economy initiatives in the Basque Country - Mirari Zaldua, Tecnalia Research and Innovation (Spain)
- The Industrial Symbiosis Scheme in Sicily - Andrea Bassi, Georg Pallaske, KnowlEdge (Italy)
- The Bioeconomy Cluster in Central Germany - Henning Wilts, Sören Steger, Meghan O'Brien, Carina Koop, Valerie Wischott, Wuppertal Institute (Germany)

Advisory Group

Project Support Team: Paolo Angelini, Ministry of Environment (Italy), Sophie De Mulder, RWO Flemish government (Belgium), Maarten Piek, Ministry of Environment (Netherlands).

ESPON EGTC: Marjan van Herwijnen (Project Expert), Akos Szabo (Financial Expert)

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Contact: info@espon.eu

ISBN: 978-99959-55-70-0

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Abbreviations

B2B	business-to-business
B2C	Business to Consumer
C2C	Consumer to Consumer
CBM	Circular Business Model
CDC	Caisse des dépôts et consignations
CE	Circular Economy
CEAP	Circular Economy Action Plan
CER	European Remanufacturing Council
CLD	Causal Loop Diagram
DE	Domestic Extraction
DEU	Domestic Extraction Used
DMC	Domestic Material Consumption
DMI	Direct Material Input
EC	European Commission
EEA	European Environmental Agency
EMAS	European Monitoring and Audit Scheme
EMF	Ellen MacArthur Foundation
EPR	Extended Producer Responsibility
ERDF	European Regional Development Fund
ESPON	European Territorial Observatory Network
EU	European Union
GDP	Gross Domestic Product
GPP	Green Public Procurement
GWR	Geographically Weighted Regression
JRC	Joint Research Centre
IS	Industrial Symbiosis
LMM	Last Minute Market
MBT	Mechanical-Biological Treatment
MFA	Material Flow Analysis
MS	Member States
MSW	Municipal Solid Waste
NACE	Nomenclature of Economic Activities
NUTS	Nomenclature of Territorial Units for Statistics
OLS	Ordinary Least Squares/Linear Regression
OVAM	Public Waste Agency of Flanders
P2B	Peer-to-business
P2P	Peer-to-peer
PPP	Purchasing Power Parity
RMC	Raw Material Consumption
RMI	Raw Material Input
ResCoM	Resource Conservative Manufacturing
SME	Small and Medium Enterprises
RIS3	Regional Innovation Strategies for Smart Specialisation
ToR	Terms of Reference
WEEE	Waste from Electrical and Electronic Equipment

1 The Circular Economy Strategy of Scotland

1.1 Executive summary

The Circular Economy Strategy for Scotland “Making Things Last” (2015) sets out Scotland’s priorities for moving towards a more circular economy. Incorporating targets and ambitions set by the country’s Zero Waste Plan (2010) and Resource Efficiency Agenda (2013), it advocates two key elements – a better approach on producer responsibility to stimulate debate and a food waste target of 33% by 2025, incentivising actions throughout the whole value chain. To realise economic, environmental and community benefits, the Strategy prioritises, amongst other actions, four areas:

- **Food and drink and the broader bioeconomy**: focusing on the beer, whisky and fish sectors;
- **Remanufacture**: contributing significantly to Scotland's economy, it is estimated that remanufacture has the potential to grow by a further £620 million by 2020;
- **Construction and the built environment**: as 50% of Scotland’s waste originates from the construction sector, there is great potential for an efficient use of resources;
- **Energy infrastructure**: in particular focusing on the reuse of equipment of wind turbines and decommissioned oil and gas platforms.

Waste prevention is recognized as a priority to achieve a more circular economy, the strategy aims to support both businesses and households in their efforts to achieve these targets. Scotland seeks to retain the quality, reliability and value of goods by making reuse of materials and repair of items a first choice and recycling the norm for businesses, communities and households. The Strategy sees the most desirable actions to promote a Circular Economy in the smallest, inner material loops – namely, maintenance and reuse. It proposes a shift in focus from resource efficiency to promoting the reuse of resources, which would boost productivity and stimulate innovation. Improving recycling rates, innovation and collaboration of the waste and packaging industries and remanufacturing businesses will help to exploit the full potential for growth. To promote inner loop activity, a specific focus is set on promoting business models to prevent waste through product and services design. Finally, the Strategy identified the need for a change in mindset and new, specific skills to take advantage of new approaches in designing, inspecting and cleaning of remanufacturing and repair. With its comprehensive, cross-sectoral approach, Scotland aims to reshape the behaviour of businesses, communities and households by transforming the “throw-away culture” into a circular economy.

1.2 Background information

Name of the Territory and country: Scotland – United Kingdom

Policy framework: Regional strategy: "Scotland strategy for a Circular Economy – Making Things Last".

Population: 5,38 Million (2017).

Surface: 77,933 km2

GDP per capita at current market prices by NUTS 1 Region: 29 200 EUR (purchasing power standard (PPS) per inhabitant)

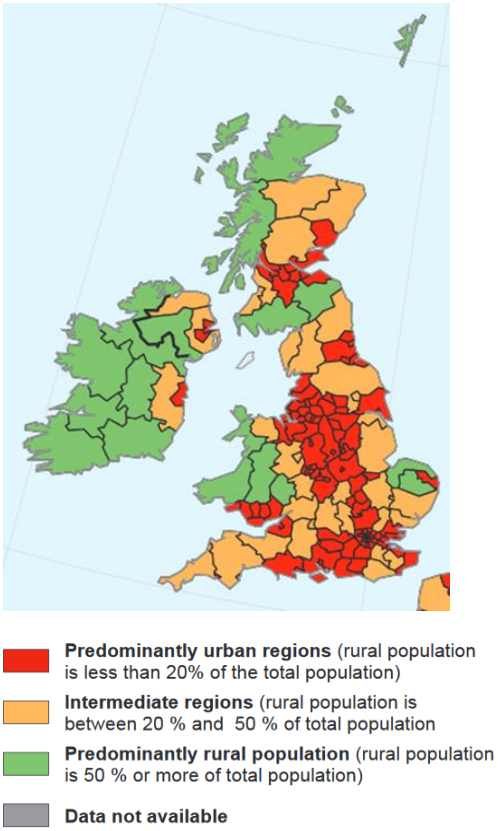
Share of people with tertiary education from 25 to 64-years old: 47.8%

Employment rate total, from 24 to 64 years: 76,3%

Scotland is a small nation of the UK, with a total population of approximately 5.4 million people and has its own parliament. It is considered an intermediate region, with predominantly urban regions at the centre, intermediate regions to the centre north and predominantly rural regions to the south and north. The main sector of its economy is the Services Industry (75% in 2014), including retail, hospitality, real estate, financial services and the public sector. Production industries account for 17% and include activities such as manufacturing, utilities and mining. Construction accounted for 6% and Agriculture, Forestry and Fishing for 1%. In the latest quarter, positive contributions to growth were made by the Production and Services sectors. Within the main sub-sectors, Business Services & Finance (part of Services) made the largest contribution due to its high growth rate[1].

[1] Scottish government Statistics Publications (2018): http://www.gov.scot/Resource/0053/00533858.pdf

Figure 1-1: Regional typology of the United Kingdom and Scotland



Source: Eurostat Regional Yearbook (2017)

Through several targeted policies, Scotland has outlined ambitious strategies and goals that have enabled the country to grasp the opportunities of a Circular Economy at an early stage. Setting the path with its Zero Waste Plan (2010), Scotland is a pioneer by recognising waste as a resource and tackling waste through its prevention. This path also seeks the reuse and refurbishment of goods and the recovery of value through recycling or composting. Circular Economy was also addressed in response to the requirements of the EU's Smart Specialisation Strategies with a strong focus on the bioeconomy through the Scottish National Plan for Industrial Biotechnology – Towards a Greener, Cleaner 2025 (2013). Together with the Zero Waste Plan, the Resource Efficient Scotland Programme (2013) and other policies (Table 1-4), show the efforts to grasp the opportunities of a Circular Economy. These efforts culminated in the Scottish Strategy for a Circular Economy: Making Things Last (2015). Scotland was able to see the opportunities of a Circular Economy at an early stage, with a clear motivation to create better conditions for companies to embrace new business models and manufacturing processes helping industries to minimise their use of raw materials, reduce energy and water use by maximising reuse, remanufacture, disassembly and reprocessing of products, and communities to reduce household waste, to provide economic, environmental and social benefits across the country.

1.3 CIRCTER Indicators

Table 1-1 Material flows in Scotland (UKM2, UKM3, UKM4, UKM6)

	UKM2	UKM3	UKM5	UKM6
Material flows				
DMC per capita 2006 (tonnes/hab)	15.61	13.22	22.42	28.61
DMC per capita 2014 (tonnes/hab)	14.78	12.93	20.64	27.48
DMC intensity 2006 (kg/euro)	0.57	0.54	0.61	1.20
DMC intensity 2014 (kg/euro)	0.52	0.50	0.46	1.07
Biomass per capita 2006 (tonnes/hab)	2.83	2.91	3.66	4.20
Biomass per capita 2014 (tonnes/hab)	3.03	3.29	3.57	4.92
Biomass intensity 2006 (kg/euro)	0.10	0.12	0.10	0.18
Biomass intensity 2014 (kg/euro)	0.11	0.13	0.08	0.19
Metal ores per capita 2006 (tonnes/hab)	0.5	0.39	1.04	1.78
Metal ores per capita 2014 (tonnes/hab)	0.8	0.27	-	4.93
Metal ores intensity 2006 (kg/euro)	0.02	0.02	0.03	0.07
Metal ores intensity 2014 (kg/euro)	0.03	0.01	-	0.19
Construction per capita 2006 (tonnes/hab)	7.08	5.93	8.88	11.66
Construction per capita 2014 (tonnes/hab)	5.01	4.32	7.63	12.51
Construction intensity 2006 (kg/euro)	0.26	0.24	0,24	0.49
Construction intensity 2014 (kg/euro)	0.18	0.17	0.17	0.49
DE per capita 2006 (tonnes/hab)	15.78	10.90	31.83	64.84
DE per km2 2006 (tonnes/km2)	11.98	8.14	24.87	76.92
DE per capita 2014 (tonnes/hab)	1.67	1.85	2.20	0.69
DE per km2 2014 (tonnes/km2)	1.34	1.42	1.86	0.86

Table 1-2 Waste in Scotland (UKM2, UKM3, UKM4, UKM6)

WASTE STREAMS AND WASTE BY NACE ACTIVITY	UKM2	UKM3	UKM5	UKM6
Waste generation				
Total waste generated per capita 2006 (kg/hab)	2,546.94	3,168.04	9,274.59	2,478.19
Total waste generated per capita 2014 (kg/hab)	1,585.49	1,588.83	600.74	1,482.73
Total households waste per capita 2006 (kg/hab)	697.53	690.73	650.66	720.24
Total households waste per capita 2014 (kg/hab)	573.49	550.34	516.03	603.13
Total foodwaste per capita 2006 (kg/hab)	350.87	380.99	291.29	251.62
Total foodwaste per capita 2014 (kg/hab)	204.88	241.26	165.68	100.93
Total WEEE per capita 2006 (kg/hab)	8.24	7.99	16.13	9.20
Total WEEE per capita 2014 (kg/hab)	9.55	8.05	12.11	7.14
Plastic waste per capita 2006 (kg/hab)	56.60	62.91	24.26	12.8
Plastic waste per capita 2014 (kg/hab)	32.11	32.12	11.26	8.46
Waste by NACE activitiy				
Agricultural waste intensity 2006 (kg/Thousand Euro) (*)	57.20	39.34	39.19	45.98
Agricultural waste intensity 2014 (kg/Thousand Euro) (*)	60.82	30.75	18.24	79.42
Construction waste intensity 2006 kg/Thousand Euro) (*)	930.60	1,052.49	185.74	191.58
Construction waste intensity 2014 (kg/Thousand Euro) (*)	944.05	1,126.65	225.52	328.30
Manufacturing waste intensity 2006 (kg/Thousand Euro) (*)	126.09	172.22	119.06	42.60
Manufacturing waste intensity 2014 (kg/Thousand Euro) (*)	45.11	46.73	33.34	19.82
Mining waste per km2 2006 (tonnes/km2 - Waste by mining/total surface)	29.74	56.20	2,819.71	8.88
Mining waste per km2 2014 (tonnes/km2 - Waste by mining/total surface)	26.72	21.74	2,538.27	18.94

(*) Waste intensity: [Waste by agriculture/construction/manufacturing - kg] / [GVA by agriculture/construction/manufacturing- Tsd euro]

Table 1-3 Provision of materials, technologies and services for a circular economy in Scotland (UKM2, UKM3, UKM4, UKM6)

	UKM2	UKM3	UKM5	UKM6
Material providers				
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	14.71	13.78	11.12	40.34
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	16.28	17.66	11.25	39.78
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	0.10	0.28	0.01	-0.01
Turnover per Material Provider Employee in 2010 (Thousand euro/employee)	164.74	187.46	129.76	103.06
Turnover per Material Provider Employee in 2015 (Thousand euro/employee)	210.73	240.99	172,26	139.47
Growth Rate of Turnover in thous. Euro per Material Provider Employee in % (2010-2015)	0.28	0.28	0.33	0.35
Technology providers				
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	15.13	14.69	27.04	9.71
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	18.58	14.34	34,21	10.98
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	0.23	-0.02	0.26	0.13
Turnover per Technology Provider Employee in 2010 (Thousand euro/employee)	143.47	140.23	140.34	138.44
Turnover per Technology Provider Employee in 2015 (Thousand euro/employee)	193.96	196.18	202.96	188.92
Technology Providers Growth Rate of Turnover in thous. Euro per Technology Provider Employee in % (2010-2015)	0.35	0.40	0.45	0.36
Circular Business Models (CBM)				
Number of CBM Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	30.85	3.87	1.68	1.86
CBM Turnover per Circular Business Models employee in 2015 (Thousand euro/employee)	87.06	461.56	296.42	294.1

1.4 Case study description

Scotland is making its case for a Circular Economy based on the Ellen MacArthur Foundation's Circular Economy Concept (2013), which distinguishes between the biological and technical cycles of an economy. The biological cycle is where consumption occurs, as biologically-based materials feed back into the ecosystem, regenerating and providing renewable resources. The technical cycle covers all abiotic materials and products, which are cycled through an economy by various strategies, referred to as loops. **The Circular Economy Strategy for Scotland, Making Things Last (2015)**, hereafter referred to as the Strategy, sets out Scotland's priorities for a circular economy. Before defining the Strategy, Scotland had outlined and implemented **several policies and strategies** that paved the way towards a Circular Economy Strategy (Table 1-4).

Table 1-4: Scotland's policies leading up to and supporting a Circular Economy

Name of Policy	Mission	Target	Year published
Scottish Renewables Action Plan (RAP)	The RAP addresses renewable energy and aims to achieve a target of 20% of total energy use from renewable sources, 50% of electricity consumption, 10% of renewable transport and 11% target of heat demand, by 2020.	Public and private sector	2009
Zero Waste Plan	Aims to achieve a zero waste Scotland, minimising Scotland's demand for primary resources, maximising the reuse, recycling and recovery of resources. It focuses on four areas:-resource streams (encouraging waste prevention and increasing the quantity and quality of resources recycled), economic opportunity (from the reuse of materials and development of sustainable markets for recycling), resource management (through the encouragement of business investment and the improvement of skills, health and safety), and education and awareness programmes.	Industry, Businesses, Public Sector	2010
A Low Carbon Economic Strategy for Scotland	Transitioning to a low carbon economy to achieve sustainable economic growth, and to meet Scotland's climate change targets. This transition will be complemented with high levels of resource efficiency and investment in low carbon goods, processes and services. Some specific targets include: a 42% reduction of emissions by 2020 and by 80% by 2050.	Industry, Businesses	2010
2020 Routemap for Renewable Energy in Scotland	Update and extension of the Scottish Renewables Action Plan 2009. It presents actions focussed on achieving some specific targets for 2020, including an equivalent of 100% demand for electricity from renewable energy, 11% renewable heat, and at least 30% of overall energy demand from renewables.	Households, industry, businesses	2011
Safeguarding Scotland's Resources programme	Built upon the Zero Waste Plan, the programme aims for an efficiently use of materials, avoiding waste and reusing items. It focuses on implementing actions towards product design and packaging, reuse, and influencing behaviours. A specific target includes a 5% reduction in all waste by 2015, and a longer-term vision of a 15% reduction in all waste by 2025.	Businesses, industry, community	2012
Waste (Scotland) Regulations	Implemented to assist the progress in achieving the targets of the waste hierarchy and to deliver three key action points: introduction of progressive bans on the types of materials to be disposed of in landfill, regulations to guide the collection and treatment of resources to exploit their reuse and recycling value, and regulatory measures to guarantee energy from waste treatment only to recover value from resources with no further value through reuse or recycling.	Industry, Businesses and Public Sector	
National Plan for Industrial Biotechnology – Towards a Greener, Cleaner 2025	To increase the competitiveness and sustainability of Scotland's industries through the development and use of Industrial Biotechnology and bio-based products, while also using less energy and water, reducing greenhouse gas emissions and contributing to Scotland's shift to a low carbon economy.	Industry, businesses, research	2013
Resource Efficient Scotland Programme	As part of Zero Waste Scotland, it intends to offers guidance, technical support and best practice sharing at no cost. In cooperation with the Eu-	Private and public sector	2013

	ropean Resource Efficiency Knowledge Centre (EREK) it offers assistance, information and business opportunities for companies, especially SMEs to save energy, material and water costs.		
Scottish Household Recycling Charter	Charter and code of practice aiming to establish the foundation for a coherent approach of recycling services. It seeks to improve household waste and recycling services and encourage the participation of citizens in recycling and reuse services, as well as guarantee the safe and competent treatment of the staff, as also the mandatory skills to deliver an efficient resource management	Community and businesses	2015

Source: Prognos own elaboration, 2018

The **Zero Waste Plan (2010)** provides a framework to maximise the reuse, recycling and recovery of resources through local action. The **Resource Efficient Scotland Programme (2013)** provides advice and support services to businesses and the public sector on resource efficiency and targeted sectoral activities to achieve resource efficiency savings. The Strategy incorporates the goals and ambitions of both policies and further advocates two key elements: a better approach on producer responsibility and a food waste target of 33% by 2025, aiming to incentivise actions throughout the whole value chain. The Strategy prioritises four areas:

- **Food and drink and the broader bioeconomy**: focusing on the beer, whisky and fish sectors;
- **Remanufacture**: due to the significance of the Manufacturing sector, it is estimated that remanufacturing has the potential to grow by £620 million by 2020
- **Construction and the built environment**: as 50% of Scotland's waste originates from the construction sector, there are great potentials for an efficient use of resources
- **Energy infrastructure**: in particular focusing on the reuse of equipment of wind turbines and decommissioned oil and gas platforms.

1.4.1 Main instruments in place

Scotland seeks to retain the quality, reliability and value of goods by making reuse of materials and repair of items a first choice, and recycling the norm for businesses, communities and households alike. Thus, the focus of the Strategy lies on the following main policy measures:

- **Waste prevention targets:** Waste prevention is recognized as a priority to achieve a more circular economy. A packet of actions is provided to both businesses and households to support their efforts in achieving these targets.
- **The identification of the most inner loops of a Circular Economy** – namely maintenance, reuse and redistribution of products and components – as the most desirable actions towards a Circular

Economy. Maintaining the highest value for extended periods of time will boost productivity, stimulate innovation and improve competitiveness in the long run.

- **Recognizing the manufacturing sector as a key segment of the circular economy:** Products, such as food, drinks, textiles or pharmaceuticals, represent half of international export and over 50% of R&D expenditures[2]. Backed by the ERDF, the Scottish *Manufacturing Action Plan* (2016) identifies the Circular Economy as an opportunity for businesses to rethink their waste strategies and improve operation and manufacturing processes as well as product design to extend their life-cycles. **Focusing on design as a strategic action area for preventing waste and promoting a more circular economy:**Preventing waste starts with the design of products, business models, services and processes (Figure 1-2). To expand business awareness on circular economy opportunities, and on circular designs, Scottish governmental agencies and the EU have put in place a Circular Economy Investment Fund. It focuses on circular design projects and services, in collaboration between businesses and academia for product innovation, support for the implementation of circular economy business models, awareness raising and networking.

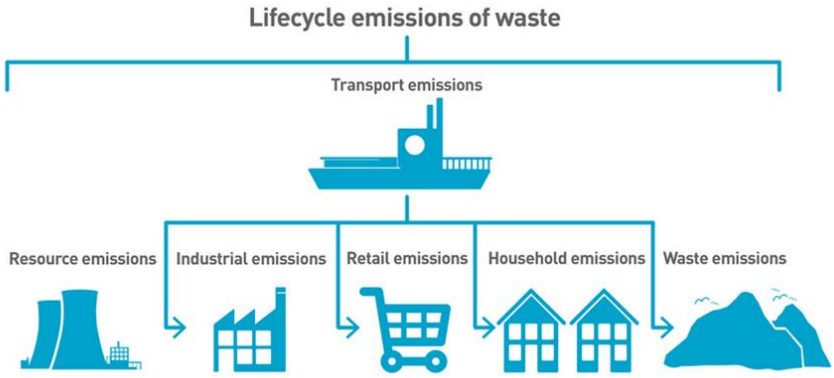
Figure 1-2: Scotland's Circular Economy Business Models

Source: Making Things Last – Scotland's Circular Economy Strategy (2016)

[2] The Scottish Government (2016): A Manufacturing Future for Scotland. Scottish Government Publications [last visited: 19.010.2018]: https://beta.gov.scot/publications/a-manufacturing-future-for-scotland-action-plan/

- **Setting a distinct focus on skills and education for a Circular Economy:** Reshaping the economy and its processes and consumption models requires identifying new, specific skills needed to enable the different approaches in product design, resource handling and communication. This will allow to increase the trust in remanufactured goods and secondary raw materials along the value chain and by consumers. As new opportunities arise, it will be important to promote and support the reskilling of the existing workforce, to allow the labour force to adapt adequately.
- **The implementation of an alternative measurement to the commonly used weight-based waste indicator, to track the progress towards a circular economy:** The **Scottish Carbon Metric** '*measures the whole-life carbon impacts of Scotland's waste, from resource extraction and manufacturing emissions, right through to waste management emissions, regardless of where in the world these impacts occur* (to quantify) *the complete lifecycle impacts of more than 30 different common waste materials,* (allowing policy makers and business leaders) *to identify and focus specifically on those waste materials with the highest carbon impacts and greatest potential carbon savings*'[3].

Figure 1-3: The lifecycle emissions of waste: a carbon metric approach



Source: Zero Waste Scotland (2018)

Specific examples[4] of interventions promoted by the strategy include:

- A pilot scheme to offer diners doggy bags in restaurants: it has been estimated that routinely offering doggy bags to customers could save up to 800,000 full meals going to waste every year.

[3] Zero Waste Scotland (2018): What is the carbon metric? Zero Waste Scotland Publication [last visited: 20.10.2018]: https://www.zerowastescotland.org.uk/content/what-carbon-metric

[4] Scottish Government (2016): Making Things Last: Consultation on creating a more circular economy in Scotland [last visited: 18.05.2018] https://consult.gov.scot/zero-waste-delivery/making-things-last/

- Blythswood Care Re-Use Hub: Scotland's first second-hand superstore, which has contributed to carbon savings of over 7,500 tonnes annually by promoting re-use.
- The Scottish Institute for Remanufacture: A centre of expertise was established to support the growth and innovation in remanufacturing by co-funding collaborative projects between industry and higher education institutions, and developing a remanufacturing community involving businesses and academics.

1.4.2 Assessment of territorial implications

The Circular Economy Strategy focuses on four key areas that have local relevance: food and drink and the wider bioeconomy, remanufacture, construction and the built environment and energy infrastructure (particularly, the reuse of equipment). As outlined in the chapters above, other interventions, mainly affecting consumption and waste management, act complementary to the Strategy. Through the provision of training activities, centralised information and household waste recycling centres, stakeholders have been able to increase the rate of collected sorted waste and reduce waste creation at source.

By offering a greater range of used and remanufactured goods at accessible prices and by increasing the availability of products through leasing or renting models rather than direct purchase, the circular economic model leads to a greater choice in markets, i.e. a wider spectrum of affordable goods available for consumption[5]. To ensure the choice of remanufactured products over new products, it is essential that the trust of consumers in such products is increased. The supported actions will contribute to grow the relevant employment and infrastructure and will enable better local job opportunities and employment rates[6].

For the implementation of circular business models, based on product or services design, a certain degree of technology level is needed. For market uptake, a certain time for adaptation is required. Both are factors that may challenge a successful circular economy strategy. Only in the longer term will insights be possible on the full impacts of the Strategy on market uptake, and the training and educational initiatives.

[5] Scottish Government (2016): Making Things Last: Consultation on creating a more circular economy in Scotland [last visited: 18.05.2018] https://consult.gov.scot/zero-waste-delivery/making-things-last/

[6] Zero Waste Scotland - European Structural and Investment Funds [last visited: 18.05.2018] http://www.parliament.scot/S5_EconomyJobsFairWork/Inquiries/ESIF-031-Zero_Waste_Scotland.pdf

1.5 Governance

The main stakeholders involved in the initiative are the **Scottish Government**, in partnership with **Zero Waste Scotland, Scotland's Enterprise Agencies** and the **Scottish Environmental Protection Agency (SEPA))[7] [8].** Since the beginning of the strategy, all actors and sectors involved have had a clear, consistent and strong commitment to a combined effort to reinforce the economy and strengthen cooperation within the framework of the Circular Economy. Leading up to the Strategy, a public consultation was conducted by the Scottish Government and its partners. Preceding the consultation a series of workshops, seminars, media releases and sectoral reports were organised to increase interest and to inform the debate. 78 responses from industry, academia, local governments and actors from the third sector helped to shape the Strategy. For example, the food waste reduction target and prominence of waste prevention was a direct result from the input received through the public consultation.

Zero Waste Scotland is funded by the Scottish Government and receives funding from the European Structural Funds Programme (ERDF) to help accelerate the circular economy and resource efficiency work with Small and Medium Size Enterprises in Scotland. This strategic intervention has a total value of £73 million and will run to December 2019[9]. It is also a founding member of "The Scottish Circular Economy Business Network (SCEBN)" in partnership with Scottish Enterprise (SE)[10], Highlands and Islands Enterprise (HIE)[11] and Scottish Environment Protection Agency (SEPA)[12].

1.5.1 Relevant clusters and multipliers

To deliver changes towards a Circular Economy, Scotland profits from collaborations at national and international level.

The Scottish Government was the first country to join the **Ellen MacArthur CE100 global network**, which enables exchanges with other member groups such as other governments and cities, corporations and

[7] The *Scottish Environment Protection Agency* (*SEPA*) is Scotland's principal environmental regulator, protecting and improving Scotland's environment

[8] https://www.zerowastescotland.org.uk/circular-economy/scottish-network

[9] https://www.zerowastescotland.org.uk/content/european-funding

[10] Scottish Enterprise (SE): Most of the assistance given to businesses by Scottish Enterprise is covered by European State Aid rules and as such we are required to publish our own State Aid schemes. These provide the basis for assistance offered by Scottish Enterprise through a range of products and services. Assistance is discretionary, based on the merits of the proposed project, and an assessment of need which is subject to rigorous due diligence appraisal.

[11] Highlands and Islands Enterprise (HIE) is the Scottish Government's economic and community development agency.

[12] https://www.scottish-enterprise.com/our-organisation/accessing-our-information/state-aid-schemes

academic institutions involving international and multi-stakeholder knowledge-sharing activities, collaboration opportunities as well as capacity building[13].

At national level, different measures for collaboration, exchange and innovation include the following:

- To be recognised as a global leader in the Circular Economy (the Strategy's action point 11), the **Scottish Circular Economy Business Network (SCEBN)** was established. Its goal is to support and '*develop business-led initiatives to promote the opportunities of a more circular approach'*[14] by providing a platform for engaged and innovative business leaders to help build responsive and networked supply chains in Scotland.

- The collaboration between Zero Waste Scotland and Scottish Innovation Centres, particularly in sectors identified within the Strategy, support businesses in their uptake of innovative processes and products to grow and strengthen the economy of the future. The focus lies especially on a close partnership with **the Industrial Biotechnology Innovation Centre (IBioIC)** to accelerate Scotland's bioeconomy, as well as **Construction Scotland Innovation Centre (CSIC)** and **Oil and Gas Innovation Centre (OGIC)**. The IBioIC, CSIC, and OGIC are funded by the Scottish Funding Council with support from Scottish Enterprise and Highlands and Islands Enterprise. The Innovation Centre programme was first launched in 2012. Since £120m (2013-18) has been invested in eight Innovation Centres across a range of key sectors[15]. The CSIC is one of eight industry led and demand driven Innovation Centres supported by Scottish Funding Council, Scottish Enterprise, Highlands & Islands Enterprise and 14 Scottish university partners. Edinburgh Napier University is CSIC's host institution. The common aim of each and every one of Scotland's Innovation Centres is to help businesses large and small increase the pace of innovation and in turn help both our economy and our people to flourish and prosper.

- To maximise the potentials of re-use, repair and remanufacturing, the **Scottish Institute for Remanufacture (SIR)**, established in partnership between Zero Waste Scotland and the Funding Council in 2015, invites businesses of all sizes to provide their input facing technical challenges and to inform other stakeholders. Access to expertise, funding, training, equipment and facilities are part of the support provided[16]. The SIR is funded by the Scottish Funding Council and Zero Waste Scotland. Hosted at the University of Strathclyde, SIR is a centre for excellence established to increase innovation in remanufacturing and provides project funding support and pays for the

[13] Ellen MacArthur Foundation (2018): Circular Economy 100. Ellen MacArthur Foundation Website [last visited: 20.10.2018]: https://www.ellenmacarthurfoundation.org/ce100

[14] Zero Waste Scotland (2018): Working in partnership. Zero Waste Scotland Website [last visited: 20.10.2018]: https://www.zerowastescotland.org.uk/circular-economy/working-in-partnership

[15] http://www.ibioic.com/who_we_are/our_role_and_focus/d10/

[16] Information retrieved from the Scottish Institute for Remanufacture Website: http://www.scot-reman.ac.uk/

cost of a researcher's time on the project. Companies and a partner university match or contribute to the SIR contribution through staff time, equipment or equivalent[17].Finally, on recommendation by the Zero Waste Taskforce, a joint initiative between Scottish Ministers and the Convention of Scottish local authorities (COSLA), a Household Recycling Charter was prepared in order to support local governments in the development of a Circular Economy through consistent and coherent waste collection services and, to increase the efficiency, quality and quantity of recyclables.

1.6 Results and impact

Scotland has pioneered a new method known as **the Carbon Metric** to analyse and measure waste reductions. The Scottish Carbon Metric allows policy makers to measure the progress achieved and to prioritize their efforts more effectively, by identifying those materials with the highest damaging impacts as well as those with the biggest carbon saving potentials. Moreover, it also allows businesses and organisations to successfully show the results achieved[18] and to contribute through the example of good practice.

The **Carbon Metric** is designed as an alternative for waste weight measurements and offers more accurate values as it is based on a **consumption accounting approach** that measures the whole lifecycle impacts of carbon waste materials[19]. By comprising the **entire carbon impact of products,** the Carbon Metric ascribes all production, use and disposal carbon emissions to the consumer, regardless of its geographical origin. Through this approach, carbon savings and emission reductions from recycling and prevention practices are as well included and attributed to the consumer[20].

The annual reports of the Carbon Metric provide an overview of the developments in waste reductions and inform about appropriate waste management plans. For the period 2011 to 2016, the following results were achieved[21]:

- Scotland's overall carbon impact hast been reduced by 26%, or 3,9MtCO_2e (million tonnes of carbon dioxide equivalent) since 2011, which can be attributed to a decline in landfilling and improved

[17] http://www.scot-reman.ac.uk/what-we-do/funding/

[18] Zero Waste Scotland (2013): The Scottish Carbon Metric, Briefing Paper for Stakeholders [last visited: 22.03.2019]: https://www.zerowastescotland.org.uk/sites/default/files/Carbon%20Metric%20Policy%20Report.pdf

[19] Zero Waste Scotland (2019): What is the Carbon Metric [last visited: 22.03.2019]: https://www.zerowastescotland.org.uk/content/what-carbon-metric

[20] Zero Waste Scotland (2013): The Scottish Carbon Metric, Briefing Paper for Stakeholders [last visited: 22.03.2019]: https://www.zerowastescotland.org.uk/sites/default/files/Carbon%20Metric%20Policy%20Report.pdf

[21] Zero Waste Scotland (2018): The Carbon Footprint of Scotland's Waste. 2016 Carbon Metric Summary Report. Zero Waste Scotland Publications [last visited: 22.10.2018]: https://www.zerowastescotland.org.uk/sites/default/files/2016%20Carbon%20Metric%20Summary%20Report.pdf

recycling rates, particularly for high impact waste materials. Higher recycling rates of Construction and Demolition wastes contributed to this trend, as well as the decrease in landfilling, the lowest rate recorded in 2016, despite still amounting to 32.5%[22].

- Household waste accounted for nearly 55% of total waste carbon impact in 2016 – an increase of 9% since 2011. This has two principle reasons: first, household waste has a higher proportion of carbon intensive materials; second, the recycling rate of non-household materials has outpaced that of household waste (between 2011 and 2016, a plus of 26% and 10%).
- The carbon metric report shows that the most carbon intensive waste sources make up only 9% of Scotland's waste by weight, but nearly half of associated carbon impacts. To maximise the benefits of waste and resource management, focus is placed on the carbon intensive materials. Based on the results, the report presents five main policy drivers which may reduce waste generation and carbon impacts.

Besides the Carbon Metric, the Charter for Household Recycling, which sets out a common approach to household recycling throughout Scotland's local governments, is gaining momentum and was signed by half of all Scottish councils by July 2016. Effects of its implementation will increase the quantity and quality of recycled household wastes and decrease that of non-recyclables. Next to the results on waste generation and management, Scotland has provided businesses sectors with the opportunity of funding for innovative approaches in product design for better re-use, repair and recycling conditions, or the hiring and leasing of products, which have opened up new revenue streams[23].

1.7 Drivers/success factors, other enabling conditions and barriers

Scotland has faced certain barriers, which may slow down or even prevent a shift towards a Circular Economy. However, the country has also proven itself to be well positioned to be a forerunner of the implementation of a Circular Economy through the numerous initiatives, strategies and policies already in place (see also information in sub-chapter Case Study Description). Barriers and drivers have been identified considering the different territorial factors that affect the circular economy.

[22] SEPA (2016): Waste from all sources – Summary data 2016. Scottish Environment Protection Agency [last visited 22.10.2018]: https://www.sepa.org.uk/media/356705/wfas_2016_official_statistics.pdf

[23] Zero Waste Scotland (2018): Investment to date – Circular Economy Investment Fund. Zero Waste Scotland Publications. [last visited: 22.10.2018]: https://www.zerowastescotland.org.uk/content/investments-date-%E2%80%93-circular-economy-investment-fund

Knowledge and awareness

At industry level, product design may prevent disassembly, provoke material cross-contamination or promote obsolescence. Unawareness of commercial opportunities and perceived risks may discourage businesses to innovate. Commercial opportunities will depend on the awareness of consumers to repair or upgrade their consumables and the trust they have in remanufactured goods.

The Scottish Household Recycling Charter introduced an approach for waste collection and recycling of food, glass, paper/card and cans/plastics. It is hoped to increase the separation of household wastes at source, thus improving the quality of collected waste streams. Such common approaches are beneficial for the exchange of best practices and possible hurdles which may be dealt with along the way and can also harmonise the collection of data and improve the information used to feed into future policy developments.

In addition to the knowledge transfer and building business capability promoted through the different centres, institutes and networks, the shift to a circular economy needs to take place alongside a transformation of the educational system. Therefore, Scotland's Circular Economy Strategy encourages the development of skills and expertise that are required to enable and support a more circular economy. The Scottish Manufacturing Action Plan of 2016 plans, among other initiatives, to establish a manufacturing skills academy to incorporate circular economy practices in both product design and resource use[24]. Furthermore, the Curriculum for Excellence, a collaboration between Safeguard Scotland Resources, Zero Waste Scotland are Education Scotland, and supported by input by the Ellen MacArthur Foundation, sets out to maximize educational opportunities on resource efficiency and the circular economy to increase public engagement and to train for lifelong learning[25]. These are important steps to facilitate a mindset shift towards waste conscious communities by enabling their understanding of the importance of reduce, reuse and recycle behaviour. For certain community groups this can be especially challenging.

Governance and territorial milieus

The absence of fiscal incentives and directives promoting recycling and re-use can pose a barrier to the business environment. In addition to structural barriers, the shift towards a circular economy also requires new ways of thinking value chains, operational processes and management systems and a sensitized consumer base. Business leaders need support and are required to show ambition to grow and innovate and take some risks.

[24] Zero Waste Scotland (2018): Circular Economy Investment Fund. Zero Waste Scotland Publication. [last visited: 12.06.2018]: https://www.zerowastescotland.org.uk/circular-economy/investment-fund

[25] Scottish Government (2013): Safeguarding Scotland's Resources - Blueprint for a More Resource Efficient and Circular Economy: Our Actions. APS Group Scotland [last visited: 20.10.2018]: http://www.gov.scot/Publications/2013/10/6262/8

Also, to accurately inform analyses and assessments of the impact of the circular economy policies and actions, appropriate indicators and data samples are needed. This is, especially, the case when assessing the development at national and European scale. Scotland has addressed this by reviewing and adding to its existing indicators the carbon impact of waste.

Public disengagement or disapproval can also be a governance challenge. Scotland's Government prevented this through a wide public consultation process. Public consultation played an important role in the Strategy by, including the public's general interest through the public consultation process in 2015, sensitizing the public and generating debate. The close cooperation between the government, its delivery partners and industry leaders were crucial in shaping the consultation process and helping to understand the opportunities of the circular economy, incentivizing firms to seek new collaborations and offer innovative types of products and services. The involvement of the Scottish Government has thus helped to increase the speed of the developments, and actions have been benefiting from the coordination and support of the Government[26].

Technology

Promoting innovation in manufacturing and product design to adapt and accommodate to Circular Economy strategies provides companies with the advantage to become leaders across the global markets. Scotland has identified this opportunity and is providing support through its Circular Economy Investment Fund, which grants funding to SMEs for circular economy related innovations in products and systems across all sectors. Being a firstmover is especially relevant in competitive markets, while companies often are hindered by uncertain frameworks and other financial investment priorities. The strategy provides a clear framework and supports the development of new circular economy products, the adoption of innovative business models and uptake of technologies, products and services supportive of a circular economy[27].

1.8 Assessment of the region's capacity to keep unlocking the potential of a CE

Public consultation for strategy and target finding

From an initial vision over several progressive policies and plans to a comprehensive strategy requires not just the involvement of several stakeholders but also the wider public. The public consultation provided a

[26] Ellen MacArthur Foundation (2018): Case Studies: Scotland: Making things last – A circular Economy. Ellen MacArthur Foundation Publications [last visited: 22.10.2018]: https://www.ellenmacarthurfoundation.org/case-studies/scotland-making-things-last-a-circular-economy-strategy

[27] Zero Waste Scotland (2018): Circular Economy Investment Fund. Zero Waste Scotland Publication. [last visited: 12.06.2018]: https://www.zerowastescotland.org.uk/circular-economy/investment-fund

substantiated framework for the strategy and the public legitimacy to further pursue the circular economy with specific actions and targets. In has allowed to engage and mobilize the commitment of the public and stakeholders, while untapping and triggering innovative ideas, initiatives and collaborations. Through engaging the public, businesses and relevant stakeholders, the resulting strategy was able to set out targets with clear aims and actions. The government agencies and partners, hereby, provide continuous support to the public and businesses to increase their awareness and involvement, as well as to promote consumers' confidence in remanufactured products for a sustainable circular economy.

Supporting innovation and education

Scotland's strategy focuses on economic opportunities across all sectors, as well as on building necessary skills to support the demands of the circular economic system, generating more employment and producing information for all citizens on the benefits associated to the circular economy model. Linking innovation centres with business and raising the awareness and education of the public are essential steps in manifesting a mindset and design shift. The Government and all stakeholders involved have already achieved positive results. Through the inauguration of the £65 million National Manufacturing Institute for Scotland, in collaboration between the University of Strathclyde as its anchor, the Renfrewshire Council and the Lightweight Manufacturing Centre, the aim is to establish an industry-led international centre for manufacturing expertise. The Centre will benefit from international industry expertise and cutting-edge research and will thus help to promote innovations for all manufacturing businesses throughout Scotland. It will also offer rewarding careers for young people and boost Scotland's manufacturing and engineering sectors.

Local action

Complex appearing concepts, such as the circular economy, run at risk of being aloft and disengaging the public. Ensuring that the public are engaged enhances participation and commitment to commonly found goals. Towards this aim, the public and communities need to have opportunities to participate and have their local initiatives recognised. The Strategy explicitly, enabled not least through the public consultation process, has supported and promoted numerous initiatives at local scale.

Developing new local indicators: the Carbon Metric

Scotland has made ground-breaking work by developing an indicator to measure the carbon impact of waste. Practical and objectively verifiable indicators enhance the understanding for waste and the aim of its reduction. As a consumption-based carbon accounting approach it makes a direct link between the local production of waste and global climate change, thereby, enhancing the understanding for a whole life cycle approach to products. Moreover, indicators enable measuring progress and can make efforts tangible. Scotland's carbon metric has made it easier for organisations to evaluate the benefits of preventing and recycling waste, and to identify those materials that are especially damaging to the environment.

The comprehensive strategy sets Scotland on a promising path that will keep unlocking the opportunities of the circular economy through further sustained investment, fiscal incentives and the safeguarding of all actors' interests.

1.9 A systemic perspective on the Scotland CE case study

The CE Strategy for Scotland focuses on four key areas of strategic relevance for the local context: (i) food and drink, and the broader bioeconomy, (ii) remanufacture, (iii) construction and the built environment and (iv) energy infrastructure (i.e. reuse of equipment from wind turbines and decommissioned oil and gas platforms).

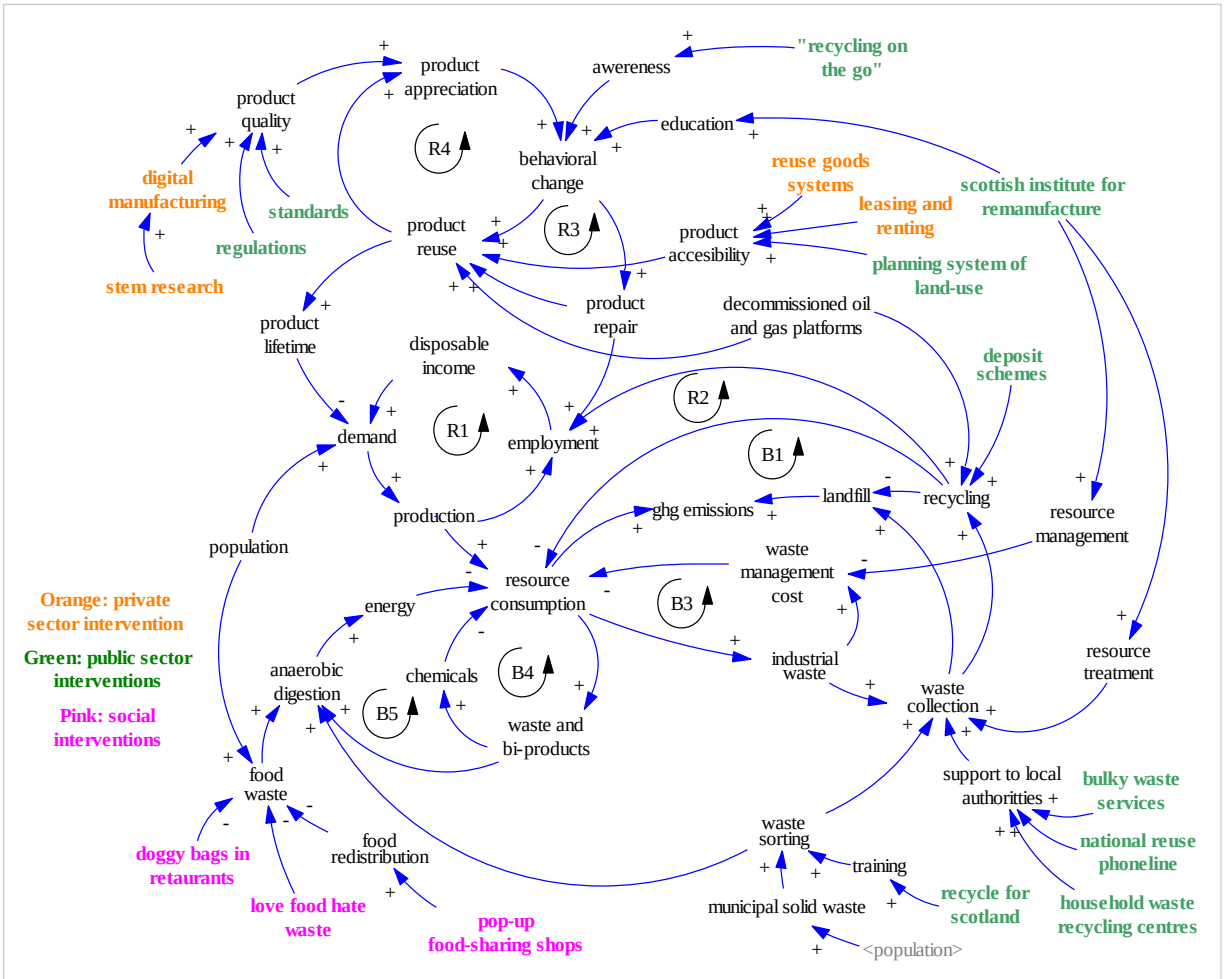
The strategy provides complementary interventions that are expected to affect (1) consumption, (2) and waste management. This required to counter current trends showing growing demand and production (R1), leading to higher resource consumption and waste management costs (B3) in addition to the accumulation of waste in landfills.

Concerning waste management, the CE strategy focuses on providing support for local authorities to increase waste sorting at the source and waste collection. The activities envisaged are, among others, the provision of training, the creation of a national reuse phoneline and the opening of household waste recycling centres. Further, with more waste collection, the CE strategy envisages the need to improve and expand waste recycling (this includes food waste as well as industrial waste). These interventions are expected to curb existing trends, through the introduction of two main balancing factors (B1 and B5) that limit resource use (including energy, through anaerobic digestion, and materials).

Regarding consumption, interventions are aimed at both expanding a product's lifetime and increasing reuse. Emphasis is put on improving the appreciation for repaired, remanufactured and reused products, also through education and awareness programs. These interventions work in synergy with those envisaged for waste management, curbing more decisively the observed growing trend of resource use and waste generation. In fact, we see the emergence of virtuous cycles (R3 and R4) that strengthen product repair and reuse, reducing resource consumption while increasing employment (and hence balancing the potential reduction in job creation resulting from reduced demand).

Overall, the strategy of Scotland seeks to find a balance between managing demand and production, as well as waste flows. It highlights that by reducing consumption (through recycling and reuse also of the construction materials of wind turbines and oil and gas platforms) there will be cost reductions for waste management, as well as new economic opportunities.

Figure 1-4: Causal Loop Diagram - Scotland



Source: Own elaboration

1.10 Conclusions and lessons learnt

Scotland is a country that has started to address opportunities of a Circular Economy very early on. Through its Zero Waste Plan (2010), the Resource Efficiency Agenda (2013), Safeguarding Scotland's Resources (2013), the Manufacturing Action Plan (2013) and the culmination into the Circular Economy strategy (2015), Scotland has emerged as a leader in the implementation of a Circular Economy strategy. Other governments can learn from the process of Scotland by identifying and examining existing relevant policies and plans through departmental wide consultation. This may also involve other levels of government. Furthermore, participating in national and international exchanges can provide stimuli to identifying key sectors and actions. In collaboration with the Ellen MacArthur Foundation, for example, specific sector opportunities were identified. The significance of sectors and their opportunities may diverge by regions, it is, therefore, important to take the specific local economic structure into account.

An essential step for governments is to decide at an early stage on the appropriate extent of consultation processes. Scotland's comprehensive strategy relied on a public consultation process and the active engagement of businesses and communities. This process can in itself provide valuable insights into existing relevant approaches and initiatives, as well as a stepping stone for establishing or linking platforms for exchange and innovation. In addition, targeted activities across sectors and Scottish cities allowed to address the particularities of industries and communities alike. A further important dimension was employment and skills. By focusing on engaging a skilled workforce capable of dealing with the specific requirements that circular systems require, opportunities and challenges could be identified. Correspondingly, it was made clear that Scotland requires skilled professionals, in areas also of digital manufacturing with knowledge of the principles of a circular economy. Increased knowledge-sharing, networking and a continued coordinated policy approach will help Scotland to remain a forerunner of regional Circular Economy implementation. By providing sustained support for industry and businesses, improving the general awareness, and by providing fiscal incentives and continued access to funding, Scotland will ensure that it remains on a prosperous Circular Economy path.

Moreover, Scotland recognizes that reducing carbon waste plays a fundamental role towards a more sustainable and circular economy. Through its pioneering Carbon Metric, Scotland uses a consumption-based accounting approach to measure the whole lifecycle impacts of carbon waste. The approach represents a tool that can be used to identify those materials with the highest damaging impacts as well as those with the biggest potential for carbon savings, therefore contribution to the reduction of GHG emissions.

This case study shows that for the successful implementation the chosen comprehensive approach was essential. As such, the Scottish strategy has presented a coherent and uniform narrative of the advantages and has been more inclusive and steered than in other parts of the UK[28].

1.11 References

Climate Action in partnership with UN environment (2017): Scotland launched £18 million Circular Economy Investment Fund, [last visited: 09.05.2018]: http://www.climateactionprogramme.org/news/scotland-launched-18-million-circular-economy-investment-fund

Ellen Macarthur Foundation: Scotland and the circular economy, a preliminary examination of the opportunities for a circular economy in Scotland, [last visited: 09.05.2018]:

28 Green alliance (2015): Circular Economy Scotland; Green Alliance in partnership with the Scottish Council for Development and Industry, [last visited: 05.06.2018]: http://www.green-alliance.org.uk/resources/Circular%20economy%20Scotland.pdf

https://www.zerowastescotland.org.uk/sites/default/files/Scotland%20and%20the%20Circular%20Economy%20(a%20report%20for%20the%20Scottish%20Government).pdf

Ellen MacArthur Foundation (2018): Case Studies: Scotland: Making things last – A circular Economy https://www.ellenmacarthurfoundation.org/case-studies/scotland-making-things-last-a-circular-economy-strategy

Employment rates, Eurostat (2018): http://ec.europa.eu/eurostat/cache/RCI/#?vis=nuts2.labourmarket&lang=en

Eurostat (2018): Eurostat regional yearbook 2017, Eurostat. Last visited on 11.05.2018 at: http://ec.europa.eu/eurostat/statistical-atlas/gis/viewer/?mids=BKGCNT,C01M01,NUTS-2013-2-CODES,CNTOVL&o=1,1,1,0.7&ch=EUP,C01,C06,TRC,NUTS&center=55.46067,-1.46802,5&lcis=NUTS-2013-2-CODES&

Eurostat (2018): Population on 1 January by age group, sex and NUTS 2 region (demo_r_pjangroup), last visited 02.05.2018: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_r_pjangroup

Green alliance (2015): Circular Economy Scotland; Green Alliance in partnership with the Scottish Council for Development and Industry, [last visited: 05.06.2018]: http://www.green-alliance.org.uk/resources/Circular%20economy%20Scotland.pdf

Gross domestic product (GDP) at current market prices by NUTS 2 regions (PPS_HAB), Eurostat (2018): http://ec.europa.eu/eurostat/cache/RCI/#?vis=nuts1.economy&lang=en

Keep Scotland beautiful (2018): Climate Challenge Fund open [last visited: 26.06.2018]: https://www.keepscotlandbeautiful.org/sustainability-climate-change/climate-challenge-fund/

Love food hate waste (2018): [last visited: 11.06.2018]: https://scotland.lovefoodhatewaste.com/

Recycle for Scotland (2018): [last visited: 11.06.2018]: http://www.recycleforscotland.com/

Robb, Cheryl - Circular Economy Cities & Regions Sector Manager, Zero Waste Scotland (2018, June 5). Phone interview.

Safeguarding Scotland's Resources - Blueprint for a More Resource Efficient and Circular Economy (2018): Our Actions [last visited: 18.05.2018]: http://www.gov.scot/Publications/2013/10/6262/8

Scottish Business News Network (2018): Major international trade mission comes to Scotland, [last visited: 09.05.2018]: https://sbnn.co.uk/2018/02/27/major-international-trade-mission-comes-scotland/

Scottish Government (2010): Scotland Zero Waste Plan, Scottish Government [last visited: 09.05.2018], http://www.gov.scot/Topics/Environment/waste-and-pollution/Waste-1/wastestrategy

Scottish Government (2016): A manufacturing future for Scotland, Scottish Government [last visited: 09.05.2018]

Scottish Government (2016): Business and regulatory impact assessment Scottish Government Pub-lication [last visited: 09.05.2018].

Scottish Government (2016): Making Things Last - A Circular Economy Strategy for Scotland – Exec-utive Summary, Scottish Government Publication [last visited: 09.05.2018]: http://www.gov.scot/Publications/2016/02/1761/2

Scottish Government (2016): Making Things Last: Consultation on creating a more circular economy in Scotland [last visited: 18.05.2018] https://consult.gov.scot/zero-waste-delivery/making-things-last/

Scottish Government (2016): Partial Business and Regulatory Impact Assessment: Making Things Last – A Circular Economy Strategy for Scotland, Scottish Government Publication [last visited: 02.05.2018]: http://www.gov.scot/Resource/0049/00494865.pdf

Scottish government Statistics Publications (2017), latest GDP publication, for 017 Quarter 4: http://www.gov.scot/Resource/0053/00533858.pdf.

Scottish Institute for Remanufacture (2018): Remanufacturing in action – examples & case studies [last visited: 26.06.2018]: http://www.scot-reman.ac.uk/

EPA, Scottish Environment Protection Agency (2018): Waste from all sources – Summary data 2016 [last visited: 11.06.2018]: https://www.sepa.org.uk/media/356705/wfas_2016_official_statistics.pdf

Share of people having attained tertiary education, Eurostat (2018):

http://ec.europa.eu/eurostat/cache/RCI/#?vis=nuts2.education&lang=en

Sustainable Brands – The bridge of better brands (2017): 3 Scottish Cities Gain 'Zero Waste Town' Status. [last visited: 26.06.2018]: http://www.sustainablebrands.com/news_and_views/waste_not/sustainable_brands/3_scottish_cities_gain_zero_waste_town_status_drive_forw

The Scottish Government (2010): Scotland’s Zero Waste Plan, Scottish Government [last visited: 14.05.2018]

The Scottish Government (2013): Zero Waste, safeguarding Scotland's resources: blueprint for a more resource efficient and circular economy, Scottish Government [last visited: 14.05.2018]

University of Strachclyde Glasgow (2017): National Manufacturing Institute for Scotland. [last visited: 28.06.2018]: https://www.strath.ac.uk/whystrathclyde/news/nationalmanufacturinginstituteforscotland/

Waste Management World (2017): Zero Waste Scotland Publishes Carbon Report as Recycling Rate Climbs, [last visited: 09.05.2018]: https://waste-management-world.com/a/zero-waste-scotland-publishes-carbon-report-as-recycling-rate-climbs

Zero Waste Scotland: European Structural and Investment Funds [last visited: 18.05.2018]: http://www.parliament.scot/S5_EconomyJobsFairWork/Inquiries/ESIF-031-Zero_Waste_Scotland.pdf

Zero Waste Scotland (2015): Sector Study on Beer, Whisky and Fish - Final Report [last visited: 11.06.2018]:https://www.zerowastescotland.org.uk/sites/default/files/ZWS645%20Beer%20Whisky%20Fish%20Report_0.pdf

Zero Waste Scotland (2018): Charter for Household Recycling [last visited: 11.06.2018]: https://www.zerowastescotland.org.uk/sites/default/files/Charter%20for%20Household%20Recycling.pdf

Zero Waste Scotland (2018): Circular Economy Investment Fund [last visited: 12.06.2018]: https://www.zerowastescotland.org.uk/circular-economy/investment-fund

Zero Waste Scotland (2018): Deposit Return Scheme Scotland, [last visited: 11.06.2018]: https://www.zerowastescotland.org.uk/deposit-return-scheme-scotland

Zero Waste Scotland (2018): European Funding [last visited: 11.06.2018]: https://www.zerowastescotland.org.uk/content/european-funding

Zero Waste Scotland (2018): Investments to date – Circular Economy Investment Fund [last visited: 12.06.2018]: https://www.zerowastescotland.org.uk/content/investments-date-%E2%80%93-circular-economy-investment-fund

Zero Waste Scotland (2018): Scotland's Zero Waste Towns and Circular Cities [last visited: 11.06.2018]: https://www.zerowastescotland.org.uk/blog/scotland%E2%80%99s-zero-waste-towns-and-circular-cities

2 The WCYCLE Strategy of Maribor

2.1 Executive summary

The city of Maribor, the second largest city in the Republic of Slovenia, has a closed landfill site. Due to the willingness of the population and of the city Council, it is not an option nor to open a new landfill site nor to build an incinerator. An innovative solution has then been proposed: The Circular Economy with economic gains through waste collection.

Recovery operators for specific circular project pillars are utility companies (Energetika/Energy, Snaga/Waste, Nigrad/public works, Vodovod/water, Marprom/Public transport) owned by the municipality, which are already carrying out public services. The implementation of the Circular Economy requires synergies and exchange of information amongst public utilities on mutual projects with the goal of recycling and recovering as many resources and energy as possible, increasing the recycling rate. It is a new business model for the City's management, working on horizontal and vertical integration into the Municipality system.

The city of Maribor has created and is involved with the Wcycle Institute that envisions a strategic development model for the city of Maribor as an urban centre in the field of integrated management of all generated waste, surplus energy, and wastewater. Wcycle Institute consequently combines an integrated material, energy and water strategy for using processed waste, energy and treated water as resources for secondary activities, such as construction and heating.

The municipality and non-governmental organisations are responsible for the collaborative economy (sharing, repair, reuse, self-supply).

2.2 Background information

With a population of more than 95,000 inhabitants, the City of Maribor is the second largest city in the Republic of Slovenia, and is situated in Styria (SI03). The inhabitants of Maribor live embraced in its wine growing hills and the Mariborsko Pohorje mountain; 274 metres above sea level, in the north-eastern part of the country. It is only 18 km away from the Austrian border. The main sectors in Maribor are: Construction, agriculture, transport, tourism. Maribor has grown into one of the country's most important tourist destinations.

Maribor and its surroundings have industry knowledge, tradition, experience, institutions and research. Maribor is a trans-regional financial, educational, trade and cultural centre.

At the national level, the roadmap[29] that focuses on Circular economy in Slovenia was presented for the 1st time by the prime Minister at the Circular Change Conference in May 2018 in Maribor. It focuses on redesigning products and services, the circulation of materials, re-use, upcycling and recycling, and relies on using energy from renewable resources, stopping the use of dangerous chemicals and an active approach by every individual, as it also involves a shift from consumerism to the responsible use of resources. Circular economy is also one of the pillars of the Slovenian Smart Specialisation Strategy (S4) and addresses several of the S4 priority domains, in particular Smart Buildings, Networks for the transition to a circular economy, Sustainable food, and Materials as products.

At the local level, the circular economy works are also linked to the Integrated Sustainable Urban Development Strategy of Maribor[30]. The objectives of this urban Maribor city strategy are:

- activation of local social and economic potential (projects involving circular business models and local food production);
- further development of sustainable urban mobility (development of urban cycling infrastructure and multimodal public transport);
- urban regeneration (public and private investment in public and complementary spaces, raising the quality of life for the citizens).

The Council of Maribor has approved its Circular Economy Strategy in June 2018. The basic idea of this Strategy is a modular system for managing all the resources, available in the municipality and wider urban environment. The pillars of the strategy are as follows:

1 – Waste / Municipal waste, services

2 – Construction / Construction and industrial waste, soil

3 – Energy / Surplus energy, renewable resources

4 – Mobility / Urban transport, joint service

5 – Water/ Recycled water, alternative sources

6 – Land / Regeneration, planning

7 – Cooperative economy / Sharing, re-use, reconstruction

[29] http://www.vlada.si/fileadmin/dokumenti/si/projekti/2016/zeleno/ROADMAP_TOWARDS_THE_CIRCULAR_ECONOMY_IN_SLOVENIA.pdf

[30] https://ec.europa.eu/regional_policy/sources/conferences/udn_ghent_2016/Maribor.pdf

2.3 CIRCTER Indicators

Table 2-1 Material flows in Vzhodna Slovenija (SI03)

MATERIAL FLOWS	SI03
DMC per capita 2006 (tonnes/hab)	21.82
DMC per capita 2014 (tonnes/hab)	21.72
DMC intensity 2006 (kg/euro)	1.25
DMC intensity 2014 (kg/euro)	1.15
Biomass per capita 2006 (tonnes/hab)	3.04
Biomass per capita 2014 (tonnes/hab)	2.53
Biomass intensity 2006 (kg/euro)	0.17
Biomass intensity 2014 (kg/euro)	0.13
Metal ores per capita 2006 (tonnes/hab)	0.48
Metal ores per capita 2014 (tonnes/hab)	0.32
Metal ores intensity 2006 (kg/euro)	0.03
Metal ores intensity 2014 (kg/euro)	0.02
Construction per capita 2006 (tonnes/hab)	-
Construction per capita 2014 (tonnes/hab)	6.85
Construction intensity 2006 (kg/euro)	-
Construction intensity 2014 (kg/euro)	0.36
DE per capita 2006 (tonnes/hab)	22.07
DE per km2 2006 (tonnes/km2)	15.06
DE per capita 2014 (tonnes/hab)	1.93
DE per km2 2014 (tonnes/km2)	1.33

Table 2-2 Waste in Vzhodna Slovenija (SI03)

WASTE STREAMS AND WASTE BY NACE ACTIVITY	SI03
Waste generation	
Total waste generated per capita 2006 (kg/hab)	1,934.73
Total waste generated per capita 2014 (kg/hab)	1,386.45
Total households waste per capita 2006 (kg/hab)	-
Total households waste per capita 2014 (kg/hab)	250.99
Total foodwaste per capita 2006 (kg/hab)	145.52
Total foodwaste per capita 2014 (kg/hab)	93.71
Total WEEE per capita 2006 (kg/hab)	3.44
Total WEEE per capita 2014 (kg/hab)	3.95
Plastic waste per capita 2006 (kg/hab)	22.21
Plastic waste per capita 2014 (kg/hab)	30.35
Waste by NACE activitiy	
Agricultural waste intensity 2006 (kg/Thousand Euro) (*)	499.90
Agricultural waste intensity 2014 (kg/Thousand Euro) (*)	75
Construction waste intensity 2006 kg/Thousand Euro) (*)	361.16
Construction waste intensity 2014 (kg/Thousand Euro) (*)	320.76
Manufacturing waste intensity 2006 (kg/Thousand Euro) (*)	332.51
Manufacturing waste intensity 2014 (kg/Thousand Euro) (*)	265.75
Mining waste per km2 2006 (tonnes/km2 - Waste by mining/total surface)	2.10
Mining waste per km2 2014 (tonnes/km2 - Waste by mining/total surface)	0.46

(*) Waste intensity: [Waste by agriculture/construction/manufacturing - kg] / [GVA by agriculture/construction/manufacturing- Tsd euro]

Table 2-3 Provision of materials, technologies and services for a circular economy in Vzhodna Slovenija (SI03)

	SI03
Material providers	
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	51.65
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	105.28
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	-0.03
Turnover per Material Provider Employee in 2010 (Thousand euro/employee)	53.51
Turnover per Material Provider Employee in 2015 (Thousand euro/employee)	75.31
Growth Rate of Turnover in thous. Euro per Material Provider Employee in % (2010-2015)	0.41
Technology providers	
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	-
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	19.4
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	-
Turnover per Technology Provider Employee in 2010 (Thousand euro/employee)	
Turnover per Technology Provider Employee in 2015 (Thousand euro/employee)	79.54
Technology Providers Growth Rate of Turnover in thous. Euro per Technology Provider Employee in % (2010-2015)	-
Circular Business Models (CBM)	
Number of CBM Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	0.39
CBM Turnover per Circular Business Models employee in 2015 (Thousand euro/employee)	323.69

2.4 Case study description

The starting point for the development and implementation of Maribor's circular economy strategy is that the city does not want anymore any landfill or a waste incinerator, which the citizens of Maribor have repeatedly expressed publicly. Therefore waste, surplus energy and wastewater generated by one sector must be used as a new source in the operation of another sector, once processed. This will be connected through the development of an interactive information support tool. Maribor's strategy (or Wcycle Strategy) covers an innovative system of the circular economy, which does not yet exist and is now complementary to the principles of a cooperative economy. The strategy makes it easier to implement the project and gives a clear signal that Maribor, as one of the first cities in the European Union, is being strategically moved to a circular economy. The strategy is coordinated by the Wcycle Institute Maribor (IWM) - Institute for the Circular Economy.

2.4.1 Main features of the circular economy strategy

The main opportunity for Maribor is to integrate material waste management processes with the city's energy and water supply systems. The city level is particularly relevant due to the proximity of stakeholders (both from a geographical distance perspective and links via public services), the instruments available in the hands of the public authority and the potential for a mass effect and relevant impact.

A technical plan determines processes and technologies for all sections of the waste management loop, beginning with collecting, recycling/re-using waste and ending with carefully chosen ways in which recovered water, energy and materials will be used:

- Mixed municipal waste and bulky waste will be sorted into recycles and handed over for processing, or into light/heavy fraction materials which go into further recovery processes;
- Collection and logistics of waste from the source (households) to further uses (recovery) will be optimized;
- Heavy fractions from the sorting plant, construction and industrial waste will be processed into fillers and composites, which will be re-sold and re-used;
- Excess heat from urban and production processes, non-contaminated biomass, energy sources from pyrolytic processes and biogas from fermentation will be turned into usable heat and electricity;
- Return lines for recycled water for business and industrial districts, urban gardens, greenhouses and other purposes will be established.

The purpose of the Circular Economy strategy of Maribor is cross-sectoral cooperation in the processing and re-use of material, energy and aquatic waste sources. The implementation of a circular economy model in Maribor is organised around seven selected sectors (pillars). The expected outcome of these activities will be the emergence of new business opportunities for the Municipality, citizens and industry, the creation of high-quality, predominantly green jobs, new added value and a new economic boost. In order to meet the general goal of the strategy, radical new ways of thinking are needed. This approach is truly innovative in all aspects of implementation - technological, organisational, social, cultural and behavioural. The idea is based on the foundation that companies and institutions in the urban environment share information and work together to achieve the highest possible re-use of resources.

One main concrete step is the construction of a new and high-tech waste management plant, capable of sorting and treating waste generated by 150,000 people (population covered by Snaga services in Maribor). The treatment capacity for one year is 40,000 tonnes in one shift, but the facility can operate an additional shift if needed. An increase of the facility's capacity is however not considered as being necessary because the overall quantity of waste to be treated is estimated to go down in time thanks to all actions implemented on the territory. The project was financed completely with commercial loans (no ERDF involved).

The municipality will also support SME's and NGO's proving additional services, such as co-sharing, repairing and refurbishing consumer products. Maribor has a long-running Re-use Centre - Ropotarnica[31], where the Smetka brand is being developed as a re-use and repair, Bikelab - a bicycle repair shop operates

[31] https://ropotarnica.org/

in the centre of the city and the Tkalka[32] facility, which is dedicated to NGOs and social enterprises on the topic of the circular economy and cooperative economy. All this contributes to the spread of knowledge and awareness of the need to move to different models of resource management as well as space.

Stakeholder engagement is fostered by an independent community centre[33] to develop social innovation, social entrepreneurship[34], and cooperatives. The municipality decided to give an unused laboratory building for free (they only pay operating costs) in order to promote tourism, entrepreneurship, social entrepreneurship, cooperatives and social innovation development. Obviously, the proximity of stakeholders due to the local geographical scale facilitates the contacts and the cooperation.

No indicator framework is currently used but the strategy foresees the monitoring of the network for prolonging the usability of products already in use (re-use, storage of useful discarded things, organization of service for repairs and replacement of spare parts, repair shop, etc.).

2.4.2 Main instruments used for the circular economy strategy

Strategic planning in place for a transition to circular economy: The transition to a circular economy is mainly based on the following strategies and plans:

- National Smart Specialization Strategy (2015)
- A waste management plan in Maribor (2015)
- Integrated Sustainable Urban Development Strategy of Maribor (2015)
- roadmap at the National level (May 2018)
- CE strategy for Maribor (May 2018)

Awareness raising, education and engagement: Public awareness is perceived as crucial. Although there is not yet an education programme dedicated to circular economy at the level of Maribor, at the end of 2017, the Maribor strategy was created with a broad inclusion approach, which enabled its co-creation with various stakeholders. It was done in particular via the working group that formulated the strategy and participatory local workshops (beginning of 2018) and it is now an ongoing role of the Wcycle Institute. Awareness raising is supported at national level by Circular Change – a Slovenian stakeholder engagement platform focusing on the best practices of pioneers transitioning to circular business models. In the future, the website of Wcycle Institute will include relevant information about the circular economy. In addition,

[32] http://tkalka.si/

[33] http://newideasforoldbuildings.eu/2015/09/24/weaver-tkalka/

[34] i.e. Društvo Aktiviraj se, social entreprise, Maribor. Association (established in 2010) deals with the development of social projects and the promotion of social entrepreneurship, to activate the individuals and strengthen and develop the ideas of civil initiatives. It is implementing non-formal education programs and intergenerational cooperation through their main programs: Ropotarnica- Re-use centre, Recycling Lab – innovative green products lab, Community gardens.

some support is provided to the students for master thesis by the Municipality (i.e. by facilitating access to data) and Snaga have created internal training program for its staff.

Regulatory and economic instruments: A Pay-as-You-Throw scheme is in place, managed by Snaga, the waste management utility, in which citizens are paying for the amount of waste that is generated. Local investment has been made in particular regarding the automatic waste management plant. Including criteria related to circular economy in public procurement is considered but not implemented yet. It is interesting to note that in terms of regulation and taxation, no other specific instrument has been developed at local level to address circular economy (the only local tax is a tax on the use of the built ground).

2.4.3 Link with European Structural & Investment Funds (ESIF)

The municipality is currently involved in several projects related to circular economy and benefiting from the financial support of EU funds. The GREENCYCLE project (INTERREG Alpine area) aims at increasing exchange of good practices about circular economy within the Alpine Space to achieve low-carbon targets. The project will enable the development of a toolbox (recommendations and good examples) that will facilitate implementation of the circular economy strategy in Maribor. The URBAN SOIL 4 FOOD (Urban Innovative Action) aims at establishing innovative urban soil-based economy circles to increase local food self-sufficiency and minimize environmental footprint of the Maribor territory. The main goal of the project is to use the City's waste to produce and valorise new products and food using an innovative process to produce urban soil using technology of fermentation and pyrolysis. The project will be articulated around four main interconnected aspects ('circles': material, food, open innovation, knowledge) backboned with two key investments: the establishment of a pilot system for urban soil production and the establishment of four urban gardens (using the urban soil produced). The CINDERELLA project (Horizon 2020) aims to reduce the environmental impacts by 20% along the value and supply chains of circular urban construction, while at the same time increasing the recycling of waste from construction and demolition by 30%, 13% of selected industrial waste, 100% heavy fractions from the processing of municipal waste and 25% sludge from municipal waste water treatment plants, by 2023.

2.5 Governance

The circular economy strategy on Maribor's territory is driven by the public authorities. Three main leviers used by the city council of Maribor for the transition towards circular economy are the following:

- To give the direction by adopting waste management plan and circular economy strategy at the city level;
- To mobilize and federate the public utility companies;
- To collect fund via European projects to concretely implement the actions plan.

The Municipality and the public utility companies, Energetika, Snaga, Nigrad, Vodovod, Marpro have established a new actor, the Wcycle Institute Maribor (IWM). Together with the business sector, they have identified 20 joint projects which will be realised collaboratively in the coming years. They have identified degraded areas to implement planned projects and thus contribute to the revitalisation of these areas.

The Wcycle Institute is the main piece of the multi-stakeholder approach of Maribor as common platform where the utility companies can speak together about general strategy and project's development. There are monthly discussion and exchanges of documents. Thanks to the Institute, every company is aware of what the others do.

The integration model also includes the community's involvement as a cooperative economy even if is less developed than the resource management. Representatives of associations are therefore regularly invited to meetings and public consultations

2.6 Results and impact

The monitoring framework is for the time being focusing on material streams and their quantities.

The main result so far is the change of mind in the management of the public utility companies. The first quantitative results will be seen at the end of 2019. The collection centres accept 20 non-hazardous and 14 hazardous waste types, including residential waste types such as waste paper, packaging waste, glass waste and electronic waste. Additionally, there are several collection points ("eco-islands") for waste glass, packaging, and paper/paper packaging. Residential waste from the commercial/ industrial sector is also collected by Snaga, but the collection of production waste is subject to the free market.

The objective is to demonstrate that the cost will be lower after the implementation of the sorting plant (the objective is to increase the recycling rate of about 30%. It will also increase the share of reusable waste from the current level of 14% to 44%) and the economic benefits will also be created thanks to the future local market for secondary raw materials.

The whole collection system is based on the "polluter pays-principle" (controlled by the municipalities) with a predefined methodology for cost calculation. Snaga weighs all collected and forwarded waste fractions, gathers the data and transmits it to the state statistics system.

The local level is particularly relevant to facilitate and support the transition to circular economy due to the proximity between stakeholders (flows, contacts), the instruments used at local level (planning, regulation, economic intruments, etc.) and the impact in terms of mass that can be generated on the territory.

2.7 Drivers/success factors, other enabling conditions and barriers

The main factors of success are related to **Governance and institutions**, as well as to what could be considered as **Territorial milieu**. In particular the city has no landfill and does not want to have it, nor does it want to dispose of waste with incineration and residents expressed their opposition to incineration (Opinion expressed by population via demonstration in the street), necessiting to find alternative approaches.

To answer to those concerns, Maribor's Mayor gave an ambitious vision of the future at Maribor: "The Opportunity for Maribor, building inclusive and circular community". Its main goal is to create new and to use existing resources more efficiently, at the same time inviting all individuals and stakeholders to actively participate in shaping the urban space. The strategy provides a clear vision for the city that is overall realistic, targeted and well presented.

Maribor can count on the level of high competences of Mayor's advisers and of some innovative civil servants.

Public companies in charge of utilities (waste management and other municipal services, energy, urban transport, water, public infrastructure) are involved in the strategic organisation Wcycle Institute and therefore facilitate the creation of synergies and local symbiosis in the urban area.

One of the main risks however is the change (loss) in political support due to elections. In addition, the regulatory constraints decided at the European and National levels are quite present and need to be tackled.

Knowledge-based factors: one of the main actions was the raising of awareness about circular economy of the management of the public utility companies as there are the main actors in the implementation of the transition.

More effort needs to be put on the awareness of the consumers and of the private companies to demonstrate the economic advantages of the circular economy. This lack of knowledge on circular economy (political area, administration staff, private companies with regards to long term benefits, etc.) is due to the difficulty to involve the academic sector in the process. To overcome this lack of skills, Snaga, the waste management agency, created internal training programs for its own workers.

Accessibility and proximity with stakeholders facilitate the circulation of resources and flows, as well as contacts with innovators and users of these resources.

On the other hand, there is insufficient financial commitment of the private sector. Maribor could look at ways to increase engagement with the business community through setting up a structure within the municipality administration that can provide continued support and facilitate information exchange.

In terms of factors related to **Technology**, **Agglomeration** and **Land-based resources**, the circular economy strategy clearly benefits from the building of a new automated sorting plant. In addition, some projects

implemented by the municipality focused on key streams – food and materials from construction and demolition – which helped to bring together the various local initiatives.

2.8 Assessment of the region's capacity to keep unlocking the potential of a CE

The circular economy opportunities are perceived as huge. The main idea is to meet the needs of the citizens locally. The focus is thus not on the interaction with others circular regions but rather to close the loop at the local and neighbouring level. The main potential (and challenge) in the increase of impact of the circular economy strategy lies in the actual implementation of local circular resource loops and business models and the collaboration with peri-urban areas that will create new opportunities.

Local circular resource loops and business models

Maribor can reuse most of the resources thanks to utility agencies. For example, 80% of the construction materials could be reused and recycled. The bio-waste has also a high potential. Projects will be used to upgrade/upscale pilots to manage the bio-waste of the city and to analyse the costs, the return on investment, costs to implement a final and innovative solution for the bio-waste of Maribor.

However, Snaga automatic new waste management plant has still to demonstrate its efficiency: EUR 12.5 million (technologies provided by a German company after a European public tender).

In addition, the engagement of the private companies and the collaboration with the associations in the field of circular economy is a challenge in terms of stakeholder engagement and resource flows circulation within the city.

Cooperation with peri-urban areas

The city of Maribor attempt to create a functional area of the city (large area of approximately 30km out of the city) for which 2 out of 20 municipalities have already given their agreement due to the business opportunities for their own stakeholders.

2.9 A systemic perspective on the Maribor CE case study

The municipality of Maribor has seen the amount of waste generated and accumulated in the local landfill increase over time. Problems are beginning to emerge, with concerns over the well-being of citizens. If no action is taken, the only options available are the expansion of the landfill (challenged by land scarcity) and waste incineration.

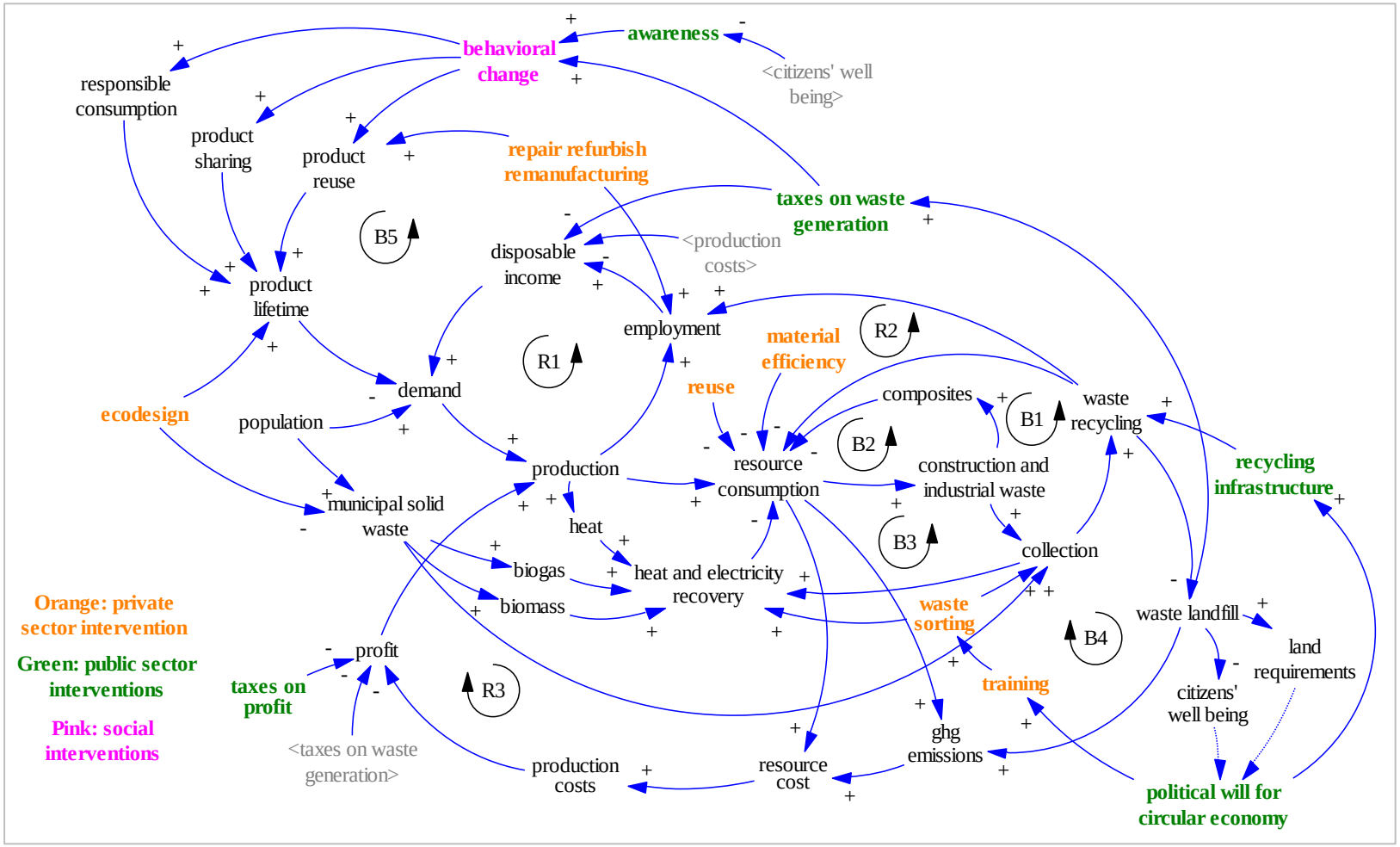
On the other hand, strong public support and leadership from the mayor have created considerable political will to implement circular economy strategies.

The first intervention relates to the creation of recycling infrastructure, to eliminate the prospect of waste incineration as well as avoid the expansion of waste landfill. This is implemented in conjunction with training for public servants, to ensure that the political will expressed by the mayor would be reflected at all levels of the administration, including the smooth implementation of waste sorting. These activities introduce four balancing loops in the system (B1, B2, B3 and B4), which avoid the growth of waste reaching the landfill.

Acknowledging that these interventions would create new opportunities and possibly increase economic performance and resource consumption (R1 and R2), and hence generation of waste (R3), emphasis is also put on material efficiency in industrial processes and on awareness raising for behavioral change at the household level. This complementary intervention adds a fifth balancing loop (B5), which reduced waste generation.

Overall, the strategy of Maribor practically combines efforts on the supply side (e.g. sorting and recycling) with interventions that reduce the generation of waste for long-term sustainability.

Figure 2-1: Causal Loop Diagram - Maribor



Source: Own elaboration

2.10 Conclusions and lessons learnt

The political will and the predominance of public actors are striking in the case of Maribor. The direction is given by the elected officials and the public agencies are networked to act together on the implementation of the circular economy.

The starting point is also quite clear: no more landfill, no incinerator. The alternatives had to be found and it is the circular economy that has become obvious.

Quite huge budget is needed. It is why participation in European projects has been seeked, mainly via the Wcycle Institute but not only, in order to support the implementation of Maribor's strategy.

2.11 References

Association Social Economy Slovenia (2018): "Slovenia will preside over the EU countries for Social Economy in 2018 – Maribor city declared for European Capital of Social Economy 2018", 1st January 2018

Cinderella project (n.d.) website [last visited 20.09.2018]: https://wcycle.com/portfolio/cinderella/

Government of Slovenia (2018): Roadmap towards the circular economy in Slovenia

European Commission (2016): "The urban development network in Maribor", presentation at the Peer Review Workshop – Integrated Sustainable Urban Development Strategies, 1-2 December, Ghent

Greencycle project (n.d.) website, [last visited 20.09.2018]: http://www.alpine-space.eu/projects/greencycle/en

Ropotarnica (n.d.) website, [last visited 20.09.2018]: http://www.ropotarnica.org/

Tkalka (n.d.) website, [last visited 20.09.2018]: http://tkalka.si/

The New Ideas For Old Buildings project (2015): Article about Weaver (Tkalka), 24th September 2015

URBAN SOIL 4 FOOD project (n.d.) website, [last visited 20.09.2018], https://www.uia-initiative.eu/en/uia-cities/maribor

Wcycle (n.d.) website, [last visited 20.09.2018]: https://wcycle.com/

3 The Circular Economy in the region of Brussels

3.1 Executive summary

The Region of Brussels Capital is a precursor and front runner city in the implementation of a strategy aiming to transition to the circular economy. The Plan Régional d'Économie Circulaire (Regional Plan for a Circular Economy, RPcircular economy in English) adopted in 2016 as part of the Brussels regional Strategy 2025 is the milestone initiative for acting upon this transition. It defines 111 actions and encompasses a holistic and transversal approach that oversees and organises the involvement of three ministries, four administrations, and several additional partner organisations. It leverages both offer and demand for circularity and brings forward a mix of bottom-up and top-down measures, which provide both the necessary amount of political direction, and the flexibility of involving a wide array of territorial actors.

An important success factor of the strategy lies in the innovative governance that was put in place. Based on the lessons learnt of the predecessor strategy, the Alliance Emploi Environnement (AEE, or Job and Environment Alliance in English), the governance structure of the RPcircular economy sought the implementation of a strong coordination structure in order to avoid silo politics, and to ensure political buy in at an early stage in order to integrate in the strategy a political vision which would serve the needs of top-down instruments and initiatives. Overall, the mix of top-down and bottom-up approaches was used to ensure the engagement of a wide array of stakeholders, from the political offices to companies and other relevant local actors.

Exploring the possibility of planning territories for circularity, actors of the transition are limited by the knowledge gap in the literature. In practice, planning for circularity is encouraged or limited by other policy imperatives, embedded in the local context, which highlights the importance of improving coherence of the circular agenda with other urban challenges in order to adequately respond to urban planning challenges with circular solutions.

3.2 Background information

Administrative structure and policy framework: Brussels-Capital is one of the three regions of the Federal State of Belgium, together with Flanders and Wallonia.

Type of territory - (2) metropolitan regions;

Description of the regional geography and economy: Centre of EU administration, Brussels' economy is largely service-oriented, i.e. dominated by regional and world headquarters of multinationals, European institutions, various administrations, and related services.

Population: 1 199 095 inhabitants (2017)

Gross domestic product (GDP): 75 893 million euros; **per inhabitant**: 58 400 euros (2016);

Share of people having attained tertiary education (levels 5-8) aged 25-64: 44.1% (2016)

Unemployment rate: 16.8% (2016)[35]

The Region Brussels Capital[36] (RBC) is a metropolitan region of close to 1.2 million inhabitants[37] stretching over an area of 162 km^2. The Brussels region counts a very large majority of jobs belonging to the tertiary sector (93,5% in 2011), namely and in order of importance, public administrations, accounting, consultancy and legal advice, education, and financial services (excl. insurance and pension related activities). The region does not count as many industrial companies of importance as before. Their activities are directed towards manufacturing or more specific sectors, e.g. automotive production, commercialisation of meat products, public transports, water treatment, etc. Industrial activities are concentrated in a couple of industrial zones located near the big transportation axis (i.e. waterway and highway). As of 2011, the metal processing and food processing sectors were the two industrial sectors employing most people.[38]

The Brussels region is front running the shift towards a circular economy in diverse ways while addressing varied economic sectors. It was one of the first large urban area of the European Union to design and implement a strategy for the circular economy, integrating the political will to transition to a circular economy in 2015 with the adoption of its regional strategy **Stratégie 2025**, and starting its reflection a couple of years before that, when the possibility of conducting an urban metabolism study was studied as early as in 2013, as a recommendation of the evaluation of Resources and Waste axis of the Employment-Environment Alliance (i.e. flagship regional environmental strategy of the RBC from 2011 to 2015). Thus, between 2013 and 2015 Brussels Environment carried out a study aimed at quantifying the flows of materials, water and energy that enter, are consumed, transformed or stored in and leave the Brussels Region. The extensive metabolism study was commissioned by Bruxelles Environnement (i.e. the regional ministry of environment) and published in 2015. The metabolic balance carried out in this context has shown in particular that the Brussels territory, strongly urbanised and densely populated (by its inhabitants but also by its "commuters", students, tourists, congress participants, etc.), with an essentially tertiary economy and of limited size, is

[35] Description of regional economy, https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/brussels-capital; Population, NUTS2 [Eurostat: demo_r_pjangroup] ; GDP, at current market prices NUTS 2 regions in million euro [nama_10r_2gdp]; GDP per capita, at current market prices by NUTS 2 regions, Purchasing power standard (PPS) [nama_10r_2gdp]; Education, http://ec.europa.eu/eurostat/cache/RCI/#?vis=nuts2.education&lang=en ; Unemployment rate, http://ec.europa.eu/eurostat/cache/RCI/#?vis=nuts2.labourmarket&lang=en

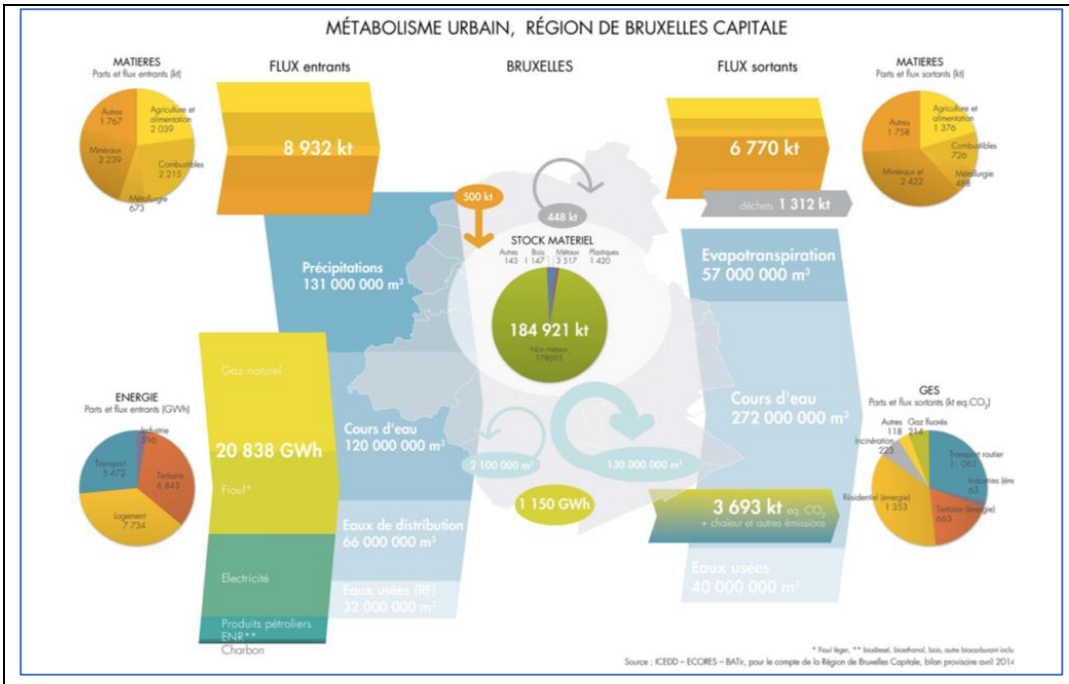
[36] Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest

[37] In 2016, in Eurostat: demo_r_pjangroup (NUTS2), demo_r_pjangrp3 (NUTS3)

[38] (Ecores sprl, ICEDD, BATir ULB, 2015)

marked by a highly linear economy and a strong dependence towards the outside concerning the resources it consumes. The study also highlighted the quantitative importance of certain flows, in particular those linked to the construction, agriculture and food sectors and fuels and petroleum products[39]. More detailed results of the study can be found in Figure 3-1. As of today, the environmental footprint of the RBC represents 400 times its surface and twice the surface of Belgium[40].

Figure 3-1 Material flows, Urban metbolism of Brussels Region



Key figures in the diagram and references to the technical explanations in the report:

- 20,838 GWh: flow of consumption of imported energy in RBC in 2011;

- 349 10^6 m^3: sum of flows of incoming water in RBC in 2011 (including precipitations, incoming watercourses, distribution water and treatment water from the Flemish Region à);

- 8,932 kt: flows of imported material in RBC (international + interregional) in 2011;

- 1,150 GWh: primary energy production in RBC in 2011;

- 2,106 m^3 and 130,106 m^3: quantity of water sourced in RBC and quantity from treated wastewater in RBC in 2011;

[39] (Ecores sprl, ICEDD, BATir ULB, 2015)

[40] (Prespective.brussels, 2018)

- 184,921 kt: total mass of the material stock which has been considered in the framework of this study in RBC in 2011 (which includes the material stock of residential, office and commercial buildings, as well as the different types of vehicles and infrastructures);

- 448 kt: waste treated by the incinerator in 2011 (this value does not intervene directly in the balance of material flows since it is a reduction of the waste leaving the system. However, waste from incineration is included in RBC's Outgoing Waste quantity);

- 500 kt: addition to material stock for 2011;

- 3,693 kt: GHG emissions in CO2 eq in RBC in 2011;

- 369 106 m^3: sum of the outgoing water flows in RBC in 2011;

- 1. 312 kt: sum of RBC's quantity of outgoing waste in 2011 (including waste from households and similar, municipal container parks, social economy, construction and demolition waste, hotel and catering sector, STEPs, offices, industry and incineration, health, retail, education and cleaning services) - some of this waste is sorted and recirculated;

- 6,770 kt: flows of exported material in RBC (international + interregional) in 2011.

Source: (Ecores sprl, ICEDD, BATir ULB, 2015)

In line with the stated rational for the metabolism study (Ecores sprl, ICEDD, BATir ULB, 2015), the realisation of an urban metabolism for the region of Brussels-Capital was considered relevant as one of the starting points for the co-construction and "operationalisation" of an ambitious and pragmatic policy in circular economy. The initiative aimed in particular at objectivizing the circularization of flows in the region and to put Brussels Environment in the capacity of establishing an assessment (including sectoral) in order to establish relevant concrete actions on a qualitative and quantitative basis for the integration of the circular economy at the scale of the region.

The lessons of the study were translated into a number of objectives for the region which were adopted in the **regional plan for a circular economy** (RPcircular economy, or Plan Régional d'Économie Circulaire). The plan is the reference document in the RBC establishing the regional circular economy strategy and defining the key actions to be implemented. It also translates the objectives of the encompassing economic Stratégie 2025 of the Brussels government into an action plan for the circular economy.

Even though there are very little formal links between the RIS3 strategy and the circular economy strategy, the RIS3 strategy is partly relevant to the achievement of the objectives of the circular economy strategy, as the innovation section of the RPcircular economy has been defined partly around the considerations of the Plan Régional d'Innovation 2016 (PRI, Regional Innovation Plan 2016), i.e. Brussels' RIS3 strategy, which mentions the Circular Economy as a strategic business area to develop. The proposed actions in the PRI have been chosen keeping their compatibility and complementarity with the projects selected under

the ERDF Operational Programme 2014-2020 in mind, with the objective of reinforcing the expected results of these Structural Fund investments, since all the amounts devoted to thematic objective 1 of the ERDF OP (strengthening research, technological development and innovation) will be used to finance initiatives under these strategic areas of activity[41]. However, if ERDF funding as well as other sources of European funding are used to a certain extent in the implementation of measures related to transitioning to a circular economy, European funding opportunities are not systematically considered in the implementation of the RPCE. Exemples of projects funded under the 2014-2020 programme include COOPCITY (on the social economy), Irisphere (on Industrial symbiosis), Brussels Retrofit Living Lab (on building efficiency), Metro-Lab (on urban ecology research), the BBSM project (Buildings in Brussels, A Source of Future Materials, focusing on material life cycle research), ATRIUM LAB (on retail), and more[42]. Additionally, two important organisations for the implementation of the RPcircular economy were funded under the previous ERDF programme (2007-2013), i.e. Rec-K (the circular economy platform and competence centre specialised on reuse, recycling, and material life cycle) and Greenbiz.brussels (the business support organisation for start-ups and enterprises in the green economy).

3.3 CIRCTER Indicators

Table 3-1 Material flows in Region de Bruxelles-Capitale (BE10)

MATERIAL FLOWS	BE10
DMC per capita 2006 (tonnes/hab)	6.85
DMC per capita 2014 (tonnes/hab)	5.95
DMC intensity 2006 (kg/euro)	0.12
DMC intensity 2014 (kg/euro)	0.10
Biomass per capita 2006 (tonnes/hab)	1.83
Biomass per capita 2014 (tonnes/hab)	1.92
Biomass intensity 2006 (kg/euro)	0.03
Biomass intensity 2014 (kg/euro)	0.03
Metal ores per capita 2006 (tonnes/hab)	0.28
Metal ores per capita 2014 (tonnes/hab)	0.01
Metal ores intensity 2006 (kg/euro)	0
Metal ores intensity 2014 (kg/euro)	0
Construction per capita 2006 (tonnes/hab)	2.74
Construction per capita 2014 (tonnes/hab)	3.11
Construction intensity 2006 (kg/euro)	0.05

[41] See http://www.innoviris.be/fr/politique-rdi/plan-regional-dinnovation/pri-2016-revision-2me-lecture-web.pdf

[42] http://coopcity.be/ ; https://www.irisphere.be/ ; https://www.livinglabs-brusselsretrofit.be/ ; http://www.metrolab.brussels/ ; https://www.researchgate.net/project/BBSM-le-Bati-Bruxellois-Source-de-nouveaux-Materiaux ; see http://be.brussels/files-fr/a-propos-de-la-region/sg/feder/tableau-des-beneficiaires ; see more at http://be.brussels/files-fr/a-propos-de-la-region/sg/feder/seminaire-02-02-2016/presentation-projets-feder-presentatie-efro-projecten

Construction intensity 2014 (kg/euro)	0.05
DE per capita 2006 (tonnes/hab)	-
DE per km2 2006 (tonnes/km2)	-
DE per capita 2014 (tonnes/hab)	-
DE per km2 2014 (tonnes/km2)	-

Table 3-2 Waste in Region de Bruxelles-Capitale (BE10)

WASTE STREAMS AND WASTE BY NACE ACTIVITY	**BE10**
Waste generation	
Total waste generated per capita 2006 (kg/hab)	4,283.21
Total waste generated per capita 2014 (kg/hab)	2,622.82
Total households waste per capita 2006 (kg/hab)	479.74
Total households waste per capita 2014 (kg/hab)	445.33
Total foodwaste per capita 2006 (kg/hab)	656.83
Total foodwaste per capita 2014 (kg/hab)	803.09
Total WEEE per capita 2006 (kg/hab)	9.37
Total WEEE per capita 2014 (kg/hab)	10.43
Plastic waste per capita 2006 (kg/hab)	71.24
Plastic waste per capita 2014 (kg/hab)	157.35
Waste by NACE activitiy	
Agricultural waste intensity 2006 (kg/Thousand Euro) (*)	0.58
Agricultural waste intensity 2014 (kg/Thousand Euro) (*)	3.85
Construction waste intensity 2006 kg/Thousand Euro) (*)	400.71
Construction waste intensity 2014 (kg/Thousand Euro) (*)	570.86
Manufacturing waste intensity 2006 (kg/Thousand Euro) (*)	132.14
Manufacturing waste intensity 2014 (kg/Thousand Euro) (*)	111.43
Mining waste per km2 2006 (tonnes/km2 - Waste by mining/total surface)	15.47
Mining waste per km2 2014 (tonnes/km2 - Waste by mining/total surface)	7.46

(*) Waste intensity: [Waste by agriculture/construction/manufacturing - kg] / [GVA by agriculture/construction/manufacturing- Tsd euro]

Table 3-3 Provision of materials, technologies and services for a circular economy in Region de Bruxelles-Capitale (BE10)

	BE10
Material providers	
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	5.51
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	4.95
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	-0.10
Turnover per Material Provider Employee in 2010 (Thousand euro/employee)	591.04
Turnover per Material Provider Employee in 2015 (Thousand euro/employee)	629.15
Growth Rate of Turnover in thous. Euro per Material Provider Employee in % (2010-2015)	0.06
Technology providers	
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	12.9
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	13.16
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	0.02
Turnover per Technology Provider Employee in 2010 (Thousand euro/employee)	184.07
Turnover per Technology Provider Employee in 2015 (Thousand euro/employee)	217.92
Technology Providers Growth Rate of Turnover in thous. Euro per Technology Provider Employee in % (2010-2015)	0.18
Circular Business Models (CBM)	
Number of CBM Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	5.76
CBM Turnover per Circular Business Models employee in 2015 (Thousand euro/employee)	157.27

3.4 Case study description

The metabolic balance of the 2015 study highlighted the importance of **food, agricultural and metal products in international flows** and the dominance of flows of **construction materials, food and manufactured products at the interregional level**. As such, the deposits of construction waste, metals, plastics and organic flows were pinned as priorities for recircularisation actions on the Brussels territory, for their potential to recreate economic activity in the territory for part or all the value chain (from production to use/consumption and reprocessing). Additionally, implementing **local control of energy and materials**, to the extent possible, including in their value chains, is a priority which coincides with the objective of promoting circular economic models on the Brussels territory (in particular a servitised economy, and eco-design for the recovery of materials at end of use). This control should take place at interregional level (imports, exports, waste treatment and recycling) or at international level (imports, exports and recycling), depending on the location of activities carried in Brussels within the value chains.

Opportunities for a transition to a Circular Economy were aligned on four axes:

- Political: through the implementation of a **partnership-based type of governance**, linking public, private and associative spheres for a concerted evolution of all human activities towards the circular economy in terms of design, production and consumption, research and development, economic stimulation, changes in regulatory provisions (waste status, eco-design, taxes to favour products and materials of technical quality -upcycling...);
- Operational: with the creation of value chains on the Brussels territory for **circular enterprises** (selective collection, sorting, reuse/reconditioning/dismantling/recycling) **that create value on the territory** (ecological, socio-economic, innovation, human, etc.);
- Socio-economic: **creation of jobs** adapted to dismantling work, repair, recovery, etc. and **training** adapted to the academic and socio-professional level;
- Economic: support for the deve**lopment of sectors and activities in line with the principles of the circular economy**, from the level of research and development to the creation of companies.

The regional plan for a circular economy (i.e. RPCE) integrates these findings. Its implementation started in 2016 and will span over a four-year period (i.e. 2016-2020). It is organised around three general objectives:

- Transform environmental objectives into economic opportunities,
- Make Brussels' economy place-based in order to produce locally when possible, reduce travels, optimise the use of the territory and create added value for the inhabitants of Brussels,
- Create new jobs.

3.4.1 Main instruments in place

It consists of **111 measures, split into four strategic parts – horizontal, sectoral, territorial, and governance-related measures** (see Text Box 3-1) – and **five sectors of focus – logistics, waste, construction, food, and retail**. In 2016, a budget of EUR 12 839 500 was mobilised for these measures.

Text Box 3-1 Description of the axis of the RPCE[43]

These measures concern all economic players and aim to establish a favourable regulatory framework, economic aid, develop innovation, sustainable and innovative public procurement, create or direct new training for new jobs adapted to the profile of job seekers in Brussels. In short, it is a question of activating the public levers that make it possible to offer a global framework favourable to the emergence and deployment of the circular economy in the Brussels-Capital Region.

Sectoral measures

Specific measures target construction, resources and waste, logistics, trade and food (which is the subject of the Good Food strategy), sectors chosen according to their job creation potential, their impact in terms of greenhouse gas emissions and because they are at the heart of the most important challenges for Brussels.

Territorial measures

In addition to transversal and sectoral approaches, the PREC wants to mobilise all the actors of the Brussels territory, from the districts to the metropolitan area. The objective is to act at the local level through Sustainable Neighbourhood Contracts (Contrats de Quartiers Durables), Urban Renovation Contracts (Contrats de Rénovation Urbaine), Agenda 21 calls for projects for municipalities, the 10 zones of priority development and the canal territory, by integrating the circular economy into the sustainable district reference framework developed by Bruxelles-Environnement.

The Region also wants to preserve spaces for circular economic activities through the Economic Real Estate project (business park dedicated to this type of activity) and will rely on the regional strategy of creating digital manufacturing workshops.

[43] https://environnement.brussels/thematiques/transition-de-leconomie/programme-regional-en-economie-circulaire

The RPcircular economy is implemented via **a mix of bottom-up and top-down measures**. The levers used offer the opportunity to act on both **offer** and **demand** of circularity, among others they are the following:

- Training: fostering competences suited to leveraging circular opportunities, for instance the creation of eco-design courses, or the promotion of competences such as qualified “upcyclists”,
- Public markets: transition to circular public markets for priority markets (i.e. construction, resources and waste, logistics, and food, with specific attention given to EEEs, furniture and medical equipment),
- Legal framework: creation of a process for identifying and overcoming legal and administrative barriers,
- Innovation: mobilising cooperation between research actors and practitioners, with the financing of several projects on green technology, circular business models, or resource efficiency,
- Indirect economic aid: creation of circular economy cluster, coaching in circularity, ions, creation of a platform gathering the business offer in circular solutions, implementation of an industrial symbiosis programme for the regional industry,
- Direct economic aid: running a call for projects for financing and incubating circular solutions, attributing grants for very small enterprises in sustainable food, eco-construction, personal care, ICT, waste and resources, and the energy and creative sector,
- Territorial: integrate the principles of the circular economy within the development plans of 10 priority zones and the Brussels canal territory, promote greater levels of interconnections between economic actors with an industrial symbiosis programme,
- Employment: identifying jobs and competences necessary to develop a circular economy,
- Economic and social: integrating the social economy into the operations of the RPcircular economy, running a call for proposals aimed at occupational rehabilitation in innovative projects,
- Sectoral: supporting the deployment of circularity principles in the construction sector, supporting these businesses to gain higher shares of the market, fostering collaboration of stakeholders of the construction and waste sectors in physical spaces of experimentation, creating a Resources and Waste observatory and a virtual desk aimed at fostering reuse, etc.

3.4.2 Synergies with other initiatives in the Brussels Capital Region (RBC)

The circular economy strategy in the RBC is not limited to the RPcircular economy, and the RPcircular economy seeks synergies with several past, present and planned initiatives. Beyond the already mentioned Strategy 2025 and Regional Innovation Plan, these initiatives mainly include:

- The Good Food strategy, focused on turning the food system in Brussels sustainable, including awareness raising, fostering local production, and reducing food waste,
- The Water Management Plan of the Region of Brussels-Capital 2016-2021 (Plan de Gestion de l'eau de la Région de Bruxelles-Capitale 2016-2021)
- The Nature Plan (Plan Nature), focusing on he management of ecological systems and biodiversity, and quality of life,
- The Forest Management Plan (Plan de Gestion de la Forêt)
- The Organic Urban Revitalization Ordinance of October 6, 2016 (Ordonnance Organique de la Revitalisation Urbaine)
- The Regional Plan for Sustainable Development (Plan Régional de Developpement Durable), focusing on urban planning and a long-term vision for the Brussels territory,
- The present and future Air-Climate-Energy Plan (Plan Air-Climat-Energie),
- The Fifth Resource and Waste Management Plan (Plan de Gestion des Ressources et des Dechets) (draft in review) focused on sustainable, sober, local and circular consumption for a zero-waste society,
- The future Industry Plan (Plan Industrie),
- And the future Plan Good Move, focused on mobility.

From the results of the metabolism study, and creating synergies with past, present and future related-strategies, the Region Brussels Capital integrated the opportunities that lied in the characteristics of its territory to leverage the environmental and economic opportunities of a circular approach.

Altogether, the approach focuses on the development of a **short-distance city**, the **densification of functions** near important transport nodes, the **mobilization of different stakeholders** and the development of **multi-stakeholder spaces**, with the **combination, articulation and development of their competences** leveraging a circular economy. Urban metabolism is the starting point for the implementation of the defined actions seeking to **dematerialise the Brussels economy** and better-position economic activities and value creation along material use and reuse. Furthermore, the territorial approach also focuses on **the relational proximity between the actors**: amplifying the interdependence between enterprises, their economic activities and the territory within which they are situated, with the intention of reducing the impact of their activities on the environment and of favouring where possible the creation of short loops.

3.5 Governance

The main stakeholders involved in the implementation of the RPcircular economy are:

- Three (Regional) ministries: The **Ministry of economy**, **employment, and professional training**, the **Ministry of housing, quality of life, environment and energy**, and the **Secretary of state for public cleanliness, collection and processing of waste and scientific research**.
- And four regional administrations: **Impulse**, Brussels business agency, (now hub.brussels), **Bruxelles Environnement**, Brussels administration for environment and energy, **Bruxelles-Propreté**, Brussels agency for the cleaning, collecting and treatment of household waste, and **Innoviris**, Brussels administration for the promotion and support of innovation.

However, overall the regional plan involves at least 13 partner administrations and many additional organisations, gravitating in its implementation.

At the heart of the implementation of the RPcircular economy are structures for enhanced cooperation. This emphasis on strengthened inter-administration/inter-ministerial cooperation is an intentional improvement from the governance system of the predecessor programme of the RPcircular economy, i.e. Alliance Emploi Environnnement (AEE). The evaluation of the AEE notably advised that increasing transversality would allow a stronger involvement of certain transversal actors. In addition, the learnings from the evaluation of the predecessor programme (i.e. AEE) also brought to the governance of the RPcircular economy a stronger strategic and political framing. Indeed, while social partners and stakeholders agreed on the relevance of continuing the AEE's approach, they also pointed to the need for a clear vision and political framework, in addition to the bottom-up methodology previously implemented. According to the evaluation of the AEE conducted, this vision is fundamental, firstly to guide the co-construction phase with the actors and lead to coherent action plans and then, secondly, to allow political arbitration among the actions emerging from the bottom-up phase and ensure transparency in the financing choices made. Consequently, the RPcircular economy is implemented via a mix of bottom-up and top-down measures.

The governance of the RPcircular economy is structured around the following elements:

- **The PREC Steering Committee** foreseen by the methodology Strategy 2025: in charge of the follow-up of the Strategy for the implementation of the PREC in accordance with the methodology of Strategy 2025;
- The **PREC Coordination Committee** with a coordination and **daily management cell** at Bruxelles Environnement that organises the concrete implementation of the PREC;
- The **management of the implementation of actions** and regular reporting to ensure good progress;
- A **framework mechanism for the emergence of new proposals**;

- The establishment of **structures for enhanced cooperation between governments and with the professional federations** to improve the effectiveness of the circular economy strategy;
- **A platform of networking and animation between actors** to share information and maintain a dynamic of stakeholder engagement.

The steering committee is composed of representatives from the three ministries in charge of the RPcircular economy, the region presidency, the regional ministries associate to the initiatives (e.g. Ministry of Education, of Social Promotion – adult education), and of the 11-chapter coordinators within the respective administration of the RBC (e.g. Bruxelles Environnement, Impulse.brussels, Brussels Economy Employment, Actiris, Bruxelles Formation, VDAB Brussel, Innoviris, Citydev, Finance.Brussels, Agence Bruxelles-Propreté, the Brussels Office of Planning, the Port of Brussels, Atrium, Bruxelles Mobilité, the CIRB, as well as the Economic and Social Council).

3.6 Results and impact

The main mapping of material flows and waste data conducted and in relation to the circular economy in the Region Brussels Capital was published in 2015 (Ecores sprl, ICEDD, BATir ULB, 2015). These results were presented above (see Figure 3-1). Additional studies include a metabolic analysis of organic matter flows, and a sectoral analysis of the construction sector[44]. Notably, one conclusion from the 2015 study has been that in order to produce valuable impact assessments further work should focus on one specific and targeted sector or resource only.

Reporting on progress and potential revisions are formally organized within the RPcircular economy every year and a half. 2018 is the first year that this reporting is going to be conducted. Therefore, there are no indication of results to date. Indicators to monitor progress are developed by the programme thematic coordinators and their collaborators. This reporting is not a cost-benefit. For each of the 111 actions, coordinators and managers have been asked to suggest an indicator that could monitor progress and evaluate results. These indicators use the propositions provisionally made in the RPcircular economy (see). Potential revisions could mainly include possible changes in the operational implementation.

[44] https://www.cairn.info/revue-de-l-ofce-2016-1-page-161.htm ; http://www.circulareconomy.brussels/wp-content/uploads/2018/02/be_prec_fr.pdf and http://www.circulareconomy.brussels/wp-content/uploads/2017/10/RAP_2017_Economie-Circulaire-Construction.pdf

Text Box 3-2 Provisional indicators in the RPCE

1. Number of legislative and normative obstacles identified and resolved
2. Number of legislative and normative incentives created
3. Number of enterprises having benefited from financial aid linked to the circular economy
4. Amount of financial aid granted to companies linked to the circular economy
5. Number of accompanied economic operators in circular economies
6. Number of economic operators made aware in circular economy
7. Number of people trained in the circular economy professions
8. Number of students trained in circular competences
9. Budget amount allocated to calls for projects/living labs implemented and number
10. of companies that have benefited.
11. Number of pilot cases set up via calls for projects/living labs
12. Number of seminars organised on circular economy in the framework of RPCE
13. Budget amount and number of pilot public procurement contracts in circular economy developed in RBC
14. Number of companies informed/aware of Brussels public procurement opportunities
15. Number of jobseekers put to work following training developed as part of the of the RPCE
16. 15. Number of new neighbourhoods integrating circular economy principles

In order to evaluate the action plan in its entirety and as defined in the RPcircular economy, Brussels Environment, with the support of UNEP-GIREC and their experts, and ECOCITYBUILDER will also develop relevant macro indicators to assess the Brussels "circularity" criterion. This work will also serve to evaluate the potential opportunities in obtaining an ISO 37120 certification (i.e. Sustainable development of communities - Indicators for city services and quality of life). In September 2018, an external consultant should also present the ongoing work on CO2 eq. emissions measurements related to the RPCE.

The use of waste and resources macro-data does not seem to be integrated in the reporting efforts of the RPCE. As a matter of fact, one interviewee mentioned that the waste or material data that they can obtain are never entirely reliable and are not suitable for the evaluation of the RPCE. According to him, waste and resources data collection is a general issue, because of the lack of local context awareness or reliability that goes with macro-data collection.

3.7 Drivers/success factors, other enabling conditions and barriers

There has been no formal evaluation to date of the main drivers and barriers in transitioning to a circular economy. Nonetheless, elements related to the governance structure and design process of the circular economy strategy have been identified in our desk research and interviews as important success factors of the implementation of the strategy, and with it the transition to a circular economy. Hindering elements related to the process of obtaining European funding and the loss of multipartite management skills are also described below.

On one hand, the **governance mechanisms** implemented as part of the RPcircular economy appear to be **important drivers** of the success implementation of the actual circular economy strategy. According to interviewees, the coordination mechanisms put in place for the implementation of the circular economy strategy constitutes a considerable change from previous programmes and constitutes an innovative and important point of advancement from previous governance structures. **All administrations** under the regional ministries in charge of implementation have the **formal obligations to cooperate in implementing the circular economy strategy and finding synergetic actions**. Silo politics is avoided by this cooperation where all fields of this transversal strategy (i.e. by nature a circular economy strategy is transversal) are formally asked to cooperate **on an equal basis**. Decisions taken by the Steering Committee, the ministries and the administrations need to be concomitant and agreed upon by all parties. The structure is reported to be the **most advance effort of inter-administration collaboration** implemented by the region to **approach a public strategy from a holistic approach**. Additionally, and as mentioned above, the **stronger involvement of political offices in the implementation of the strategy** is considered a driver. A lesson learnt from the evaluation of the AEE (i.e. the programme preceding the RPCE), the circular economy strategy in RBC benefits from a clearer political vision which eases the top-down processes of implementation. Despite the slowness that can be sometimes experienced, the framing of the multipartite cooperation as implemented for the RPcircular economy is seen as an important good practice that could benefit other regions' implementation of circular economy strategies.

Moreover, the emphasis put on **stakeholder engagement and multi-stakeholder collaboration in the design and implementation of the RPcircular economy** is also reported to be a success factor. The mix of bottom-up and top-down approaches with the involvement of a large array of stakeholder is reported to benefit the implementation of the actions defined in the RPcircular economy, by bringing on board many actors and ensuring their buy-in. Additionally, the different stakeholder platforms put in place are reported to bring an important amount of feedback on the reality of implementation. It enables the emergence of potential areas of innovation, barriers to overcome and opportunities for the future. For instance, the meetings organised as part of the inter-administration governance provide a platform for the identification of barriers and the simplification of administrative processes. Equally, the strategic monitoring meetings organised by the research and innovation chapter of the RPcircular economy are used for the identification of new research topics and the monitoring of related-European funding opportunities.

On the other hand, one of the issues put forward in the case study was the l**oss of skills related to inter-administration project management**. The operational coordination of the RPcircular economy has indeed been contracted out to an external organisation, in charge of assisting Bruxelles Environnement in the implementation of the action plan and in managing the coordination between the different administrations. The skills obtained in the management of such multipartite project is valuable, given the foreseen importance of holistic and transversal approaches. The evolution from silo to transversal approaches requires an evolution in the skillset of public servants, traditionally required to be topical experts but now increasingly asked to manage interdisciplinary projects. The **management of this multipartite project being given to an external organisation means that these new competences will not be retained internally.** As such, the involvement of externals to ensure this coordination is hindering skill retention.

As it stands, European funding and projects are reported as not being attractive as they tend to pose administrative problems and require an important time investment for few results. Often, administrative capacity and human resources management (e.g. hiring an extra FTE to ensure capacity) are issues that are difficult to overcome, especially since the austerity measures implemented by the Brussels government. In practice, and outside the Research and innovation chapter, the RPcircular economy does not seem to integrate deep-enough reflection on the potential use of European funding.

Some of the identified gaps in the current framework and identified by implementers of the RPcircular economy is for instance **knowledge on the creation of circular public markets from a legal and animation point of view**, namely, which steps need to be implemented in order to transform public procurement practices, or which new type of contracts, monitoring or performance indicators should be used. This is closely linked to green public procurement and the definition of the role of public administrations in fostering a circular economy within the legal context of procurement practices. This is also linked to questions of identifying market maturity in providing circular economy solutions to public procurement requests or how to help this market develop adequate solutions. Another gap which requires attention is related to the territorial aspects of the circular economy – namely, **how to implement a territorial strategy linked to planning which create favourable conditions for the circular economy to flourish**. To address some of these knowledge gaps, the innovation chapter of the RPcircular economy via Innoviris (the RBC administration in charge of innovation policy) created an academic chair at the Université Libre de Bruxelles, which aims are to link academic research conducted on the circular economy with the work undertaken by public administrators and private practitioners. Additionally, we can expect that the participation of Brussels region stakeholders in present and future multi-stakeholder projects will help identifying the knowledge and solutions to these mentioned gaps.

3.7.1 Relevant Clusters

GreenTech Brussels[45], hosted by hub.brussels (Brussels Agency for Enterprise Support), provides free advice and guidance to startups and companies who are active in the field of environment, sustainable energy or circular economy. GreenTech Brussels supports circular projects of 'mini-clusters' of companies in the fields of Textiles, food industry, WEEE and logistics.

Ecobuild.brussels[46] is the networks of Brussels' sustainable construction and renovation actors, a cluster that fosters the business development of companies active in these fields.

CoopCity[47], a centre dedicated to supporting social entrepreneurship in Brussels, offers support programmes to would-be social entrepreneurs and also engages with established social entrepreneurs in the reigon.

3.8 Assessment of the region's capacity to keep unlocking the potential of a CE

The RPcircular economy intends to act upon the areas of potential identified in the 2015 metabolism study with the laid-out intentions (mentioned above) of integrating environmental concerns (dematerialising the economy), making the Brussels economy place-based (closing material loop on the territory), and creating new jobs. The direct targeting of potentials identified in the study places the Brussels region in the right track to improve the circularity of its economy. The evaluation of the RPcircular economy conducted in 2018[48] determined that its actions have been able to set the basis and provide incentives to creating an ecosystem that fosters a transition to a more circular economy in the fields targeted by the strategy: construction, logistics, waste, and retail.

The territory of Brussels is on track to become more circular as a consequence of the RPCE. The **territorial characteristics which could be levered to improve the circularity of the region**, identified by the 2015 metabolism study, are related for instance to:

- The **resources endowment of the region** and the identification of activities which could help retain more value and extend the life of these resource within the territory

[45] http://www.greentechbrussels.be/en/about-us/

[46] https://www.ecobuild.brussels/en

[47] https://coopcity.be/le-centre/

[48] See PREC Mid-term Evaluation, 2018 http://circulareconomy.brussels/chronologie/images/chronologie/PREC_%20EVALUATION-Mi-Parcours.pdf

- The introduction of a **holistic approach to leveraging this circularity**, integrating actions on circularity demand and offer
- The **creation of positive framework conditions** (e.g. creation of circular skills and jobs, removing of legal barriers, etc.). These activities are expected to shape the Brussels territory by densifying functional areas (i.e. of industrial and economic activity) where interlinkages between stakeholders are increased.

The Region Brussels Capital does not have the infrastructure and therefore cannot currently valorise (i.e. reuse, refurbish, recycle) the entirety of outgoing flows. Improving the valorisation of outgoing flows would mean heavily setting up recycling industries and other initiatives to prolong resource life. The territory of Brussels is limited in space, and as such, this circular potential is constrained by these territorial characteristics. It is however not only the territorial characteristics of the Brussels region which impede the latter from happening, but also a myriad of socio-economic and political factors, e.g. demographic pressure, local programmes and politics, desire to develop manufacturing jobs, etc. In practice, the potential for implementing the circular economy is encouraged or limited by other policy imperatives, **embedded in the local context**. This highlights the inherent iterative nature of planning for circularity and the importance of **improving the coherence of the circular economy with these other priorities, to limit the mismatch between the offer and demand of territories**.

Unlocking the potential of a circular economy in the future (taking additional actions than the ones defined today) will come along with the integration of all these factors. Linked to the aforementioned territorial perspective (i.e. **how to implement a territorial strategy linked to planning which create favourable conditions for the circular economy to flourish**), it is **important to contextualise** Brussels circular economy strategy. And as such, transition to a more circular economy in Brussels means **responding to urban planning challenges with circular solutions**. In the scope of the Brussels circular economy strategy and especially of territorial planning initiatives, the circular economy is more of a mean than an end.

3.9 A systemic perspective on the Brussels CE case study

The CE strategy for Brussels focuses on the metropolitan nature of the city, and of its economic focus on the services sector. One of the key goals of the strategy is to transform environmental objectives into economic opportunities, making Brussels' economy more place-based. This would result in more local production, reduced travels, and in an optimization of the use of the territory to generate more value added for the inhabitants of Brussels, also through job creation.

The CE strategy for Brussels includes 111 measures, split into four strategic sections: horizontal, sectoral, territorial, and governance-related measures. There are five sectors of focus: logistics, waste, construction, food, and retail.

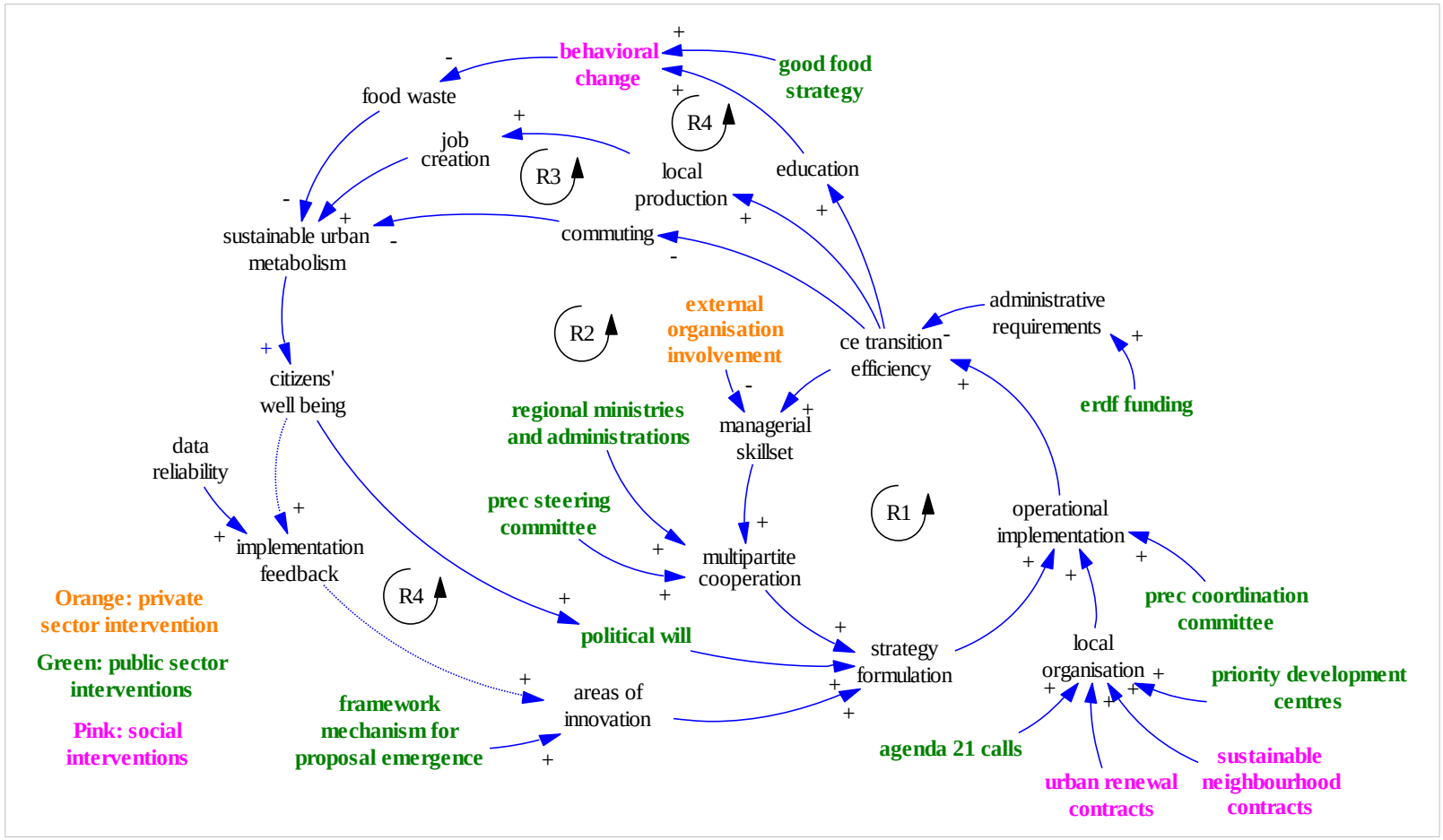
Governance is at the centre of Brussels' CE strategy and is an important success factor of the programme. Specifically, the governance structure envisaged is expected to generate two main virtuous cycles:

- First (R1), emphasis is put on the involvement of local organizations, which is expected to improve the operational implementation of the strategy. Involving external organization will create synergies, by improving the managerial skillset of all parties involved, which include regional ministries and administrations as well, creating a multipartite cooperation.
- Second (R2, R3 and R4), specific strategies, such as emphasis on education, strengthening local production, and reducing the number of commuters, are expected to create a more sustainable urban metabolism. This will lead to improved citizens' well-being, and to a more active engagement of citizens (which ultimately would translate in political will and public support for the CE).

The monitoring and evaluation of the CE strategy plays an important role in the governance strategy. Data will be collected, and feedback from citizens used to identify new areas of innovation and continue updating the CE strategy on an ongoing basis.

Concluding, the governance of the CE strategy for Brussels aims at creating virtuous cycles by using a multipartite cooperation for strategy design and implementation, and will adopt an evidence based approach to better involve citizens and update and improve the strategy on an ongoing basis.

Figure 3-2: Causal Loop Diagram - Brussels



Source: Own elaboration

3.10 Conclusions and lessons learnt

The Region of Brussels Capital is a precursor and front runner city in the implementation of a strategy aiming to transition to the circular economy. The Plan Régional d'Économie Circulaire (Regional Plan for a Circular Economy, RPcircular economy in English) adopted in 2016 as part of the Brussels regional Strategy 2025 is the milestone initiative for acting upon this transition. It defines 111 actions and encompasses a holistic and transversal approach that oversees and organises the involvement of three ministries, four administrations, and several additional partner organisations. It leverages both offer and demand for circularity and brings forward a mix of bottom-up and top-down measures, which provide both the necessary amount of political direction, and the flexibility of involving a wide array of territorial actors.

In case other regions would like to set up a similar initiative, an **important success factor** of the strategy lies in the **innovative governance** that was put in place. Based on the lessons learnt of the predecessor strategy, the Alliance Emploi Environnement (AEE, or Job and Environment Alliance in English), the governance structure of the RPcircular economy sought the implementation of a **strong coordination structure** in order to avoid silo politics, and to ensure political buy in at an early stage in order to integrate in the strategy a political vision which would serve the needs of top-down instruments and initiatives. Overall, **the mix of top-down and bottom-up approaches was used to ensure the engagement of a wide array of stakeholders**, from the political offices to companies and other relevant local actors.

The **engagement of all implementors along with the involvement of academic partners** has also allowed an agile structure to be put in place in order to make barriers and drivers emerge, address them when possible, and fill-in knowledge gaps which were identified via the involvement of the academic chair created at the ULB. Knowledge gaps however remain, notably regarding the impacts of territorial planning on the facilitation of a circular economy and the fostering of circular markets.

Exploring the possibility of planning territories for circularity, actors of the transition are limited by the knowledge gap in the literature. In practice, planning for circularity is encouraged or limited by other policy imperatives, embedded in the local context, which highlights the **importance of improving coherence of the circular agenda with other urban challenges** in order to adequately respond to urban planning challenges with circular solutions.

3.11 References

Be Circular be.brussels (n.d.) website, [last visited 04.06.2018] : http://www.circulareconomy.brussels

Bruxelles Environnement (2016): Mise en Place d'une Gouvernance Multi-Acteurs Favorisant la Transition de secteurs Economiques vers plus de Durabilite, [last visited 04.06.2018] : http://document.leefmilieu.brussels/doc_num.php?explnum_id=7258

Bruxelles Environnement (n.d.) Focus: Alliance emploi-environnement : bilan et enseignements, [last visited 04.06.2018] : https://environnement.brussels/etat-de-lenvironnement/rapport-2011-2014/environnement-pour-une-ville-durable/focus-alliance-emploi

Ecores sprl, ICEDD, BATir ULB (2015): Métabolisme de la Région de Bruxelles-Capitale : identification des flux, acteurs et activités économiques sur le territoire et pistes de réflexion pour l'optimisation des ressources, [last visited 04.06.2018] : http://document.environnement.brussels/opac_css/elecfile/RAP_20150715_Metabolisme_RBC_rapport_compile.pdf

Eurostat (2018) website: [last visited 04.06.2018]: http://ec.europa.eu/eurostat

Innoviris (n.d.) Website, Co-create Urban resilience, [last visited 04.06.2018]: http://www.innoviris.be/fr/soutien-financier-au-secteur-non-marchand/co-create-urban-resilience-non-marchand

Région Bruxelles Capitale (2016): Plan Régional pour l'Innovation 2016-2020, [last visited 04.06.2018]: www.innoviris.be/fr/politique-rdi/plan-regional-dinnovation

Région Bruxelles Capitale (2016): Programme Régional En Economie Circulaire 2016-2020, Mobiliser les resources et minister les richesses perdues: Pour une économie régionale innovante, [last visited 04.06.2018] : http://document.environnement.brussels/opac_css/elecfile/PROG_160308_PREC_DEF_FR

4 The Circular Economy initiatives in the Basque Country

4.1 Executive summary

The Basque Government has significant competences in the environmental protection field. The Basque environmental policy has demonstrated in the last 40 years a proven track to drive the region towards environmentally sustainable development. A new stage of environmental policy was initiated in 2013. Environment is now increasingly treated as a cross-cutting aspect in the overall Euskadi[49] 2020 strategy, which seeks leveraging territorial assets to seize the economic and social opportunities of transitioning towards a Circular Economy.

The Basque Country is one of the main industrial hotspots in Spain, with traditional manufacturing activities such as metallurgy and machinery and equipment, as well as energy (and related manufacturing) as main activities. Raw materials consumption means 61% of the industry's cost structure, and import dependency is notably high (70%). Therefore, a strong industry orientation features the shift to a circular economy in this region, although reducing food waste and awareness raising and education to drive environmentally responsible consumption attitudes are also pursued through dedicated plans. The implementation of the circular economy in the Basque industry is expected to **decrease 6% the raw material consumption and consequently saving 2,000 million euro** by 2030.

A longer lifetime for products (through eco-design, remanufacture, maintenance and repair, new product-service based business models), increasing process efficiency and material reuse (best available technologies in industrial emissions legislation, cleaner technologies and waste recycling) and responsible consumption and business environmental transparency (green procurement, environmental declaration or carbon footprint) are the three main priorities. Likewise, eco-design, remanufacturing and advanced repair, servitisation and new business models, key metals, and plastics, composites and rubber form the action lines to work on those priorities.

The Basque authorities are wisely combining demand pull measures (public and private green procurement and standardisation) with others aimed at pushing the supply side. The latter include grants (for circular economy demonstration, eco-design and eco-innovation projects, as well as to RDI projects that link industry 4.0 to CE), financial support to equipment and infrastructure and fiscal deductions for companies that invest in environmental projects and production equipment.

[49] Euskadi is the Basque term for Basque Country

The main Basque industries are adopting circular strategies, based on greener products, technological developments and new circular service and business models. Consequently, Basque industry is starting to achieve a circular competitiveness advantage, particularly on the transport, electric and electronic equipment, machinery and metal sectors.

4.2 Background information

Basque Country (ES21), which occupies 1.4% of the Spain's surface (7,234km^2) and shows quite a high population density (300 inhabitants/km^2), is formed by three NUT3 regions: Araba, Bizkaia and Gipuzkoa, The Basque Country is a predominantly urban region that borders with France to the North-East and is bathed by the Bay of Biscay. The geography is very diverse despite the small size of the region. It is formed by many valleys with short rivers that flow from the mountains to the Atlantic Sea. The region enjoys a mild climate; extreme temperatures of either very hot or very cold are rare, although there is a fair amount of rainfall. The Basque Country is one of the most relevant industrial hotspots in Spain, meaning 24% of the GVA, with traditional manufacturing activities such as metallurgy and machinery and equipment, as well as energy (and related manufacturing) as main activities. The GDP per capita is 35,300 (Eurostat, 2016), 49.7% of people from 25 to 64 years old has attained tertiary education (Eurostat, 2017) and the unemployment rate is 11.3% (Eurostat, 2017).

Following the Statute of Autonomy signed in 1979, the Basque Government has significant competences in the environmental protection field. In the last 40 years, the Basque environmental policy has demonstrated a proven track record in mobilising public and private endeavour, as well as civil society to drive the region towards sustainable environmental development. companies.

The "Green Manufacturing" key project (2013), and **"The IV Environmental Framework Programme of the Basque Country 2020 (2015-2020)"** marked the start of a new stage of environmental policy aimed at using the social and economic opportunities provided by improving the environment to create wealth, employment and wellbeing. Environment is now treated as a cross-cutting aspect in the overall Euskadi 2020 strategy. **"The 2020 regional waste prevention and management plan"** is another relevant policy document that is driving the shift to a circular economy (CE). The findings unveiled by a recent diagnosis of the circular economy in the Basque industry, as well as the indicators dashboard (which includes the indicators suggested by the EC's Monitoring Framework on the circular economy and others) are the starting point for the **2030 Circular Economy Strategy**[50]. Alignment with the Basque Industry 4.0 strategy is pursued and

[50] Draft version published in January 2019. Other tentative goals until 2030 set by this (draft) strategy are to increase 30% the material productivity, double the use of circular material, decrease 40% the waste generation (in proportion to GDP) rate, generate more than 30000 jobs in the Circular Econmoy.

"Circular Economy in food" will be also a key initiative. Besides, an ongoing study will identify the opportunities offered by circular economy to Basque companies. The regional **Strategy for Sustainability education 2030** was approved in June 2018.

Circular Economy is well linked to the RIS3 priorities, particularly Advanced Manufacturing and Energy (renewable energies and energy efficiency). The thematic groups working on Advanced Manufacturing agreed Circular economy (CE) as one of the eight strategic initiatives to transform the Basque industry towards Industry 4.0[51]. The Basque Industry 4.0. strategy has spotlighted the enabling role that Industry 4.0 technologies can play towards the CE. The Basque Country is involved in the "De- and Remanufacturing demo-case", developed in the frame of the "Efficient and Sustainable Manufacturing" Pilot Project of the VANGUARD initiative[52].

Figure 4-1 shows that the amount of raw materials per capita processed in the Basque Country in 2015 is significantly higher than in the EU average. This is due to the meaningful contribution of industry to the regional GVA. The regional economy is highly reliant on material imports (almost 13-fold higher than in the EU28 economy).

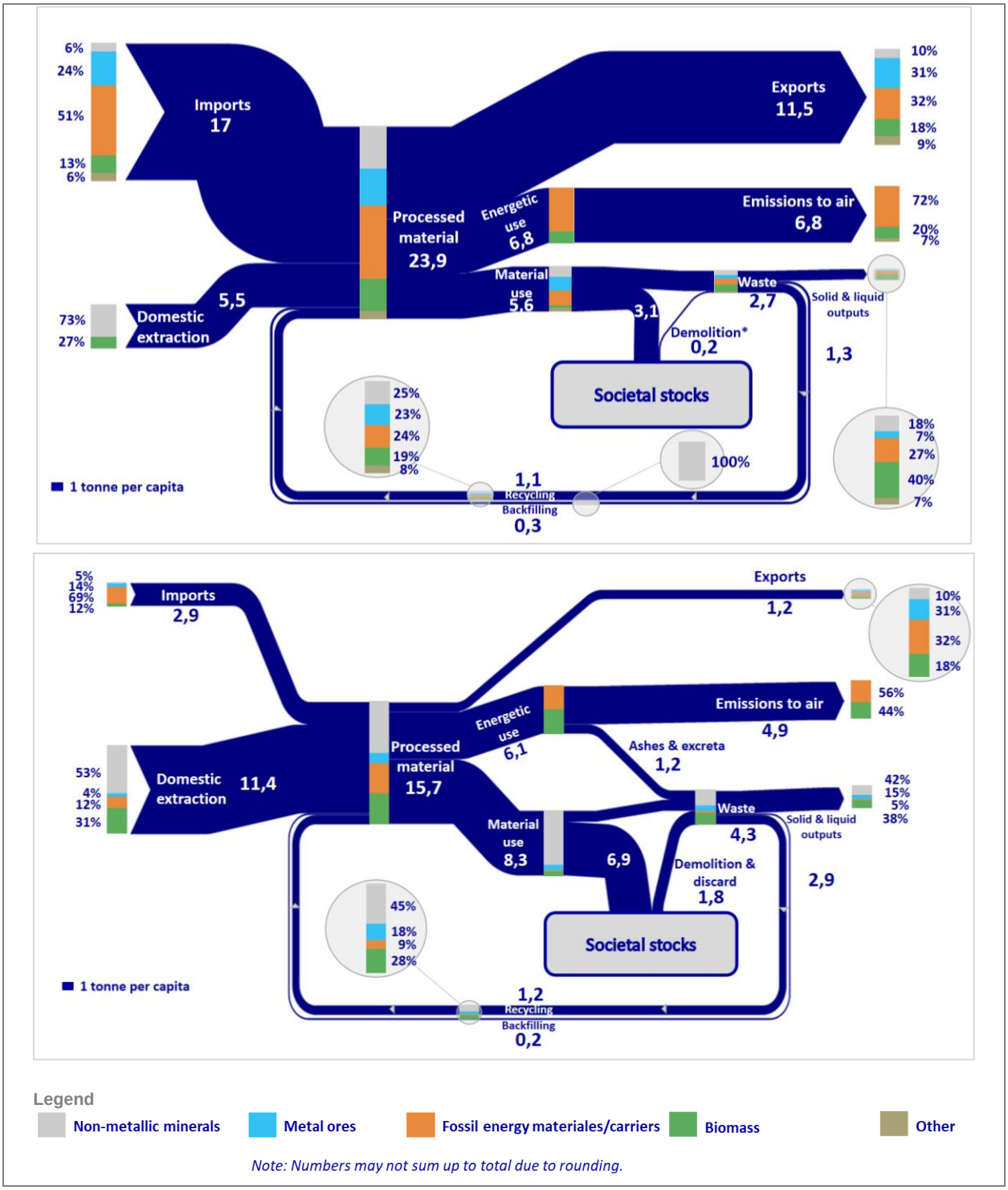
In fact, raw materials consumption is the main cost category in the industry's cost structure (61%), and consequently, price volatility impacts heavily on the production costs, especially in most material-intensive sectors. In fact, this represents the main motivations to achieve a CE. Circular material use-rate (CMU) is around the EU28 average, meaning 11.5% (much higher than the Spanish rate, which is 7.7%) (IHOBE, 2018).

As regards the outputs of the system, the region generates more waste per capita than the EU average, and it seems to keep an increasing pace. The overall recycling rate is close to the EU28 rate, but the municipal waste recycling rate is still well below the EU average. If we look at the different waste streams, the Basque Country stands out meaningfully on the rate of recycled packaging waste, and particularly the plastic packaging, which is twice the rate of the EU28, and is already well above the 2025 EU objective. The rate of recycled plastic waste has increased from 60% to 80% in the last five years. The rate recycled e-waste (33%) has more than doubled in the last two years and surpassed the EU28 average.

[51] Orkestra (2016), Implementing RIS3: The case of the Basque Country, Cuadernos Orkestra 2016/17 ISSN 2340-7638

[52] https://www.s3vanguardinitiative.eu/

Figure 4-1 Comparison between the Sankey diagram for the Basque Country (above) and for the EU-28 (below) for 2015 with material flows expressed in tonnes per capita



Source: IHOBE (2018) Circular Economy indicators – Basque Country 2018

Basque public authorities are trying to promote a circular economy through Green Public Procurement, which represents 28% of total value contracted through public procurement. This share increases up to 61% in products or services eligible to be greened. Information is still not available at EU level. 2,08% of total employment is employed in CE[53], which is higher than the EU28 average (1.71%). Value added of circular economy activities represents 1.12% of GDP, slightly higher the EU 28 average (1%).

4.3 CIRCTER Indicators

Table 4-1 Material flows in País Vasco (ES21)

MATERIAL FLOWS	ES21
DMC per capita 2006 (tonnes/hab)	18
DMC per capita 2014 (tonnes/hab)	17.68
DMC intensity 2006 (kg/euro)	0.56
DMC intensity 2014 (kg/euro)	0.54
Biomass per capita 2006 (tonnes/hab)	2.33
Biomass per capita 2014 (tonnes/hab)	2.05
Biomass intensity 2006 (kg/euro)	0.07
Biomass intensity 2014 (kg/euro)	0.06
Metal ores per capita 2006 (tonnes/hab)	0.6
Metal ores per capita 2014 (tonnes/hab)	0.08
Metal ores intensity 2006 (kg/euro)	0.02
Metal ores intensity 2014 (kg/euro)	0
Construction per capita 2006 (tonnes/hab)	10.67
Construction per capita 2014 (tonnes/hab)	3.43
Construction intensity 2006 (kg/euro)	0.33
Construction intensity 2014 (kg/euro)	0.10
DE per capita 2006 (tonnes/hab)	11.25
DE per km2 2006 (tonnes/km2)	5.14
DE per capita 2014 (tonnes/hab)	3.31
DE per km2 2014 (tonnes/km2)	1.53

Table 4-2 Waste in País Vasco (ES21)

WASTE STREAMS AND WASTE BY NACE ACTIVITY	ES21
Waste generation	
Total waste generated per capita 2006 (kg/hab)	2,474.45
Total waste generated per capita 2014 (kg/hab)	1,830.79
Total households waste per capita 2006 (kg/hab)	562.31
Total households waste per capita 2014 (kg/hab)	435.67
Total foodwaste per capita 2006 (kg/hab)	322.37
Total foodwaste per capita 2014 (kg/hab)	369.71
Total WEEE per capita 2006 (kg/hab)	10.82
Total WEEE per capita 2014 (kg/hab)	4.22

[53] Calculated according to the EC's monitoring framework. See http://ec.europa.eu/eurostat/documents/8105938/8465062/cei_cie010_esmsip_NACE-codes.pdf to learn about the NACE codes that are considered to build this indicator

Plastic waste per capita 2006 (kg/hab)	22.90
Plastic waste per capita 2014 (kg/hab)	14.47
Waste by NACE activitiy	
Agricultural waste intensity 2006 (kg/Thousand Euro) (*)	79.25
Agricultural waste intensity 2014 (kg/Thousand Euro) (*)	29.95
Construction waste intensity 2006 kg/Thousand Euro) (*)	154.21
Construction waste intensity 2014 (kg/Thousand Euro) (*)	199.67
Manufacturing waste intensity 2006 (kg/Thousand Euro) (*)	102.47
Manufacturing waste intensity 2014 (kg/Thousand Euro) (*)	75.74
Mining waste per km2 2006 (tonnes/km2 - Waste by mining/total surface)	8.90
Mining waste per km2 2014 (tonnes/km2 - Waste by mining/total surface)	12.87

(*) Waste intensity: [Waste by agriculture/construction/manufacturing - kg] / [GVA by agriculture/construction/manufacturing- Tsd euro]

Table 4-3 Provision of materials, technologies and services for a circular economy in País Vasco (ES21)

	ES21
Material providers	
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	18.13
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	19.22
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	0.06
Turnover per Material Provider Employee in 2010 (Thousand euro/employee)	171.98
Turnover per Material Provider Employee in 2015 (Thousand euro/employee)	196.31
Growth Rate of Turnover in thous. Euro per Material Provider Employee in % (2010-2015)	0.14
Technology providers	
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	23.77
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	24.25
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	0.02
Turnover per Technology Provider Employee in 2010 (Thousand euro/employee)	108.6
Turnover per Technology Provider Employee in 2015 (Thousand euro/employee)	110.94
Technology Providers Growth Rate of Turnover in thous. Euro per Technology Provider Employee in % (2010-2015)	0.02
Circular Business Models (CBM)	
Number of CBM Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	16.12
CBM Turnover per Circular Business Models employee in 2015 (Thousand euro/employee)	161.6

4.4 Case study description

Far from being just a legal requirement, sometimes in conflict with economic growth, environmental protection is now considered as a key competitiveness driver for the Basque industry. Breaking down the silos, environmental sustainability is now integrated in the overall regional strategy across departments (mainly Environment, territorial planning and housing; Economic Development), and builds upon a strong public-private relationship, which has laid the ground for interesting business cases. The implementation of the

circular economy in the Basque industry is expected to **decrease 6% the raw material consumption and consequently to save 2,000 million euro** until 2030[54].

Main features of the circular economy strategy

The Basque Country's circular economy strategy is featured by a **strong industry orientation and material circularity approach**, as well as **three main priorities**, namely, a longer lifetime for products, process efficiency and material reuse (giving special attention to metals and plastics, composites and rubber), and responsible consumption and business environmental transparency:

A strong industry orientation and a material circularity approach: The Basque Country is one of the main industrial hotspots in Spain. Industrial agglomerations related to metallurgy, or rubber and plastics (for the automotive or aeronautics industry) and machine tool industry, but also energy, or the furniture industry exist. In many cases, these agglomerations take place at smaller geographical levels (sub-regional) and local level-specialisations are a common phenomenon[55]. A cluster policy is in place since the 1990s to better articulate these industrial agglomerations and improve its performance regarding internationalisation, and technological and business innovation. The circular economy strategic areas, measures and initiatives in the Basque Country are clearly aimed at making the best use of this territorial asset. The leitmotiv of the Basque circular economy model is "more industry with less material". This transformation of the industry is taking place under a broader process to turn the industry into a more advanced and innovative one (Basque Industry 4.0), which is taking place by making the meaningful specialized knowledge and technology of the Basque RDI network available to industry.

Three main priorities: A longer lifetime for products (through eco-design, remanufacture, maintenance and advanced repair, new product-service based business models), increasing process efficiency and material reuse (best available technologies in industrial emissions legislation, cleaner technologies and waste recycling) and responsible consumption and business environmental transparency (green procurement, environmental declaration or carbon footprint). While the regional Strategy for Sustainability education 2030, approved in June 2018, is aimed at driving changes in the way we consume, publications related to real-life circular economy cases in Basque companies or the practical guide of technologies for the remanufacturing process (prepared in the framework of a publicly supported project, and published in July 2018) are intended to drive environmentally responsible production patterns. The latter are part of the "Circular Thinking Campaign", which is aimed at promoting a circular economy among the regional socioeconomic actors (particularly industrial players). The Basque authorities know that transitioning to a circular economy is also about developing the right skills-set. Significant steps are being made, particularly to train youngest

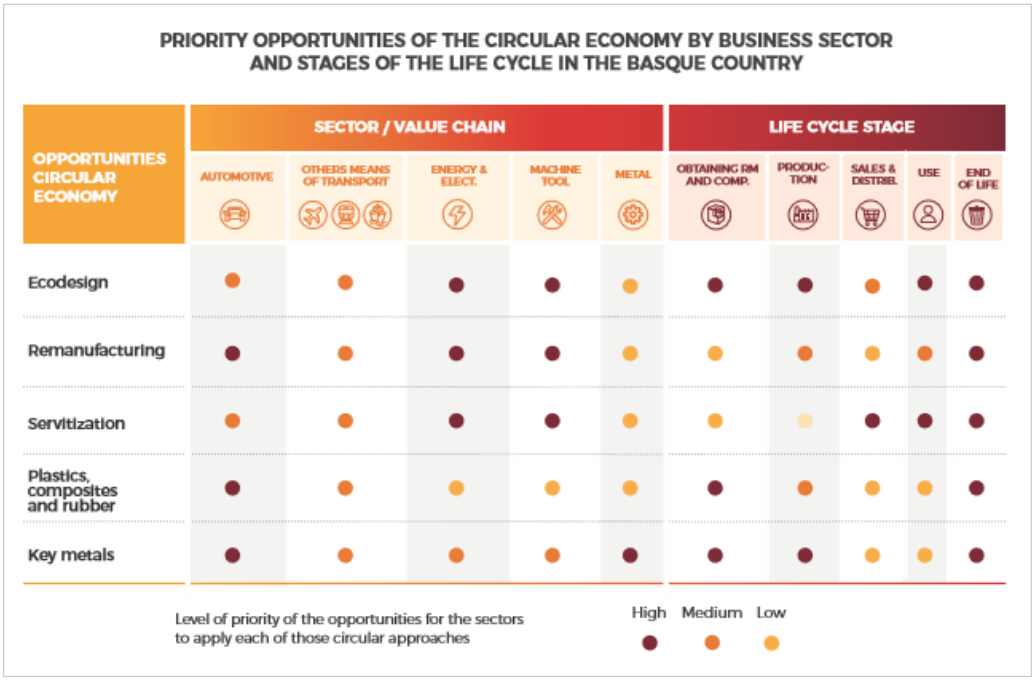
[54] https://www.irekia.euskadi.eus/es/news/45320-industria-vasca-ahorraria-sus-materias-primas-000-millones-euros-con-implantacion-practicas-economia-circular

[55] This place-based approach, influenced by the existence of many valleys, dates to the industrialisation process in the XIX century.

generations on eco-design, through the Basque Eco-design Hub. This hub is a partnership of universities and other training centres, public authorities and companies (entrepreneurs, SMEs and clusters).

The following matrix indicates the business opportunities across the key sectors:

Figure 4-2 Priority opportunities of the circular economy in the Basque Country



Source: IHOBE (2018) The circular economy in Basque Country. Analysis

4.4.1 Main instruments in place

The instruments in place to thrive a circular economy in the Basque Country combine demand and supply oriented measures:

Green public procurement: Aimed to incorporating environmental clauses in 50% of public contracts until 2020. 20 categories of products, services and jobs have been prioritized. Currently, efforts are mainly placed on construction and public works

Private green procurement - Green Supply Chain Management: The Basque Eco-design Centre support the participants companies to get and apply cutting edge eco-design knowledge. Technical eco-design project development, SME support, new business models and capacity-building are the main activities of

this centre). Besides, the new UNE-EN ISO 14001 (2015) obliges the 1200 certified companies to implement environment sensitive supply chains

Standardisation: Some standards have been developed at regional level, primarily in the construction sector. Besides, the Basque Environmental Agency – IHOBE – is engaged in the early implementation of the EC's Product Environmental Footprint

Grants for Circular Economy Demonstration projects: 87 projects have been implemented in 2014-2017. The goal is to develop marketable innovative solutions, safeguard raw material supply and create new circular business models. The material saving potential is estimated at 276 tn/year, and additional 38.7 million-euro revenues and 156 jobs are expected. The results will be brought into the market in the short run, according to the 42% of the companies that got these grants.

Grants for eco-design projects: Aimed at supporting the design and development of lower environmental impact products and services (all throughout their lifecycle) – Improve durability, maintenance, repair, disassembly, remanufacture and recyclability. Both to redesign existing products and services or to design new products and services. 12 projects have been developed in two years.

Grants for eco-innovation projects: Lower TRL levels (compared to the previous ones) - Demonstration of technologies, combined with non-technological innovation and feasibility assessments (of new products, services and business models). Aimed at promoting collaboration among companies and the R&D organisations. Next step of these projects is to apply for international RDI projects. 18 projects have been supported in the last two years (remanufacture, metal and plastics recycling, etc.)

Grants under the Basque Industry 4.0 strategy: Industry 4.0 technologies such as Internet of Things, Cloud Computing, Smart Factory, Additive manufacturing, digital business models are driving the circular economy. Collaborative research (ELKARTEK), business R&D, industrial research/experimental development (HAZITEK), product/market/service diversification (LEHIABIDE)

Financial support to equipment and infrastructure: More than 300 investments have been supported in the last five years (9.8 million euro)

Fiscal deductions: Companies that invest in environmental improvement projects get a 15% deduction in the Corporate Tax. Companies that invest in equipment related to the "List of Clean Technologies"[56] (e.g. radio-frequency identification – RFID, vacuum evaporator-crystallizers, plastics and non-ferrous metal separators, briquetting press, etc.) get a 30% deduction in the Corporate Tax. Fiscal incentives to incorporate

[56] The "List of Clean Technologies" prioritizes 92 technologies because of their contribution to resource efficiency and environmental benefit. http://www.ihobe.eus/Publicaciones/Ficha.aspx?IdMenu=97801056-cd1f-4503-bafa-f54fa80d9a44&Cod=4dd2d2bf-850a-4155-a0c2-65af9882d664&Idioma=es-ES&Tipo=

clean technologies in the production process are just available in The Netherlands and The United Kingdom.

4.4.2 Linkage with European Structural & Investment Funds (ESIF)

The above listed programmes are partially funded by ESIF. Besides, IHOBE and other Basque organisations are driving forward the Life project GISWASTE, which is intended to develop a GIS-based methodology and IT tool which simulates the technical, economic, and environmental viability of the recovery alternatives for the agri-food by-products (chiefly vegetables, meat, and dairy products) in the Basque Autonomous Community. The Bizkaia County Council is a partner in the RETRAcircular economy INTERREG project. H2020 projects dealing with Circular Economy projects with Basque participation include FIBERUSE, FUTURING, PAPERCHAIN, New Innonet, Green.eu, Polycircular economy, CYCLAG, HISER, etc.

Initiatives at lower territorial levels

The circular economy can only be fully effective if action is taken at several territorial levels, including the local and municipal ones. Some initiatives that are taking place at lower levels are shortly described below:

- Bilbao Bizkaia Circular project: The goal was to identify market niches with high potential for circularity. In consortium with Circle Economy, a Circle City Scan was performed. Meals from surplus food; Digital solutions for excess food; Design of an innovative sorting system; Collective retail logistics; Additive manufacturing; Awareness of circular business models
- Fighting climate Change is one of the main concerns of the Etorkizuna Eraikiz (Building Future) initiative in the Gipuzkoa province. And Circular Economy is one of the priorities of the Strategy to fight climate change 2050. Awareness raising in companies and society, promotion of reuse and recycle (through boosting the dedicated cluster), increasing sustainability criteria in the textile and building industry are the goals pursued by this strategy regarding circular economy.
- The Plan for prevention and management of urban waste (2017-2030) encompasses 80 measures and an investment of 60 million euro to amongst others, put in place a new infrastructure for the repairing and reutilisation of potentially reusable waste, waste prevention through responsible consumption and reduction of food waste.
- The network of Basque Municipalities towards sustainability (Udalsarea 21) has set up a working group to offer the right tools and knowledge on circular economy to the public workers.

4.5 Governance

The main stakeholders involved in the design and implementation of the Basque Country's Circular Economy Strategy are IHOBE (The Basque Environmental Agency), as the main responsible for the environmental policy and the Basque Government (mainly though the Environment, Territorial Planning and Housing, and the Economic Development and Infrastructure departments, along with SPRI, the Basque Regional Development Agency). The Environment department of the Basque Government is coordinating a working group that covers the entire circular economy value chain. This group is providing insights to help public authorities shape their policy agenda and measures, aimed at supporting the industry in tackling the environmental factors as a competitiveness driver.

The following multipliers are relevant actors in the transition to a CE:

BASQUE ECO-DESIGN CENTER: Established in 2011, the Basque Eco-design Centre is made up by 8 of the most advanced companies of the Basque Country, and pursues the following goals: (1) foster the design and execution of innovative eco-design projects, in order to make the region a European benchmark in the field of eco-design; (2) enhance competitiveness of participating firms through eco-design; (3) stimulate product eco-innovation through partnerships with top knowledge hubs; (4) full integration of the environmental factors into the supply chains of the participating firms. Basque Eco-design hub, one of the initiatives promoted by the Basque Eco-design Centre, is the nucleus of the eco-design and circular economy training activity in the region.

INNOBASQUE: The Basque Innovation Agency. Private non-profit association, one of the promoters of the circular economy in the Basque Country. INNOBASQUE coordinates the Circular Basque Initiative. Circular Basque is a network of organisations (currently 34) that are committed to promoting and implementing a Circular Economy in the Basque Country. It is also a forum for raising awareness about initiatives that are taking place in this field and sharing the latest news.

4.5.1 Relevant clusters:

- ACLIMA: Basque Environment Cluster. With over 100 members, the cluster represents the waste value chain, soil pollution (research and remediation), climate change, water and air integral cycles, efficient manufacturing and eco-design.
- ERAIKUNE: Building industry cluster with around 80 members. New materials for sustainable construction is one of the strategic areas that this cluster is pushing forward.

4.6 Results and impact

Trust on circular economy as a competitiveness factor is one of the most significant achievements so far: 59% of the Basque companies that eco-design considered in 2014 that eco-design is fundamental to differentiate in international markets (Ihobe, 2014).

The main Basque industries are adopting circular strategies, based on greener products, technological developments and new circular service and business models. Consequently, Basque industry is starting to achieve a circular competitiveness advantage, particularly on the transport, electric and electronic equipment, machinery and metal sectors. Besides, the Basque Country is consolidating in the recovery and recycling sectors, as well as in the environmental engineering and consultancy.

The Circular Economy represents 1.12% of the GDP (764 million-euro revenue). 18,463 jobs are related to circular economy activities (2.08% of total employment) (Ihobe, 2018). The number of companies working on circular economy approaches, **such as eco-design, servitisation, remanufacturing, LCA or environmental declarations** is increasing over time. The Basque Country is among the four top **eco-design** regions in Europe. 68 companies are UNE-EN ISO 14006 certified and other 19 have certified 38 products according to the EPD declaration (Ihobe, 2018a). **Remanufacturing revenues** are estimated at more than 74 million (2.1% remanufacturing rate) (Ihobe, 2017). The 87 companies that have participated to the "circular economy Demonstration Projects Programme" expect additional 38.7 million euro (as a consequence of new solutions) (Ihobe, 2016). These projects are contributing significantly to the material saving, which is estimated at 15tn/year for the 2016 projects. Job opportunities offered by the circular economy are also meaningful. 90% of the students trained in the Basque Eco-design Hub finds a job in the industry sector.

4.7 Drivers/success factors, other enabling conditions and barriers

Governance factors are being of outmost importance to drive a Circular Economy in the Basque Country. The **forward looking strategic planning** (political vision) and leadership, combined with an array of public support instruments, and **public-private partnerships** both at policy design and policy implementation stages are facilitating and creating the necessary conditions for circular economy transition to materialise. The Basque Eco-design Centre and the Basque Eco-design Hub, the Circular Innovation Factory initiative and the publicly supported circular economy initiatives (through e.g. the eco-innovation, eco-design, demonstration calls) showcase the public-private collaboration in stepping towards a CE. Likewise, **industrial agglomerations and clusters**, in collaboration with the expert know-how of the STI system, are playing a key role in unfolding innovation potentials in the circular economy field. The companies that are already pioneering the shift to a circular economy in a variety of sectors are expected to encourage others to

adopt more sustainable production patterns, and thus achieve a wider range of community-based initiatives around the circular economy.

But challenges remain significant. Still, knowledge about the **technologies** and methods that can close the material and energy loops is not sufficient, and in many cases, implementing those technologies involve high product and process modification costs (that risk their competitiveness). Likewise, technical uncertainties about lifecycle behaviour, adaptation to new legislation or lack of finance challenge the delivery of innovative solutions into the market. Similarly, transitioning to a circular economy means to many companies opening new markets, transforming their business model and profoundly understanding the new customer requirements: While some environmentally responsible customers are increasingly interested in knowing what happens with waste, or how products are produced, and make decisions based on these parameters, others are still reluctant to adopt more sustainable products (and potentially pay more). Companies are still not fully aware of the changes that are happening on their markets and have insufficient knowledge about the benefits that shifting to a circular economy can bring to them.

4.8 Assessment of the region's capacity to keep unlocking the potential of a CE

The implementation of the circular economy in the Basque industry is expected to **decrease 6% the raw material consumption and consequently saving 2,000 million euro**. The metal (steel, foundry, metal-products) and transport (automotive, aeronautics) industries, with 49% of total savings, would be the main beneficiaries. Besides, Basque companies expect increasing 46% the green product sales by 2025.

According to a 2017 survey to 41 companies to whom eco-design offers strategic value, the eco-design products will almost mean half of their total turnover in 2020 (Ihobe et al, 2017). Moreover, 33 companies show high potential to initiate remanufacturing companies (in addition to the current 42). Remanufacturing rate could increase from the current 2.1% to 3,6% in 2020 and 5.6% in 2025 (Ihobe, 2017).

4.9 A systemic perspective on the Basque Country CE case study

The Basque Country is one of the main industrial hotspots in Spain. As a result, its CE strategy focuses on economic competitiveness.

The CE strategy combines pull and push measures to stimulate investments in the modernization of production as well as in stimulating behavioural change for sustainable consumption. Both of these outcomes

would reduce the cost of waste management, and make the economy of the Basque Country more competitive.

Specifically, the current situation has been characterized by the dominance of a reinforcing loop (R1) underlying the increase of demand and production, and hence resource consumption. This has led to the emergence of various undesired effects: the increase of import dependency, with associated price volatility (B7), the increase in waste generation and landfilling (B4), the growth of resource and production cost (B6) and the growth of GHG emissions (B5). All these factors are signs of the erosion of competitiveness of local production, and have the potential to undermine R1 and employment creation. Further, the expansion of waste landfills and emissions negatively impacts citizens' well-being.

The CE strategy tackles these undesired dynamics in a systemic way, by:

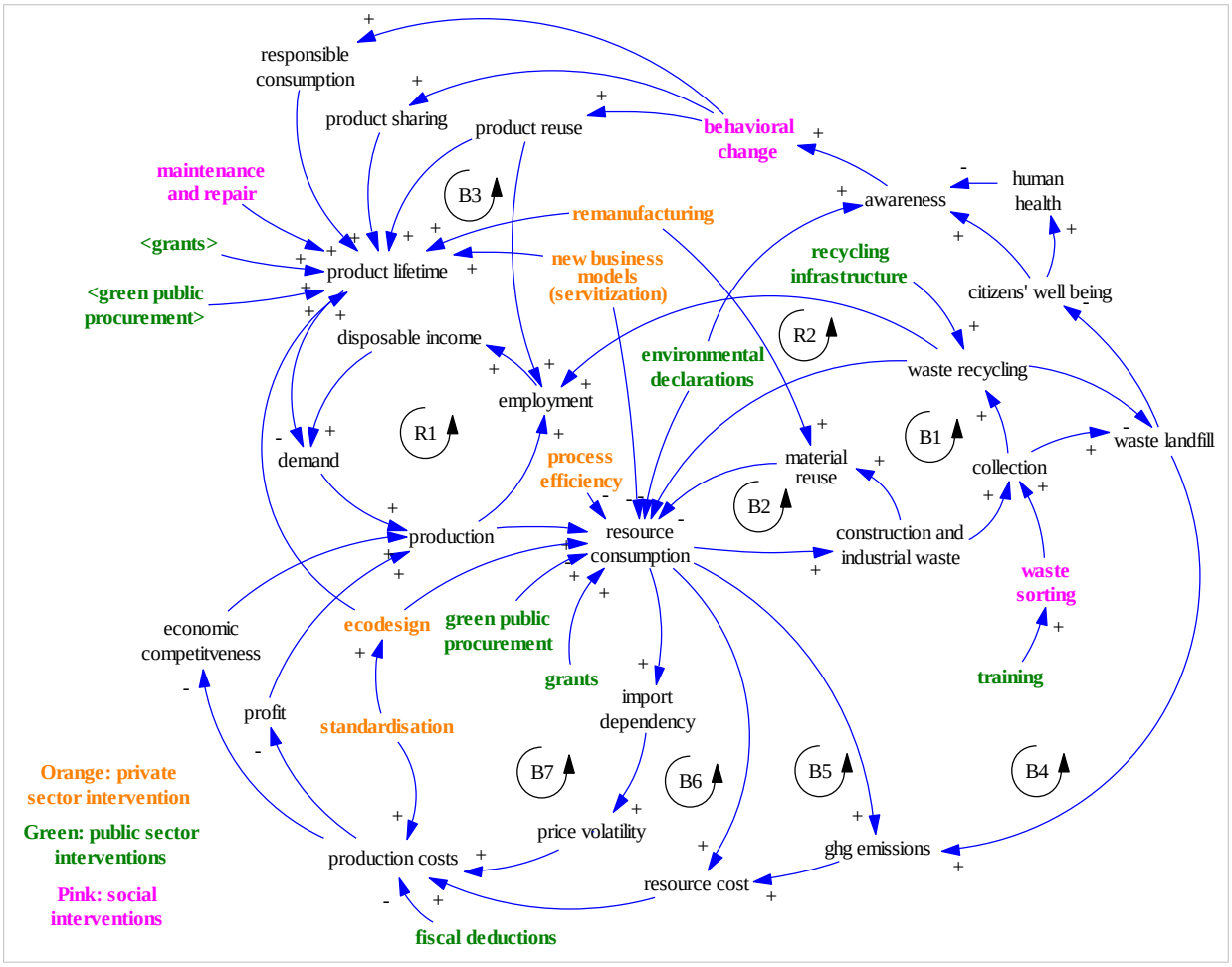
a) Stimulating the reduction of resource consumption through green public procurement, joining environmental declarations and providing grants (direct interventions) and by promoting the improvement of process efficiency, standardization, and the creation of new business models and ecodesign. These interventions affect B5, B6 and B7 described above, weakening the known undesired effects of production.

b) Providing infrastructure to better sort, collect and recycle waste (B2, B3 and R2), creating a synergy, through specifically the creation of infrastructure, with private investment. These interventions are also expected to create new jobs, possibly leading to more income creation and consumption.

c) Supporting behavioral change through, among other options, the creation of awareness and the provision of grants, to extent a product's lifetime and reduce demand. This introduces new balancing loops (B3) that ultimately limit the growth of resource consumption, even if new growth opportunities for jobs and income emerge from recycling, remanufacturing, repairing and the reuse of products.

Concluding, the Basque Country strategy adopts a systemic approach to increase competitiveness and do so sustainably, by preventing the emergence of side effects while aiming at reducing waste management costs.

Figure 4-3: Causal Loop Diagram - Basque Country



Source: Own elaborationConclusions and lessons learnt

4.10 Conclusions

The Basque Country is a good laboratory to develop new circular economy solutions. It combines well developed value chains in amongst others, automotive and aeronautics, electric equipment, steel and machine tool industry, with significant technological assets in a rather small territory (2.2 million inhabitants). However, the complex administrative structure and competence allocation among the various territorial levels add some governance challenges. The regional authorities are making significant steps to break down the silos and treat environment as a cross-cutting aspect in the overall regional development policy-making, well connected to the territorial factors (e.g. strong industry orientation). The outcomes of this shift in the environmental policy-making are still to be seen, and so are the results of the recently launched Education for Sustainability Plan. Awareness raising (since primary school) is crucial to shift our consumption habits, and so is putting the right skills in the right place. But skill needs for circular economy activity in the industry must be assessed and anticipated in a wider context that also considers other relevant trends

and phenomena such as the digitalisation. and the training offer and mechanisms will have to be updated and upgraded accordingly.

It is worthwhile to note that the Basque Country is a frontrunner in collecting data to monitor the transformation into a circular economy (based on the European Circular Economy Monitoring Framework), which is of outmost importance to achieve the goals set out in the plans, as well as to benchmark with other regions and countries in Europe.

The measures in place to promote a circular economy are wisely targeted at increasing the demand for circular economy solutions (standards, green public procurement, waste levies, etc.) while encouraging the supply of circular economy solutions (fiscal deductions, grants for RDI, eco-design and circular economy demonstration projects, as well as for investments, etc.). The circular economy demonstration projects have proven to be effective to untap the business opportunities around the circular economy. The success of this instrument relies on the simplicity and agility in the application and evaluation process, geared by the two-step application process and quick decision on the projects to be granted (24 days on average). Short projects, and industry leadership are the main features of these projects. The strong dissemination of these projects (through dedicated publications) are expected to raise awareness among other companies and increase the pool of companies that are willing to transform their production processes and business models. Besides these small-scale projects and to guarantee that the public RDI funds are truly promoting the shift to a circular economy, applicants (beyond the calls directly targeted at promoting a CE) should be asked to describe how the new technologies and innovations in the applications promote the circular economy implementation, as well as to conduct environmental impact assessments. And this information could be incorporated as an additional evaluation criterion.

4.11 References

Bilbao Ekintza, Bizkaia Beaz, Circle Economy, Innobasque (2018): Circular Bilbao & Bizkaia

Etorkizuna Eraikiz (n.d.) website [last visited 16.10.2018] https://www.gipuzkoa.eus/es/web/etorkizunaeraikiz

Eusko Jaurlaritza/Gobierno Vasco (2018): Estrategia de Educación para la Sostenibilidad del País Vasco 2030

Eusko Jaurlaritza/Gobierno Vasco (2016): Plan de Industrialización 2017-2020 “Basque Industry 4.0”

Eusko Jaurlaritza/Gobierno Vasco (2014): The IV Environmental Framework Programme of the Basque Country 2020 (2015-2020)

Eusko Jaurlaritza/Gobierno Vasco (2014a): PCTI Euskadi 2020 – A Smart Specialisation Strategy

Eusko Jaurlaritza/Gobierno Vasco (2015): Plan de prevención y gestión de residuos de la CAPV

Ihobe (2018): Circular Economy Indicators Basque Country 2018

Ihobe (2018a): The circular economy in Basque Country. Analysis

Ihobe (2018): Economía circular en Euskadi. Video available at https://www.youtube.com/channel/UCbaw-gwm7rbApaWcpl9Gywsw

Ihobe (2017): Situación actual y desarrollo del potencial de la remanufacturaen el País Vasco desde la colaboración público-privada. Presentation delivered at the Basque Eco-design meeting 2017

Ihobe, Orkestra (2017): Oportunidades de negocio que ofrece le ecodiseño a las empresas del País Vasco

Ihobe (2016): 36 Proyectos de demostración en Economía Circular en el País Vasco. Resultados de iniciativas empresariales

Ihobe (2014): Eco-design made in Euskadi. 15 años de innovación ambiental de producto

Mondragon Unibertsitatea (2018): Practical guide of technologies for the remanufacturing process

5 The Industrial Symbiosis Scheme in Sicily

5.1 Executive summary

In May 2011, the Environmental Technologies Technical Unit of ENEA, the Italian national agency for new technologies, energy and sustainable economic development, launched a three-year project to unlock the potential of Industrial Symbiosis in the Sicilia Region. This includes data collection, extensive exchanges with local stakeholders to collect data and identify companies that could validate the approach, the development of an online platform to analyse material and waste flow and identify potential matches for waste reuse, and the preparation of guiding documents for the operationalization of such matches.

The platform is the central tool in this project. Its main objective is to provide the information necessary to launch industrial symbiosis at the local level, by supporting the creation of a cost benefit analysis for selected potential matches of production inputs and outputs, processes and companies.

In addition to the technical aspects of the development and use of the platform as an online tool, stakeholder outreach turned out to be a critical activity to create a collaborative environment based on reciprocal trust. Confindustria Sicilia, with which ENEA has signed a specific Cooperation Agreement, Sicilia Region, (specifically the Regional Agency for Waste) the local Chamber of Commerce and the University of Catania have been instrumental in determining the success of the project.

Starting from a database of almost 2,000 companies, and a validation exercise carried out during two meetings in Catania and Siracusa, ENEA identified potential matches for more than 80 SMEs, for 400 output resources and almost 180 input resources, totalling 690 potential matches (by company/material). The cost benefit analysis carried out for construction materials also showed potential benefits in the range of 15 euros/ton of material, when considering material, transport and waste disposal costs.

5.2 Background information

Sicily is the largest island in the Mediterranean Sea. It is an autonomous region of Italy, in Southern Italy along with surrounding minor islands, officially referred to as *Regione Siciliana*. The total population is 5 million (2016) and GDP per capita is 17,500 Euros per person (2016). The unemployment rate was 22.1% in 2016 and economic activity is driven primarily by agriculture, manufacturing and tourism.

Thanks to the stable economic growth recorded during the last decade, Sicily is the eighth richest region of Italy when considering total GDP. A series of reforms and investments on agriculture such as the introduction of modern irrigation systems have made this important industry for the region competitive at the national level and beyond. In the 1970s economic growth was primarily driven by the industrial sector, but in recent years services (tertiary sector) have taken the lead. In fact, tourism is an important source of wealth for the island, owing to the natural and historical heritage of this area. Today Sicily is investing heavily in the hospitality industry, to make tourism more competitive. However, this region continues to have a GDP per capita below the Italian average and more unemployment than the rest of Italy.

Of relevance to the circular economy, there are several synergies to be explored in the context of the manufacturing of food products; agriculture, manufacture of fabricated metal and non-metals products, and construction sectors. Most of the industries are local (i.e. these satisfy local demand), in addition to tourism.

Specifically, the main sectors of the economy that hold potential for waste recycle and reuse are agriculture and manufacturing. The central zones of Sicily (Enna and Caltanissetta) are characterized by a productive sector prevalently rural, and based on agriculture activities. Agriculture and particularly fishing are also well developed in the northern part of the island (Palermo and Messina, Trapani and Agrigento. In the south east (Ragusa) the manufacturing sector is one of the largest contributors to economic activity, together with agriculture. Numerous farms for breeding livestock are present in this area. Industrial production in Sicily is characterized by a few but important industrial centres. Industrial poles, in particular petroleum and chemical industries, are concentrated in eastern Sicily (Catania and Siracusa) where the manufacturing sector represents an important percentage of production (over 30%), subdivided prevalently in manufacture of food products (20%) manufacture of other non-metallic mineral products (16%) and manufacture of fabricated metal (13%).

Being aware of the potential held by the circular economy to deliver social, economic and environmental advantages, ENEA has developed the first Industrial Symbiosis Platform in Italy and worked to implement it in Sicily. Strong of the growing support for a circular economy in Europe (e.g. in the context of green economy and green growth, since 2008), and with knowledge of increasing challenges for industrial competitiveness in the region, Industrial Symbiosis was seen as a good example for the implementation of Circular Economy principles in Sicily. As a result, ENEA worked between 2011 and 2015 at the creation of a platform to connected local actors and realize the potential of the circular economy in the region.

5.3 CIRCTER Indicators

Table 5-1 Material flows in Siclia (ITG1)

MATERIAL FLOWS	ITG1
DMC per capita 2006 (tonnes/hab)	11.36
DMC per capita 2014 (tonnes/hab)	11.08
DMC intensity 2006 (kg/euro)	0.64
DMC intensity 2014 (kg/euro)	0,67
Biomass per capita 2006 (tonnes/hab)	2.83
Biomass per capita 2014 (tonnes/hab)	2.55
Biomass intensity 2006 (kg/euro)	0.16
Biomass intensity 2014 (kg/euro)	0.15
Metal ores per capita 2006 (tonnes/hab)	0.37
Metal ores per capita 2014 (tonnes/hab)	0.25
Metal ores intensity 2006 (kg/euro)	0.02
Metal ores intensity 2014 (kg/euro)	0.01
Construction per capita 2006 (tonnes/hab)	6.94
Construction per capita 2014 (tonnes/hab)	2.25
Construction intensity 2006 (kg/euro)	0.39
Construction intensity 2014 (kg/euro)	0.14
DE per capita 2006 (tonnes/hab)	9
DE per km2 2006 (tonnes/km2)	3.43
DE per capita 2014 (tonnes/hab)	1.74
DE per km2 2014 (tonnes/km2)	0.68

Table 5-2 Waste in Sicilia (ITG1)

WASTE STREAMS AND WASTE BY NACE ACTIVITY	ITG11
Waste generation	
Total waste generated per capita 2006 (kg/hab)	1,146,46
Total waste generated per capita 2014 (kg/hab)	1,256.02
Total households waste per capita 2006 (kg/hab)	559.90
Total households waste per capita 2014 (kg/hab)	480.45
Total foodwaste per capita 2006 (kg/hab)	249.61
Total foodwaste per capita 2014 (kg/hab)	111.05
Total WEEE per capita 2006 (kg/hab)	3.42
Total WEEE per capita 2014 (kg/hab)	3.36
Plastic waste per capita 2006 (kg/hab)	14.13
Plastic waste per capita 2014 (kg/hab)	31.60
Waste by NACE activitiy	
Agricultural waste intensity 2006 (kg/Thousand Euro) (*)	36.42
Agricultural waste intensity 2014 (kg/Thousand Euro) (*)	18.18
Construction waste intensity 2006 kg/Thousand Euro) (*)	516.26
Construction waste intensity 2014 (kg/Thousand Euro) (*)	449.19
Manufacturing waste intensity 2006 (kg/Thousand Euro) (*)	44.13
Manufacturing waste intensity 2014 (kg/Thousand Euro) (*)	39.63
Mining waste per km2 2006 (tonnes/km2 - Waste by mining/total surface)	3.16
Mining waste per km2 2014 (tonnes/km2 - Waste by mining/total surface)	4.53

(*) Waste intensity: [Waste by agriculture/construction/manufacturing - kg] / [GVA by agriculture/construction/manufacturing- Tsd euro]

Table 5-3 Provision of materials, technologies and services for a circular economy in Sicilia (ITG1)

	ITG1
Material providers	
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	38.36
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	36.93
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	-0.04
Turnover per Material Provider Employee in 2010 (Thousand euro/employee)	142.82
Turnover per Material Provider Employee in 2015 (Thousand euro/employee)	158.49
Growth Rate of Turnover in thous. Euro per Material Provider Employee in % (2010-2015)	0.11
Technology providers	
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	18.19
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	17.02
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	-0.06
Turnover per Technology Provider Employee in 2010 (Thousand euro/employee)	111.97
Turnover per Technology Provider Employee in 2015 (Thousand euro/employee)	116.17
Technology Providers Growth Rate of Turnover in thous. Euro per Technology Provider Employee in % (2010-2015)	0.04
Circular Business Models (CBM)	
Number of CBM Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	0.13
CBM Turnover per Circular Business Models employee in 2015 (Thousand euro/employee)	98.69

5.4 Case study description

Acknowledging that resources are being depleted, and their scarcity leads to higher prices as well as growing costs (e.g. for waste management), ENEA has developed the first Industrial Symbiosis Platform in Italy and worked between 2011 and 2015 to implement it in Sicily. The rationale is that by reusing resources (now considered waste), when this is economical and bankable for companies, is more sustainable economically, socially and environmentally.

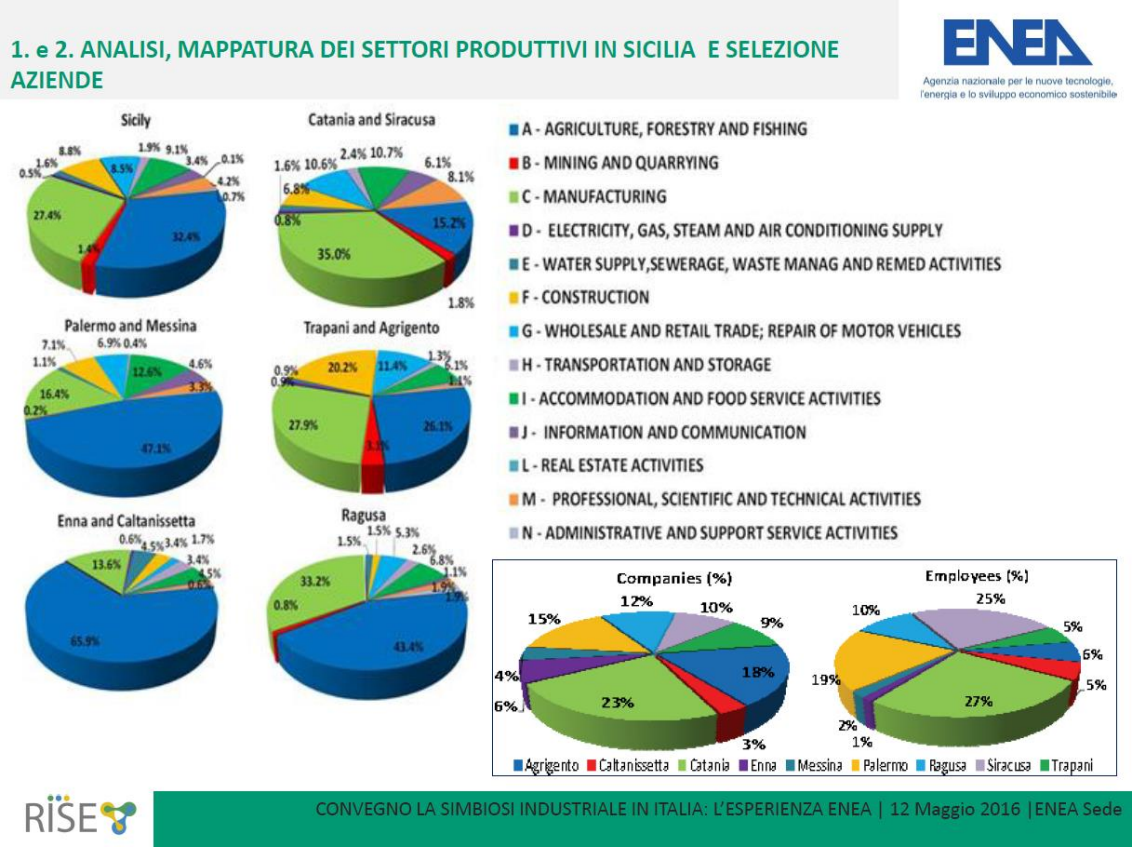
Figure 5-1: The Symbiosis logo

The goals were achieved through different steps: first, the design of the architecture, then the analysis of the productive system in the region, data collection and companies' involvement in operative meetings. Collected data were used for potential matches individuation, through a collaborative approach with the companies who participated in the meetings, and then they were analysed in technical and regulatory terms to individuate potential synergies.

As a result, the steps of the project include: (1) network activation, (2) platform architecture design and implementation, (3) analysis of the productive sector in Sicily, (4) data collection and companies involvement for match making, and (5) preparation of manuals to operationalize material recycle and reuse.

Concerning network activation (1) and data collection and companies' involvement for match making (4), a database of almost 2,000 companies was created. This was achieved by collecting data from regional productive districts, chambers of commerce, universities, industrial associations and companies' web sites. Two meetings were then organized to gather more information and validate the initial results of the analysis. At the Siracusa meeting 109 output resources and 88 input resources of different categories were shared. The resources shared by the companies were mainly "materials" (59% of the output resources and 59% of the input resources) and expertise, consultancy and services (34% of the output resources and 32% of the input resources). In the category "materials", companies were interested to share as output prevalently packaging (19%), plastics and plastic products (15%), metals and metal products (11%), organic chemicals (10%), water (8%), materials from agriculture (8%), construction and demolition wastes (6%). As input the resources more requested were: foodstuffs (31%), organic chemicals (21%) and fuels, products from live-stock and fisheries, construction and demolition wastes (6%).

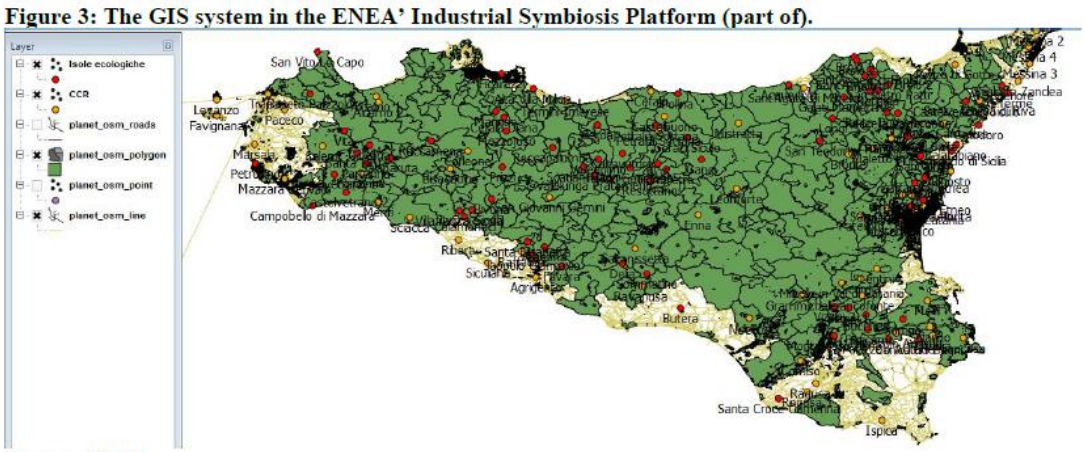
Figure 5-2 Identification and analysis of the economic sectors in Sicily and initial shortlisting of companies (Mancuso, 2016)



Concerning the development of the platform (2), whose main objective was to launch Industrial Symbiosis in Sicily through a geo-referred information system, the goal was to create a tool to support of business and

the territory. As a result, the platform was designed to offer a range of features that can directly benefit SMEs. The core novelty of the platform is represented by the possibility to find matches among firms by using an algorithm that links output with inputs (with a logic one-to-many) or vice versa, by means of <origin, destination> strings, linking one type of output with its potential productive destinations (or vice versa). The platform architecture helped identifying opportunities for matching in two ways: by tracking material and waste flows, and by allowing for the assessment of proximity (and hence the impact of location on transport costs). This was possible because the platform is based on a GIS system where many different databases have been uploaded, and where both entries and results can be consulted transparently. One of these databases is that of the registered companies, that, through the www.industrialsymbiosis.it portal can provide their general information (name, address, activity sector by mean of Italian and European codes - Istat 2009; Eurostat, 2008 - and so on). As a result, the GIS system can localize registered companies in the map. Then, companies can go further and look for "cooperation" in terms of industrial symbiosis potential. In order to look for industrial symbiosis potential, registered companies can become "associated companies", providing their own information about inputs and outputs they want to share within the industrial symbiosis network.

Figure 5-3 The GIS system in the ENEA's Industrial Symbiosis Platform (part of)



Source: ENEA

Concerning item (5), company-specific manuals were developed to support turning potential matches into actual collaborations, leading to cost savings (e.g. 15 euros per ton in the case of construction materials) as well as reduced environmental impacts. These manuals focus on the main resource streams identified for potential trade and reuse and include European, Italian and regional regulations, guidelines, technical standards, logistic and economical aspects useful for supporting companies in synergies implementation.

Funds for this project were received from the Italian Government in the context of the eco-innovation law: EcoInnovazione Sicilia: Legge finanziaria del 2010 art. 2 – comma 44 (2011-2015). *Supporto allo sviluppo delle attività produttive nel Sud: interventi pilota per la sostenibilità e la competitività di turismo ed aree industriali.*

In particular, the project was conceived before the circular economy concept became known/mainstream locally (in Sicily). The potential was primarily for agri-food sector and for construction (with the potential to recycle construction waste for, for instance, road construction and cement manufacturing). On the other hand, ENEA saw potential for applying the same approach in other regions. This is because some aspects are unique to the Sicilian context, but in general the approach (match-making based on an online and transparent platform) and resulting business models are broadly applicable to other regions. Sicily was the first viable project of its kind in Italy, and its success led to further applications in the regions of Umbria, Emilia Romagna and Lazio.

5.5 Governance

Between 2011 and 2012, contacts were established with the administration of the Sicilia Region and Confindustria Sicilia (the organization representing the interests of Italian manufacturing and service companies).

Concerning the former, a collaboration was established with the Regional Waste Agency, to better understand the census of first and second level treatment and the valorisation for waste and by-products.

Several consultation meetings were also held with Confindustria Sicilia which led, in June 4 2012, to the signing of a Framework Agreement for eco-innovation in productive systems (Adnkronos 2012), including industrial symbiosis.

Finding strong local partners, trusted by companies, was necessary because there was little to no awareness about the advantages of a circular economy back in 2011, and hence there was little interest and no explicit commitment at the regional and local level. Awareness raising activities did help considerably, also through collaborations with local chambers of commerce and local branches of Confindustria (Confederation of Italian Industries).

Local stakeholder's involvement followed, with support from the Sicilia Region, Confindustria, the local Chamber of Commerce and the University of Catania. It was then decided to organize meetings with companies in Catania and Siracusa, the most productive areas in Sicily. These are the provinces with the greatest number of companies (33%) and where the largest companies are located.

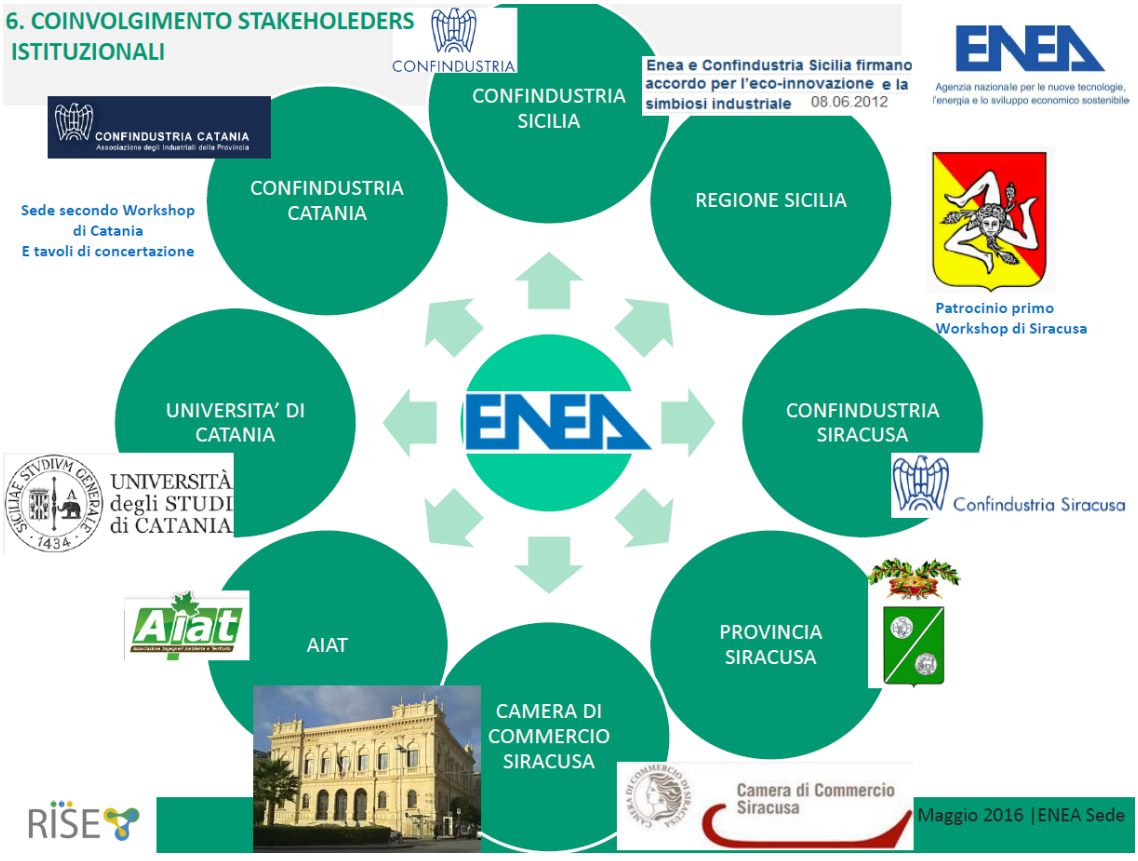
The most represented manufacturing sector in Catania meeting was manufacture of food products (28%) followed by manufacture of other non-metallic mineral products (17%), manufacture of fabricated metal

products (17%), manufacture of rubber and plastic products (11%), manufacture of electrical equipment (11%), manufacture of beverages (6%) and manufacture of chemicals and chemical products (6%).

During Siracusa meeting the main sector of participating companies was manufacture of computer (36%) followed by manufacture of food products (14%) manufacture of machinery and equipment (14%), repair and installation of machinery and equipment (14%), manufacture of rubber and plastic products (7%), manufacture of basic metals (7%), manufacture of fabricated metal products (7%).

It is worth mentioning that in other regions new key stakeholders emerged. For instance, in the case of Umbria it was Sviluppo Umbria, a regional agency for development, which took the lead in doing initial outreach to stakeholders and raise awareness about the CE. In the case of Emilia Romagna, it was instead laboratories that provided technical feasibility analysis that served as the foundation for matchmaking. ENEA contributed to stakeholder outreach, coordination of activities and match making (e.g. using the online platform).

Figure 5-4 Stakeholder involved in the implementation of the Industrial Symbiosis in Sicily (Mancuso, 2016)



5.6 Results and impact

Starting from the database of almost 2,000 companies, and the validation exercise carried out during the two meetings in Catania and Siracusa, more than 80 SME were matched for potential collaborations to reuse waste. This is based on almost 400 output resources and almost 180 input resources identified as being potentially available and viable for trade. Overall, more than 690 potential matches were found between the participating enterprises showing interesting opportunities both for substituting resources with waste products in real and virtual cases and for sharing waste management services and infrastructure.

Specifically, at the Siracusa meeting 109 output resources and 88 input resources of different categories were shared. The resources shared by the companies were mainly “materials” (59% of the output resources and 59% of the input resources) and expertise, consultancy and services (34% of the output resources and 32% of the input resources). In the category “materials”, companies were interested to share as output prevalently packaging (19%), plastics and plastic products (15%), metals and metal products (11%), organic chemicals (10%), water (8%), materials from agriculture (8%), construction and demolition wastes (6%). As input the resources more requested were: food products (31%), organic chemicals (21%) and fuels, products from livestock and fisheries, construction and demolition wastes (6%).

A total of 165 potential matches were found, involving prevalently materials (53%) and expertise, consultancy and services (37%). Matches were mainly related to plastics and plastic products (16%), metals and metal products (16), municipal wastewater treatment sludge (11%), construction and demolition wastes (10%).

At the workshop held in Catania 529 potential matches were found starting from 187 outputs (37% materials, 35% expertise, 16% equipment) and 91 input resources (66% materials, 23% expertise, consultancy and services). The sharing was more balanced for output resources.

After identifying the potential synergies and performing match making, manuals were prepared to support implementation at the company level. Since these manuals were heavily customized to the companies involved in the matchmaking, they include information specific to companies that cannot be shared and are therefore not publicly available. On the other hand, a cost benefit analysis was performed for each case, considering the cost of materials, fees for disposal and transport/delivery cost. A presentation given on 12 May 2016 (Mancuso, 2016) indicates net savings of 15 Euros/ton of material in the construction sector. Other estimates were prepared but are not publicly available.

Despite the lack of public information on the extent to which companies have agreed to collaborate on waste recycling and reuse, it was indicated that the online platform is still being used and confirms that there is still interest in the circular economy in Sicily despite the end of the ENEA project in 2015. Specifically, the platform was created by ENEA, populated during the project, and then taken over by the local

chamber of commerce to continue expanding the database and support companies with matchmaking activities. The replication of the project in other regions also confirm the economic potential of the circular economy, and the interest of local stakeholders to exploit it.

5.7 Drivers/success factors, other enabling conditions and barriers

The main success factors for the implementation of Industrial Symbiosis in Sicily is the positive economic return for waste recycle and reuse. Once companies understood that there was potential to reduce costs and the administrative (procedural) burden for their production activities, especially in relation to waste accounting and disposal, they showed stronger commitment to facilitate the realization of the matchmaking highlighted by the platform. From the point of view of companies, it was the emergence of new business models, related to costs reductions, the key success factor.

For ENEA on the other hand, the main driver emerging from the experience in Sicily is the capacity to overcome difficulties in creating trust between companies. Policy makers and regulators are critical to create the market conditions that incentivize Industrial Symbiosis and more resource efficient behaviour. This case study highlighted that at this stage there are policies and regulations that are difficult to understand and do not facilitate the reuse of waste. The organization of workshops and working through local organizations allowed ENEA to create collaborative environment and to openly discuss responsibilities, predictability of outcomes and the reliability of the assessment. This open environment (including the availability of a transparent online platform everyone could use) supported the transition from a climate of distrust and scepticism to one of collaboration and symbiosis.

In addition to the creation of trust, the explicit consideration of local laws and administrative requirements for the management of waste, and the need to receive local support to create such bottom up approach, an important success factor emerging from this case study is the creation of a local database. This implied that territorial factors were considered from the very beginning of the project (e.g. considering local industries, related material flows, waste generation and costs). Matchmaking exercises were then carried out considering the geographical location of the companies, considering access to waste, timing and cost of transport.

A drawback everyone agreed upon is the existing legislation, and the considerable requirements (or burden) emerging when a material is classified as waste as opposed to a resource (or input to production). In fact, if resources are considered as waste, paperwork and costs for collection, transport and disposal are higher. The procedural burden is smaller if a material is considered a sub-product rather than waste.

A secnd challenge found is the limited potential for leveraging, scaling up and monitoring the impacts of the project. This is primarily because ENEA's role was to support the identification of potential matches between

companies, and ENEA has not taken an active role in supporting matchmaking, aside fom organizing workshops and supporting companies on the legal side. As a result, in addition to the information included in the portal of the project being reserved for companies based or operating in Sicily (and hence not to individual users), there is no information about whether companie actually signed contracts to reuse end of life materials. As as result, it seems that the implementation of the project has led to awareness about the opportunity to reuse waste, but there is no information that is publicly available regarding the extent to which this potential was turned into reality.

Despite the burdensome regulation, the potential to deliver social, economic and environmental advantages was a shared motivation to sit together and discuss the potential of the Industrial Symbiosis in Sicily.

Agglomeration

While agglomeration was not created by the project, the work of ENEA helped create awareness about the availability of synergies for local enterpreises that can be found in geographical proximity. The cost benefit analysis carried out by ENEA in collaboration with interested industries and companies estimated the cost of transport, which therefore took into account the geographical dimension, and shed light on the potential advantages of agglomeration.

Land-based resources

This is certainly a success factor for the project implemented by ENEA. In fact, the industries selected for the project, creation of the database and matchmaking are all heavily reliant on local resources (e.g. for the construction sector).

Accessibility

As mentioned above for agglomeration, accessibility was directly considered in the matchmaking assessment. It is not possible to know the extent to which contracts were signed, but accessibility (or the monetary value of it, via the estimation of the cost of transport) was an important element in the assessment carried out by ENEA.

Knowledge

Awareness about the possibility to create synergies and reduce costs was created by ENEA and the project. It is not possible to know what was the extent to which end of life materials were already reused before, but certainly the creation of the database has certainly increase the knowledge about material use and available technologies to materialize synergies.

Technology

Technology is not eexplictly mentioned in the work carried out by ENEA, although it seems clear that it plays an important role in the final phases of the project, where the potential synergy between companies is assessed, resulting in the potential signing of a contract for the trade of materials.

Governance /Milieus

The ENEA project definitely supported the understading of local regulations, and helped companies avoid bottlenecks (especialy when materials would otherwise be considered waste rather than potential inputs for other economic activities). ENEA also established trust, which proved fundamental for the success of the project.

5.8 Assessment of the region's capacity to keep unlocking the potential of a CE

This project was conceived before the circular economy concept became known/mainstream locally (in Sicily) and the goal of the project was to develop and test a platform that could raise awareness about the opportunities emerging from the use of Industrial Symbiosis.

Potential was primarily identified for the agri-food sector and for construction, primarily regarding the reuse of construction waste for, among other options, road construction and cement manufacturing. The high availability of these materials, and the presence of local industries that rely on local materials are the main drivers of success going forward. Strong potential remains in these areas, especially because of the new evidence that synergies can be found, and costs reduced.

Some aspects of the project are unique to the Sicilian context, but in general the approach (match-making) and resulting business models are broadly applicable to other regions. ENEA's approach is the one of an initiator, strong of the fact that the interventions proposed (through matchmaking) are economically viable. They therefore engage directly with local institutions (e.g. Chamber of Commerce and Confindustria) with the goal of having them endorse the project and continue promoting and supporting it after ENEA's engagement ends. In fact, while Sicily was the first viable project for Industrial Symbiosis, ENEA has since implemented a similar approach in three other regions.

Having shown how to unlock the potential of Industrial Symbiosis, ENEA sees opportunities for this project and work to grow further in Sicily. This is in the context of expanding the collaboration between companies (i.e. realizing a larger portion of the matches identified) as well as to expanding the analysis to more sectors.

5.9 A systemic perspective on the Sicilian CE case study

The CE strategy for Sicily focuses on identifying partnerships for turning waste into resources, or valuable production inputs via Industrial Symbiosis. Practically, it provides a platform for companies to identify partners in the recycling and reuse of materials, to reduce costs both for the seller (waste management costs) and the buyer (purchase of production inputs), and enhance economic productivity.

Historical trends show two main dynamics at play, both of which are harming the economic competitiveness of the region: (i) the increase of production and creation of waste, resulting in growing waste disposal fees (B1), (ii) the increase of costs and the erosion of profits, reducing the potential to invest and make use of opportunities for waste reduction, creating a lock-in effect, or vicious cycle (R1).

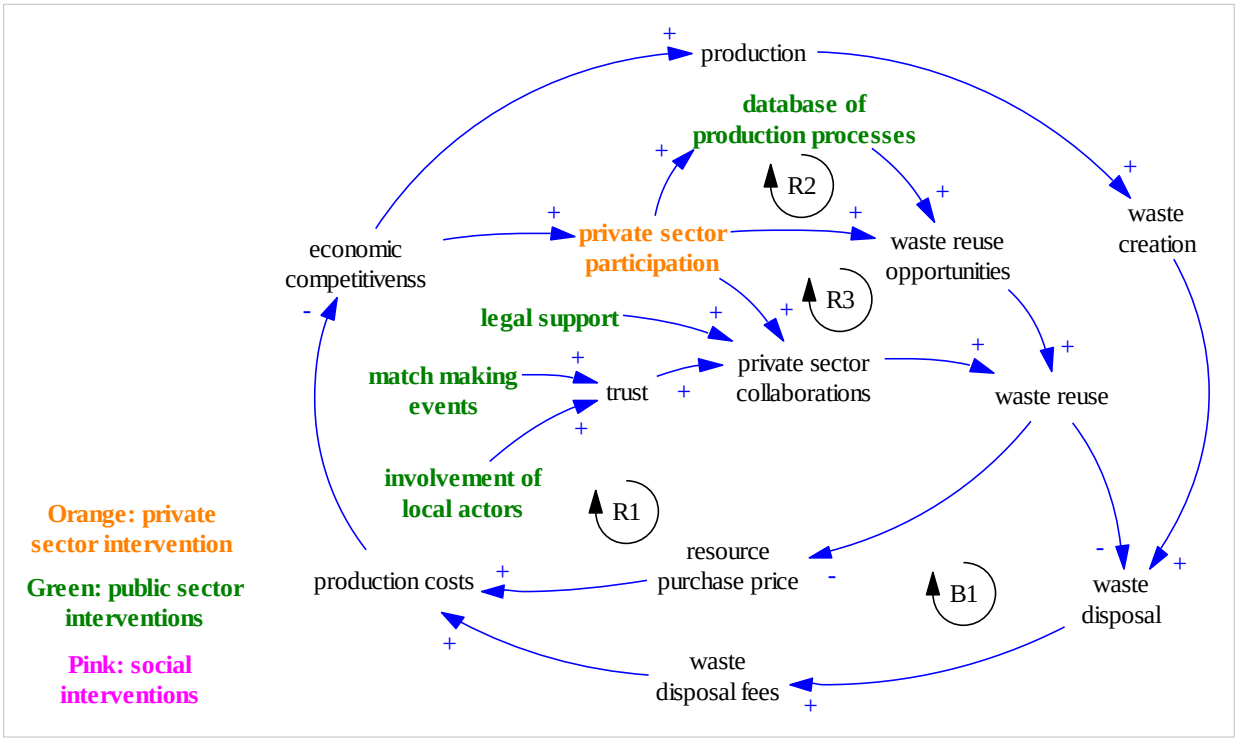
The Industrial symbiosis strategy includes upfront work on data collection and extensive exchanges with local stakeholders. This has allowed to identify waste reuse opportunities in the region and introduce a virtuous cycle (R2).

Further, the involvement of local actors and the organization of face to face meetings have allowed to create trust. Together with legal support and the preparation of implementation guides, these interventions led to private sector collaborations, creating a second virtuous cycle (R3).

The overall outcome of these interventions for the companies involved is (a) the reduction of waste disposal fees for waste producers, and (b) the reduction of resource/material purchase price for the buyers, turning also R1 into a virtuous cycle.

The dynamics emerging from the case of Sicily suggest that the database as well as collaborations could grow, as the interest of private actors extents to more companies and more economic activities. Further, an important synergy is found with municipalities and the region, in that they will also accrue cost savings for waste management.

Figure 5-5: Causal Loop Diagram - Sicily



Source: Own elaboration

5.10 Conclusions and lessons learnt

The Industrial Symbiosis project led by ENEA has unlocked the potential for waste reuse in several economic sectors in Sicily. It has provided research and data to better understand the concept of Industrial Symbiosis and assess its potential outcomes; it has created a network of local stakeholders and companies, and organized workshops to overcome the traditional distrust that characterizes the Sicilian business environment; it has also created, piloted and shared a platform for the identification of potential matches between companies that generate waste and those that can use it as a resource; finally, it has provided guidelines with details on the economic viability of the matches identified, and with information on the steps to follow to realize the potential of Industrial Symbiosis while complying with the complex web of laws and regulations surrounding waste flows and their reuse.

This project has shed light on the key drivers and success factors to consider when promoting Industrial Symbiosis and Circular Economy strategies. It has served as an incubator in Sicily and ENEA has made use of lessons learned to replicate the same approach in three other regions. Here new stakeholders came on board, creating synergies from a technical or institutional angle, indicating that the key success factors of the Sicilian project were (1) the use of a transparent and multi-stakeholder approach, where roles and

responsibilities are shared, (2) the creation of new information for cost reductions, and (3) the creation of trust for the long-term success of the project. These are the main lessons learned, which allowed ENEA to replicate the project in other Italian regions, and can be summarized in: (i) transparency, (ii) relevance and (iii) trust.

5.11 References

Cutaia et al. (2015): “The Experience of the First Industrial Symbiosis Platform In Italy”, Environmental Engineering and Management Journal 14 (2015), 7, 1521-1533

Cutaia L. et al. (2014): “The project for the implementation of the industrial symbiosis platform in Sicily: the progress after the first year of operation”, in “Pathways to environmental sustainability. Methodologies and experiences”. Salomone R. and Saija G. Editors, Springer (2014) (ISBN 978-3-319-03825-4)

Cutaia L., Mancuso E., Sbaffoni S., Luciano A., Barberio G. (2014): “First results of the implementation of the Industrial Symbiosis Platform in Italy”, Symbiosis Conference, Athens 19-21 June 2014

Mancuso, E. (2016): “L’Esperienza di Simbiosi Industriale in Sicilia”, La Simbiosi Industriale In Italia: l’Esperienza ENEA conference, 12th May 2016. https://studylibit.com/doc/990802/mancuso---simbiosi-industriale

6 The Bioeconomy Cluster in Central Germany

6.1 Executive summary

The circular bioeconomy occurs at the intersection of the bioeconomy and circular economy. It is characterised by a re-use of renewable resources, e.g. in cascades, and is just emerging as a market opportunity and policy aim, whereby it remains largely absent as an explicit strategy in political frameworks nationally and at the level of the EU. The region of central Germany (in particular Saxony-Anhalt) has the potential to become a frontrunner in developing a circular bioeconomy due to its high availability of biomass, strong chemical industry presence, and high-quality research and development infrastructure. The regional innovation strategy for the federal state of Saxony-Anhalt highlights “chemicals and bioeconomy” as one of five potential lead markets. Activities of the Bioeconomy Cluster in Saxony-Anhalt and its surrounding areas work to bring key actors toward building such a lead market together in order to foster joint innovation opportunities, share knowledge and support companies and research projects. The Cluster consists of around 80 members (including SMEs, large companies, research facilities and corresponding networks). Between 2012 and 2017 it was connected to 45 joint research projects and 145 individual projects with a budget of 80 million Euro (from which 50% stemmed from industry and 50% from federal and state-based funding). Altogether evidence points to the Bioeconomy Cluster as having a key role to play in building and fostering relationships and sharing know how crucial to innovation efforts toward a circular bioeconomy. However, to scale up both efforts and impacts regional and structural barriers related in particular to the lack of a strong regulatory framework for promoting a circular bioeconomy, e.g. connected to missing incentives for companies to invest and innovate in such changes, must be overcome. Regional weaknesses include a migration of educated workers from the region, low availability of venture capital for investments perceived as high risk with a long pay-back period, and a low level of start-up activity and entrepreneurship in general. To this end, policy must take on a stronger role to provide a level playing field (in particular as relates to the price of fossil-based alternatives), promote product innovation through market incentives and economic instruments, and help to raise awareness among both entrepreneurs and consumers. Altogether, the region of Saxony-Anhalt appears well suited to experiment, innovate and drive such a circular bioeconomy transition, which could be replicated in other parts of Germany, the EU and the rest of the world, if the right mix of policies and incentives are established. The Bioeconomy Cluster can build on the experiences and know how it has generated over the last 6 years to continue to connect potential partners toward opportunities for cascades and industrial symbiosis, supporting research and industry to implement innovations toward such a transition.

6.2 Background information

This case study focuses on the transition to a “circular bioeconomy” in central Germany. In that sense it looks at how and where the concepts of Bioeconomy and circular economy overlap, and specifically examines how the activities of the Bioeconomy Cluster in central Germany contribute to building this transition. It is based on data from the CIRCTER project[57], literature review and interviews with managers of the Cluster and the research institute that accompanied the cluster scientifically. This background section provides some basic information on the socio-economic, cultural and resource conditions within the region of central Germany and its transition to a circular economy; it defines what the circular bioeconomy is; and examines the extent of policy motivations to move towards a circular bioeconomy, in the context of the regional innovation strategy (RIS3).

Saxony-Anhalt is a land-locked German federal state located in the western part of eastern Germany. It is the 8th largest state by size and 10th largest by population (with around 2.2 million residents). With an unemployment rate of 7.4% it is well above the German average (3.4%), however unemployment has also dropped significantly since the year 2000 (20%), when it had the highest level of unemployment in Germany. Geographically it is largely characterised by a flat expanse of the North German Plain. The Harz mountains (with the highest peak being 1,140 meters) are located in the south-west area. It is known especially for its strong chemical industry, as well as good soil for agriculture and forestry. For example, it is estimated that 40% of the German beech stock is concentrated in the region and its surroundings. Particularly strong sectors include the following (the numbers indicate the extent to which the number is above the national average, with 1 being the national average) (Thrän et al. 2018):

- Manufacture of machinery for processing and manufacture of plastics/rubber (4,39)
- Institutes of Mechanical Engineering and Equipment (2,86)
- Manufacture of industrial gases (2.45)
- Manufacturer of other organic raw materials and chemicals (2.01)
- Research and development in biotechnology (1.9)
- Manufacture of plastic sheets, foils, etc. (1,62)
- Manufacture of plastic construction materials and supplies (1.58)

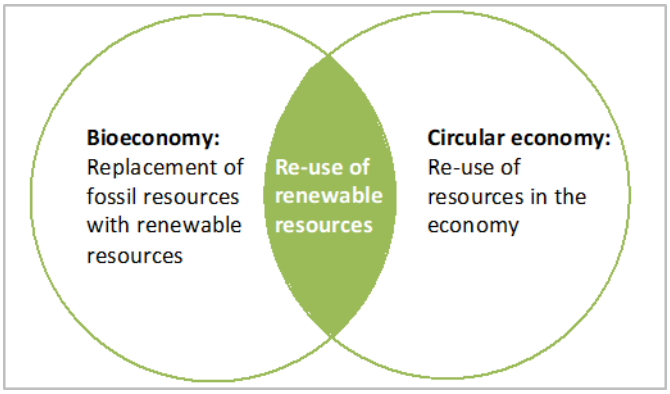
Characteristic of Saxony-Anhalt's business structure is its small size. In 2010, 63% of employees worked in small and medium-sized enterprises, while the national average was only 44%. Saxony-Anhalt has a low

[57] Data is based on the dataset generated by the CIRCTER project and may slightly differ from regional statistics stemming from German national statistics agencies.

proportion of companies that are continuously conducting research and development. Measured against all companies in the federal state, it was 13% in 2011. This value is even significantly below that of the comparable regions Saxony (35.5%) and Thuringia (20%) (MW 2013). The start-up intensity in Saxony-Anhalt is also significantly below the German average. While there were 47 start-ups per 10,000 employable persons in Saxony-Anhalt in 2011, the German average was 78 start-ups (MW 2013). Furthermore, there is an increasing shortage of skilled workers in Saxony-Anhalt, in particular for small enterprises (MW 2013). In contrast, the region is known as a hub of research and development. Leading research institutions with laboratory, pilot and demonstration facilities as well as high performance industrial parks comprise the other side of the coin. A high availability of research institutes and universities trains young people for highly skilled work, especially in the chemical and biotechnology sectors, potentially providing a key workforce for the "circular bioeconomy".

The bioeconomy is defined by the German "National Research Strategy Bioeconomy 2030" as a "natural cycle-oriented, sustainable bio-based economy that carries with it the promise of global food supplies that are both ample and healthy, and of high-quality products from renewable resources that will strengthen our competitiveness" (BMBF 2010, p. 8). There are high hopes for the bioeconomy across Germany to create new opportunities for economic growth, employment and innovation, while reducing fossil fuel use and mitigating climate change (BMEL and BMBF 2014). Similar hopes are placed on the circular economy, which focuses on keeping resources within the economy for further re-use. Carus and Dammer (2018) define the circular bioeconomy as the intersection of bioeconomy and circular economy. They stress that both have similar targets and overlap to a degree, but are not fully embedded in one another (e.g. bioeconomy also focuses on aspects like precision farming, food quality and less toxicity whereas circular economy includes multiple other resources (minerals and metals) connected to new business models and behaviour change). In essence a circular bioeconomy focuses on the re-use of biomass within the economy (see Figure 6-1), including concepts like cascading use, utilisation of organic waste, nutrient cycling, bio-based products and resource-efficient value chains (Carus and Dammer 2018). The extent of implementation in Germany remains small today. For example, while the use of wood has doubled over the last two decades in Germany (Mantau 2012), a higher portion of the demand can be attributed to energy-related uses, and when material use is achieved, the portion that is used in new and innovative applications is rather small. For example, only 2.2% of Germany's total wood consumption is used by the chemical industry (FNR 2014) (in comparison to around 56% for the sawmill industry, 25% for wood materials and 16% for wood pulp and cellulose) (Mantau 2012). It is unclear how much is then re-used for e.g. cascades, but such applications remain rare.

Figure 6-1 Defining the circular bioeconomy



Source: own elaboration

The circular economy and bioeconomy transitions have been strongly, but separately, pushed at the European and national levels of governance: for example by the European Commission in "An EU action plan for the Circular Economy" (EC 2015) and respectively the Strategy "Innovating for Sustainable Growth: A Bioeconomy for Europe" (EC 2012) as well as in Germany within the German "National Resource Efficiency Programme" and respectively by the "National Policy Strategy on bioeconomy" (BMEL 2014). However, the opportunity to maximize synergies between circular economy and Bioeconomy goals has been largely ignored in these strategies, with responsibilities for implementation spread between different ministries, and with separate networks having been initiated and overlapping and even contradicting instruments implemented, e.g. that focus on an extended use of biomass and other renewable resources without considering their regenerative capacities. A key example is promotion of the energetic use of biomass, which may contradict goals to increase the material use of biomass and hinder the potential for cascades.

The regional level is particularly key as it is where implementation happens. At the regional level in Saxony-Anhalt, the potential for a circular bioeconomy, in particular in joining aims of the Chemical industry with the bioeconomy, is pointed to in the regional innovation strategy (RIS3). The "Innovation Strategy Saxony-Anhalt 2014-2020" aims to identify important future markets against the background of advantageous existing and potential future specialisation opportunities of the region (MW Sachsen-Anhalt 2014). The lead market "chemistry and bioeconomy" was identified as one of five areas for strong growth[58]. In it, the vision of raw material diversity is highlighted, with further strategic aims being:

- Broadening the raw material base by exploiting the potential uses of domestic lignite and non-food renewable raw materials such as timber;
- Development and marketing of bio-based products for the chemical industry.

[58] The other lead markets included (i) energy, mechanical enerineering, plant construction, resource efficiency; (ii) health and medicine; (iii) mobility and logistics; (iv) nutrition and agriculture

Further strengths and opportunities highlight the potential to promote cascades, e.g. through joint production for optimal added value creation of biogenic raw materials (see also the SWOT analysis in Chapter 6.8). All in all, the aim of a circular economy is often mentioned in the regional innovation strategy - and highlighted through lead demonstration projects, such as “Circular economy and resource management /use of biogenic resources” - but no quantitative aims or concrete measures to achieve a circular economy, or a circular bioeconomy, are specified.

In general, a crucial dimension of the political framework for steering the circular bioeconomy transition in a sustainable direction is missing across all levels of governance (particularly at EU and national levels). It demonstrates the importance of frontrunner activities initiated in pilots and demonstrations of the sort pushed forward by activities of the Bioeconomy Cluster that could push the policy framework forward, with key benefits for the region and beyond.

6.3 CIRCTER Indicators

Table 6-1 Material flows in Sachsen-Anhalt (DEE0)

MATERIAL FLOWS	DEE0
DMC per capita 2006 (tonnes/hab)	19.22
DMC per capita 2014 (tonnes/hab)	21.14
DMC intensity 2006 (kg/euro)	1.02
DMC intensity 2014 (kg/euro)	0.88
Biomass per capita 2006 (tonnes/hab)	3.35
Biomass per capita 2014 (tonnes/hab)	5.11
Biomass intensity 2006 (kg/euro)	0.18
Biomass intensity 2014 (kg/euro)	0.21
Metal ores per capita 2006 (tonnes/hab)	0.57
Metal ores per capita 2014 (tonnes/hab)	0.97
Metal ores intensity 2006 (kg/euro)	0.03
Metal ores intensity 2014 (kg/euro)	0.04
Construction per capita 2006 (tonnes/hab)	11.02
Construction per capita 2014 (tonnes/hab)	9.48
Construction intensity 2006 (kg/euro)	0.58
Construction intensity 2014 (kg/euro)	0.39
DE per capita 2006 (tonnes/hab)	20.41
DE per km2 2006 (tonnes/km2)	20.79
DE per capita 2014 (tonnes/hab)	2.47
DE per km2 2014 (tonnes/km2)	2.28

Table 6-2 Waste in Sachsen-Anhalt (DEE0)

WASTE STREAMS AND WASTE BY NACE ACTIVITY	DEE0
Waste generation	
Total waste generated per capita 2006 (kg/hab)	1,468.10
Total waste generated per capita 2014 (kg/hab)	1,805.49

Total households waste per capita 2006 (kg/hab)	411.95
Total households waste per capita 2014 (kg/hab)	453.46
Total foodwaste per capita 2006 (kg/hab)	181.14
Total foodwaste per capita 2014 (kg/hab)	147.07
Total WEEE per capita 2006 (kg/hab)	5.53
Total WEEE per capita 2014 (kg/hab)	7.97
Plastic waste per capita 2006 (kg/hab)	10.75
Plastic waste per capita 2014 (kg/hab)	20.83
Waste by NACE activitiy	
Agricultural waste intensity 2006 (kg/Thousand Euro) (*)	79.25
Agricultural waste intensity 2014 (kg/Thousand Euro) (*)	29.95
Construction waste intensity 2006 kg/Thousand Euro) (*)	154.21
Construction waste intensity 2014 (kg/Thousand Euro) (*)	199.67
Manufacturing waste intensity 2006 (kg/Thousand Euro) (*)	102.47
Manufacturing waste intensity 2014 (kg/Thousand Euro) (*)	75.74
Mining waste per km2 2006 (tonnes/km2 - Waste by mining/total surface)	8.90
Mining waste per km2 2014 (tonnes/km2 - Waste by mining/total surface)	12.87

(*) Waste intensity: [Waste by agriculture/construction/manufacturing - kg] / [GVA by agriculture/construction/manufacturing- Tsd euro]

Table 6-3 Provision of materials, technologies and services for a circular economy in Sachsen-Anhalt (DEE0)

	DEE0
Material providers	
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	19.85
Number of Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	21.18
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	0.07
Turnover per Material Provider Employee in 2010 (Thousand euro/employee)	284.22
Turnover per Material Provider Employee in 2015 (Thousand euro/employee)	319.11
Growth Rate of Turnover in thous. Euro per Material Provider Employee in % (2010-2015)	0.12
Technology providers	
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2010	22.56
Number of Technology Provider Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	21.3
Growth Rate of Number of Persons Employed per 1,000 Persons Employed in the Total Economy in % (2010-2015)	-0.05
Turnover per Technology Provider Employee in 2010 (Thousand euro/employee)	153.17
Turnover per Technology Provider Employee in 2015 (Thousand euro/employee)	171.09
Technology Providers Growth Rate of Turnover in thous. Euro per Technology Provider Employee in % (2010-2015)	0.12
Circular Business Models (CBM)	
Number of CBM Persons Employed per 1,000 Persons Employed in the Total Economy in 2015	3,67
CBM Turnover per Circular Business Models employee in 2015 (Thousand euro/employee)	147.07

6.4 Case study description

This case study focuses on the activities of the Bioeconomy Cluster, which is a leading-edge cluster active in Central Germany. It was founded by 23 members in 2012 and organized as a network within BioEconomy e.V.. BioEconomy e.V. bundles the interests of the cluster's members and forms a legal platform for organising and financing of joint activities. The centre of the cluster region is located in Saxony-Anhalt (with strong links to Saxony, Brandenburg, Thuringia and Lower Saxony) and it is interlinked with national and international initiatives to promote a bioeconomy as well as with decision-makers from relevant industries. It has two key strategic objectives:

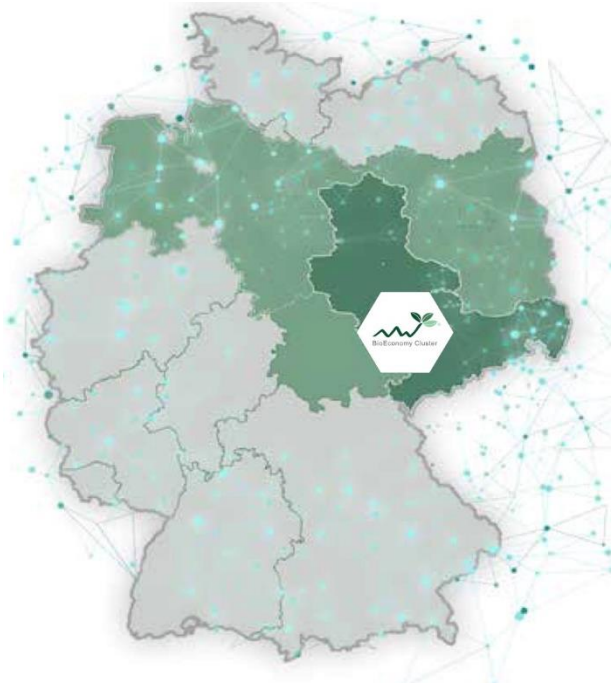
Objectives

The Bioeconomy Cluster has two key strategic objectives:

1. To sustainably maximize value creation of non-food biomass through **coupled production and cascade utilisation** to generate chemicals, new materials and energy.

2. To **speed up innovation** through integrated, temporally and spatially coordinated up-scaling of processes and plants from laboratory to development demonstration scale.

Figure 6-2 Core and extended regions of the BioEconomy Cluster in central Germany



Source: from the Bioeconomy Cluster flyer: "Grow with Bioeconomy Cluster", 2018. Provided by Beck, A.

Of particular interest for the development of a circular economy is the utilisation of cascades to re-use biomass and close loops in production processes. This is understood as a key pathway toward sustainable use of renewable resources within the Cluster. In this way, although the circular economy was not such a well-known, major topic when the Cluster was founded, circular economy ideas were integrated with bio economy aims in an implicit way from the beginning of the Cluster's inception.

Sectors

The Cluster covers a wide range of sectors related to various branches of the chemical industry, the plastics and plastic processing industry, the paper and pulp industry, as well as machine and plant engineering for processing industries. It focuses on technology areas concerning biochemistry / biophysics, bio-based high-performance materials and integrated waste-energy processes. The core technological competencies include the development, up-scaling and application of innovative technological processes for the sustainable use of bio-based raw materials from the non-food sector. These are used to produce high-value products for various industrial sectors.

Instruments

The cluster acts to facilitate innovation and provide support (e.g. workshops) and a platform for networking companies and research organisations interested in pursuing new projects and co-developing new ideas. It offers partners multiple options for cooperation, project initiation and coordination as well as infrastructure

use, specifically in the areas of knowledge and technology transfer, a pool of research and development partners from the regional, national to international levels, support for developing new business ideas, accompanying support for start-ups, support for process scaling, advice for project and support funding, and access to political decision makers across all levels of policy. An important task of the cluster is to establish a link between the companies. A cycle can only occur if the companies have information about each other to find out where residual materials are needed. For example, “Business A” must know what types of by-products/waste “Business B” produces, in order to be able to maximise synergies for potentially using that waste. Such business opportunities may be fostered by bringing people together but must stem from the actors themselves to be effective. To that end, actors need to understand the potential that a circular bio economy could have for them. This type of knowledge sharing is also a key strength of the Cluster.

Financial support

The Cluster has received support from the federal state Saxony-Anhalt until the year 2026 as an innovation cluster, has received support nationally as a Leading-Edge Cluster and will continue to receive national support (from the BMBF) toward internationalisation as a strategic cluster partner. It is run and managed by a 5-person team. There are around 80 members of the Bioeconomy Cluster (stand as of 31.12.2017) comprising a mix of SMEs, large companies, research organisations and universities. The Bioeconomy Cluster integrates pre-existing cluster structures in the region and has also joined forces with leading bioeconomy clusters in France, the Netherlands and the UK to form Europe’s Bioeconomy Intercluster (3BI), which was founded in 2015. It aims to help European companies make the most of new markets and new opportunities from the bioeconomy. Specifically, it intends to strengthen European collaboration and innovation to create globally competitive products and services for the bioeconomy as well as to help European companies working in this sector to access the international partnerships and overseas markets they need.

European Structural and Investment Funds (ESIF) play a big role in the region Saxony-Anhalt, however it is relatively difficult to establish projects with these funds. It requires strong support and engagement of regional policy makers, a solid understanding of the administrative time and effort required, and it helps to have ”a foot in the door”. The cluster itself hopes to be involved in 4 or 5 projects that will be supported by Structural Funds. It has also taken part in a couple of H2020 projects. Currently they are involved in 2 projects (e.g. Bio-based Industries Consortium) with participation in topics regarding communication, dissemination and application. H2020 projects depend on the initiative and engagement of companies and research organisations within the Cluster, while the cluster does offer support for proposals and networking.

6.5 Governance

This section looks at the dedication of regional governance toward promoting a circular bioeconomy. It argues that from an innovation perspective, regional, national and EU governance must move beyond words and intentions to actions if a true circular bioeconomy transition shall be implemented.

German economic policy has committed itself to the strategic option of the bioeconomy in several strategic papers of the Federal government: “National Policy Strategy on bioeconomy”, the “National Research Strategy BioEconomy 2030”, the “Action Plan of the Federal Government on Material Usage of Renewable Resources” and the “National Biomass Action Plan”. Since there is still no comprehensive bioeconomy policy in Germany, bioeconomy sectors follow different laws and regulations for their specific sector. Some general regulations, such as the German Waste Management Act, also apply the entire value chain of the bioeconomy, but do not offer many incentives for the growth of the bioeconomy. On the regional level, Saxony-Anhalt has two authorities that are mainly active in the field of circular economy. These are the Saxony-Anhalt State Office for Environmental Protection with the department "Waste Management, Soil Protection, Water Management Plant Engineering" and the Ministry of the Environment, Agriculture and Energy with its department “Circular Economy, Chemical Safety and General Health Protection". For example, the topics of waste, food waste, product responsibility and chemicals are covered.

The federal state of Saxony-Anhalt can help to establish a circular bioeconomy. Saxony-Anhalt has a lead market strategy in which the circular economy is integrated. Ideas are also collected across the federal states (Saxony, Saxony-Anhalt and Thuringia) to establish a circular economy and the interest is evident, especially at an exploratory level of discussion and information gathering. At the same time, this means that such a transition is still in its beginning stage and has not yet been implemented. There is also a lack of consistency across political and administrative strategies and regulations, in particular at a national and EU level. For example, a public procurement strategy that favours bio-based products could be a key way to increase demand for lead bio economy markets, paving the way for a circular bio economy, but is happening far too little in the region and country. For example, the existing State Procurement Act of Saxony-Anhalt (LVG LSA) could be expanded to focus also on bio-based products. Currently § 4 regulates the permissibility of taking environmental concerns into account, in particular if they lead to additional energy savings (Umweltbundesamt 2014). All in all, policy makers could steer the market toward a smart circular bioeconomy, but to do so must overcome vested interests in the status quo (in particular about the use of fossil fuels in industry and for energy) to promote new products, processes and business models.

6.6 Results and impact

This section presents key results and impacts of (a) the Bioeconomy Cluster (b) positive social and environmental impacts regarding a circular bio economy and (c) the transition to a circular economy in the region, including monitoring needs.

6.6.1 The Bioeconomy Cluster

In 2012 the cluster was one of the winners of the Leading-Edge Cluster Competition held by the Federal Ministry of Education and Research (BMBF) which was the starting point of the "Bioeconomy Cluster e.V.". Between 2012 and 2017 it was connected to 45 joint research projects and 145 individual projects with a budget of 80 million Euro (from which 50% stemmed from industry). Ongoing processes of internationalisation and strong interlinkages with existing regional, national and international clusters also points to a high level of knowledge sharing and exchange toward strengthening the innovation and research and development potential of both the region, the country and the European Union.

Between 2012 and 2017 the Cluster was accompanied by scientific research[59] aimed at developing and implementing sustainable competitive action plans and management tools for the Bioeconomy Cluster. A monitoring process also helped to evaluate the structure and instruments used by the Cluster, as well as to derive future recommendations (Thrän et al. 2018). The project also highlighted key results and impacts.

On the ground, specific projects have met with success for progress toward a circular bio economy. The cluster is able to identify complete value chains and has developed a strong research and development knowledge base and know-how in multiple areas. Examples from projects include the ability to process large quantities of undergrowth for the chemical industry, including knowledge on both logistics and technical processes. Derived products have been tested in different types of product groups, with success. Further projects and pilots have led to better recycling of wood species that would otherwise be incinerated and much progress has been made in developing high quality products for the material use of biomass. These projects have also led to a rich knowledge basis for the operation and management of the Cluster itself, with valuable contacts and experiences opening the door for future opportunities, in particular as regards industrial applications and industry participation.

[59] Performed by the Helmholtz Centre for Environmental Research (UFZ), the German Biomass Research Centre (DBFZ) and the Leipzig Graduate School of Management (HHL).

6.6.2 Social and environmental benefits

Hildebrandt et al. (2015) examined bioeconomy regions to understand the potential benefits of innovative production networks for bio-based products compared to conventional fossil-based products. They developed four scenarios and a sustainability monitoring system based on e.g. extended life cycle assessment relevant for central Germany. The scenarios included conventional production (e.g. fossil based), wood on innovative pathways (e.g. biorefinery to combine wood and chemical industries), thermal cascades (energy for the biorefinery in scenario 2 is met through bio-based sources) and resins fully bio-based (in which the bioeconomy is fully integrated). The results showed significant ecological advantages of a regional, bio-based product basket compared to fossil-based alternatives. Climate change and ecotoxicity were reduced by a regional bioeconomy network by 75 to 80%. The use of waste wood in cascades for powering biorefineries significantly reduced environmental impacts in categories such as eutrophication potential, marine aquatic ecotoxicity, photochemical ozone production, fresh water ecotoxicity, human toxicity potential, and abiotic depletion potential of fossil fuels. It shows the large potential for improving environmental impacts through integration of circular and bioeconomy principles, as in scenario 3. Key is the integration of biomass for material and energetic purposes and moving beyond technology substitution toward system innovation. Regarding social impacts, around 500 to 600 jobs have been created with a potential for at least 5,000 new jobs in the entire region if a complete circular bioeconomy is developed (including all service personnel, etc.).

6.6.3 Regional transition to a circular (bio)economy

The circular economy is mentioned in political strategies for the region. The waste management plan of the state of Saxony-Anhalt (2017) emphasizes the aim of creating a sustainable circular economy to conserve natural resources. For instance, by consistently implementing the landfill ban on untreated waste, reduced greenhouse gas emissions have been achieved. To further optimise the circular economy in the future, projects for the implementation of innovative measures for waste prevention, for the improvement of resource efficiency, for waste treatment (for reuse and recycling) as well as for energetic waste treatment are promoted. Waste prevention measures are also implemented at municipal level. These include inter alia the promotion of waste management structures and systems, including the design of waste collection or the development of waste prevention concepts by municipalities with the aim of educating citizens and local businesses about waste prevention behaviour and encouraging them to avoid waste. In addition, there are several activities at state level that make important contributions to waste prevention. For example, advising companies on waste prevention aspects and consulting services for SMEs (Landesverwaltungsamt Sachsen-Anhalt 2017).

The regional innovation strategy of Saxony-Anhalt (RIS3) highlights chemistry and bio economy as a key lead market for the region (see section 1.3), but little to no data is available on how much biomass is used in a circular bioeconomy, e.g. in cascades (at any level of governance). This is partly due to the nature of these emerging lead markets, which so far consist mainly of pilots and demonstrations. Work is being done to strengthen both bioeconomy monitoring (e.g. the BMBF and EU have multiple research projects ongoing to this end and Hildebrandt et al. (2015) is an example from the regional level) and circular economy monitoring (e.g. with much overlap to resource efficiency indicators and sustainability monitoring), however a systematic overlap of concepts and joint monitoring so far seems to be missing from political agendas.

Statistics from the region on material flows and waste can be used to derive some preliminary conclusions regarding the transition to a circular economy:

- Material consumption (Domestic Material Consumption (DMC)) has gone down for both the region and on a per capita basis between 2006 and 2014. Per capita consumption is around 20 tonnes per capita, which is well above the EU average (13.4 tonnes per capita in 2014 according to EUROSTAT) and German average (16.8 tonnes per capita in 2014 according to EUROSTAT). Material intensity has also decreased (in total and also e.g. for biomass), indicating a more efficient use of direct resources within the economy.

- While total waste has gone down on a per capita basis in Saxony-Anhalt between 2006 and 2014, the areas of household waste, food waste, Waste Electrical and Electronic Equipment (WEEE) and plastic waste have shown increases on a per capita basis, with particularly strong increases in e.g. food waste generated. This mirrors trends in Germany - where food waste per capita more than doubled between 2006 and 2014. It is particularly worrisome for the region of Saxony-Anhalt as food waste per capita is much higher than the EU average (around 140 kg/person in 2014). Agricultural waste and mining and quarrying waste have gone down significantly, potentially indicating a structural shift as well as perhaps a better use of agricultural waste for the bioeconomy. Waste intensity has also decreased in general between 2006 and 2014, except for food waste, manufacturing waste and plastic waste. These are all areas with strong potential for the circular economy, as well as the circular bioeconomy, but require a better use of waste resources. Further, the strong growth in per capita waste generation as relates to consumers is indicative of a direction that is the opposite of that strived for by circular economy and waste management objectives—namely to first and foremost prevent waste generation, and secondly, to better use waste as secondary inputs in production processes.

However, the data basis here also needs to be strengthened considerably to develop strategic policy recommendations based on a robust evidence base, in particular as regards waste generation and use of secondary (recovered) resources in production at a regional (as well as national and EU) level.

6.7 Drivers/success factors, other enabling conditions and barriers

Since many conditions can act both as drivers and barriers, the territorial factors that may condition the way a circular economy is operationalised are assessed to understand how they influence the transformation to a circular bioeconomy in the cluster region.

Agglomeration

The basic conditions for the establishment of a circular bioeconomy in the region have been created. Main drivers are the established **strong chemical industry** with a **well-qualified workforce** in the region. Nevertheless, there are also some factors that barrier the expansion of the circular bio economy in the region. Although the employees in the companies are highly qualified, the region has difficulties **attracting or retaining new skilled workers.** In order to solve this problem the Ministry of Science and Economy Saxony-Anhalt is committed to strengthening the attractiveness of the region as a business location, e.g. for cooperation between SMEs and university and the expansion of spin-offs and start-ups (MW Sachsen-Anhalt 2014).

Land-based resources

Around 40% of the German beech stock is concentrated in the region, making it a key driver for regional development of the bioeconomy. There is a high **availability of a large amount of biomass** for which there was no application. However, beech wood is subject to long production times and a growing influx of timber from fast-growing plantations in other regions of the world could threaten local supply loops.

Accessibility

Looking at the accessibility **missing investments in bio-based innovations** represent the main barrier in the region. Value-added chains are often theoretically established, but investments in large-scale industry are lacking. Investors are particularly deterred by the high-risk potential of investments, due to changing market conditions. In addition, the small companies are economically too weak to establish complex processes over a long period of time. Innovation is also hindered by the fact that only a **few start-up activities** take place in the region although these are key factors for innovation transfer. On the other hand, there are also drivers, such as the cluster, which plays a key role in supporting and promoting innovation. Specifically, close integration of SMEs in innovation processes within the Cluster is key to providing them with support,

know-how and resources otherwise unavailable to them. For example, **opportunities for industrial symbiosis** can be co-developed through the Cluster's network of potential partners and contacts. A weakness could be the homogeneity between the partners in the Cluster regarding previous experiences (e.g. with beech wood-based processes) whereas a mix of competencies and structures could lend itself to strategic innovation processes.

Knowledge

High-performance research and development has been an important driver for the transformation to a circular bioeconomy. The region is a hub of research and developments (e.g. leading research institutions with demonstration facilities and high performance industrial parks). Thus, young people are trained for highly skilled work. The cluster also plays an essential role in building knowledge. It provides information for the local firms and acts as a **platform /network** so that the companies can exchange their knowledge and learn which bio-based residues they can reuse from the other companies. These cascade utilizations reduce the amount of waste generated and resource consumption.

Technology

The technical prerequisites to create closed-loop systems are in place and can be expanded accordingly. In the region there are many approaches to maximize value creation of non-food biomass through **coupled production** and **cascade utilisation** to generate **bio-based chemicals, new materials and energy.** The region is prepared to speed up innovation through the integrated up-scaling of processes and plants from laboratory to development demonstration scale. Particularly drivers are the **significant ecological advantages** of a regional, bio-based product basket compared to fossil-based alternatives. The use of waste wood in cascades for powering biorefineries significantly reduced environmental impacts.

Governance /Milieus

There is a **lack of policy incentives** to implement a circular bioeconomy. Large chemical companies are missing incentives to invest in innovation to replace crude oil as a basic product. The introduction of clearly defined, **strategic policy measures** could become a key driver of a circular bioeconomy transition. For example, stable **long-term framework** conditions could be created for the development of wood-based products, including the direct promotion of innovative applications and technologies as well as the consistent increase in the price of fossil raw materials. Prohibiting plastic bags or plastic cups from non-renewable sources could open market opportunities for finding renewable alternatives. Policy makers can also act as a **pioneer** in using bio-based products in procurement as well as **provide funding** for research and development. In the region, greater acceptance and openness towards the bioeconomy is required both among companies in conventionally operating sectors and their potential customers to become a key driver for the transition. Knowledge, know-how and information must also permeate education, training and skills,

in particular as regards entrepreneurs and innovators in order to spread **awareness** of opportunities related to the circular bioeconomy and therefore the consumers' willingness to pay for bio-based products. A **consistent pricing policy** (addressing specifically environmentally harmful subsidies), but also communication and information from policy makers can contribute to this, but has hardly happened in the region so far.

External effects

External effects, such as a **decline in the price of oil**, can act as a barrier. For developing the Cluster, all calculations were based on a high oil price, but since then the price of oil has fallen by half making all calculations obsolete. As a result, important partners have withdrawn from the Cluster and lack motivations to participate in innovative projects. Considerable adjustments have had to be made regarding strategic product lines and new strategic partners have been sought. However, the price of oil can also act as a driver. If the **price of oil rises**, companies are willing to search for alternatives and thus switch to bio-based substances.

6.8 Assessment of the region's capacity to keep unlocking the potential of a CE

Through the unique linkage of the core industries of timber, chemicals and plastics, the region has great potential to establish and further expand a circular bioeconomy. The following three factors could form the basis for this transformation: Established chemical site, high availability of bio-based raw materials, high quality research in chemistry and bioeconomy.

Established chemical site

The chemical industry and plastics processing are important branches of the economy in Saxony-Anhalt, characterised by high-performance industrial parks and important chemical sites. Saxony-Anhalt covers the entire value chain from basic chemicals to the processing industry. The unique profile of the region also includes specialization in the areas of polymer synthesis in close connection with plastics processing, agrochemicals and fine and specialty chemicals. New fields of application with market perspectives are e.g. automotive lightweight construction with composite materials or plastics in power plant construction (MW Sachsen-Anhalt 2014).

High availability of bio-based raw materials

There is a high availability of bio-based raw materials in the region from beech forestry. Based on a scenario analysis for the region, Hagemann et al. (2016b) conclude that the wood-based bioeconomy has the potential to make a substantial contribution to a change from a fossil-based economy to a sustainable, bio-based circular economy, provided certain conditions are met.

High quality research in chemistry and bio economy

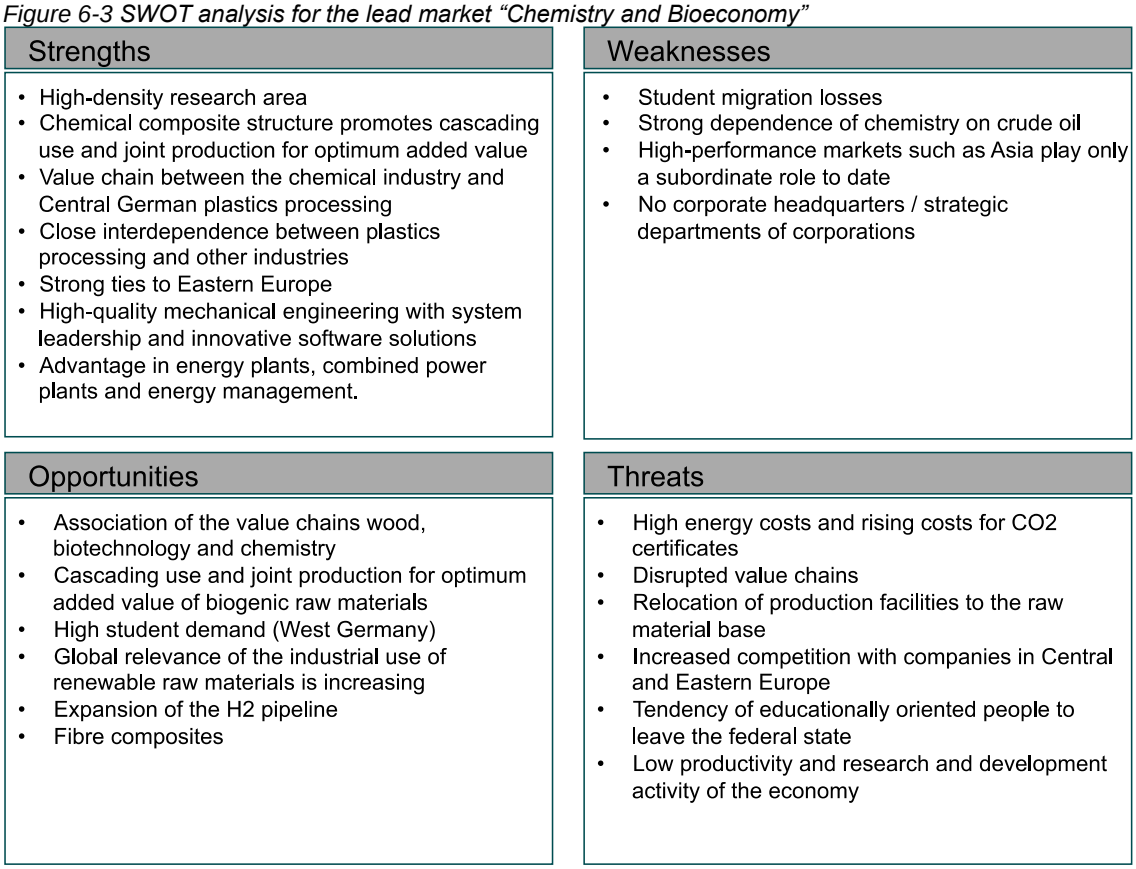
The science system in Saxony-Anhalt is institutionally well equipped with two universities, four universities of applied sciences and a large number of non-university research institutions. Leading research institutions with laboratory, pilot and demonstration facilities are located in Saxony-Anhalt. For example, the Fraunhofer Centre for Chemical-Biotechnological Processes CBP in Leuna is researching petroleum substitutes from renewable raw materials. Biotechnological and chemical processes are transferred from laboratory results to production-relevant dimensions (MW Sachsen-Anhalt/IMG 2014). The universities and research institutions offer high quality research and cooperations with regional companies. Nevertheless, the region Saxony-Anhalt has problems attracting students and workers to move to this region. In order to fully exploit the innovation potential, the following strategic objectives are being pursued by the Ministry of Science and Economy such as: improving cooperation between SMEs and university, strengthening the attractiveness of the region as a business location, expansion and creation of spin-offs for knowledge and technology transfer, further development of start-up-related support and financing offers (MW Sachsen-Anhalt 2014). For example in the project GISBERT, which ran from 2015 until the end of 2017 and was funded by the Federal Ministry of Education and Research, start-up and spin-off projects with biobased business models were supported.

In total, efficient university and non-university research as well as industry-related research infrastructures enable an effective transfer of technology and knowledge and form the basis for establishing a circular bioeconomy.

SWOT-Analysis of the regional potential

The regional innovation strategy of Saxony-Anhalt included a Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis for development of the lead market “Chemicals and Bioeconomy”. This could pave the way toward further developing a circular bio economy and thus provides key insights for the region. Figure 6-3 depicts the SWOT-analysis. Of noteworthy interest are the opportunities for cascading use, particularly in light of a growing EU and global relevance of circular bioeconomy manufacturing processes and business models. Weaknesses and threats include above all a “brain drain” of key potential players in such a transition as well as growing competition from other regions to become frontrunners in circular bioeconomy industries. This points to the chance that Saxony-Anhalt currently holds to take advantage of its unique position to build a lead market in this area with multiple social, economic and environmental benefits for the region.

Figure 6-3 SWOT analysis for the lead market "Chemistry and Bioeconomy"



Source: MW Sachsen-Anhalt 2014

6.9 A systemic perspective on the German CE case study

The main rationale for the use of a CE approach in Central Germany is economic revitalization. The key assets for the design and implementation of a successful CE strategy are (i) high availability of biomass, (ii) strong chemical industry presence, and (iii) high quality research and development infrastructure.

The current situation is characterized by the extensive use of resources, leading to the creation of health and environmental hazards (e.g. through the consumption of fossil fuels and the accumulation and incineration of waste). This is exacerbated by economic growth (R1), which, over time, has caused the emergence of various balancing factors. These include production cost increases (B6) and health impacts (B4

and B5). It is becoming clear that these emerging trends are ultimately affecting profits and the economic competitiveness of the region.

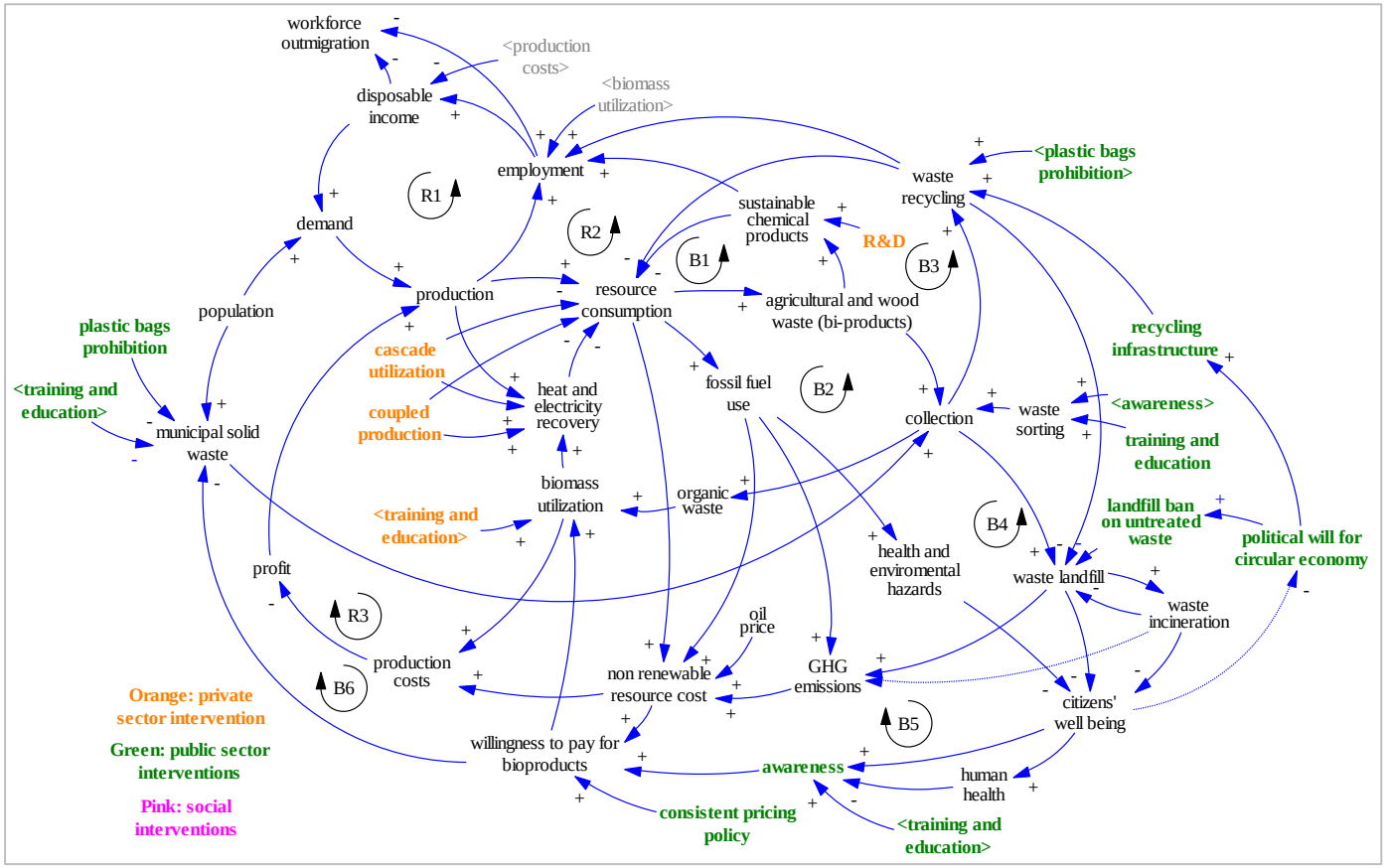
The CE strategy is designed to address several challenges simultaneously, primarily with active support of the public sector and private actors.

First, the government implemented a landfill ban on untreated waste, and planned to strengthen infrastructure for recycling. This will reduce the amount of waste reaching the landfill, thereby also reducing waste incineration, emissions and health impacts (B4, B5). Interventions are required to raise awareness about the benefits of a CE, which, together with consistent pricing policy, are expected to increase the acceptance of bioproducts and increase their demand (through a higher willingness to pay for bioproducts) (B6 and R3). This intervention is specifically designed to create a synergy with the private sector, i.e. generating demand for bioproducts and reduce municipal solid waste. Finally, with municipal waste prevention concepts that have the aim of educating citizens and local businesses about waste prevention behavior as well as with the prohibition to use plastic bags, the government will also reduce the creation of municipal waste, and contribute to environmental preservation while reducing waste management costs (B3).

Second, the private sector is encouraged to invest in R&D to create sustainable chemical products from agriculture and wood waste. This is expected to create employment and reduce resource consumption (B1). Synergies are also found through the use of cascade utilization and coupled production, as well as on the use of biomass for heat and electricity recovery (B2). The expectation is that the industry will increase resource efficiency, reduce reliance on fossil fuels and see an increase in profits as well as production in light of renewed competitiveness.

To conclude, the CE strategy in Central Germany is crafted around the strengths of the region, and aims at increasing competitiveness by reducing production costs. An important synergy, supported by strong political will, is found in the improvement of citizens' well-being. These key strategic areas of intervention introduce new balancing loops that curb known side effects of conventional production processes, and create new opportunities from waste recycling.

Figure 6-4: Causal Loop Diagram - Central Germany



Source: Own elaboration

6.10 Conclusions and lessons learnt

There are many opportunities to implement and push forward a circular bioeconomy transition. Potential ideas, innovations and business models have not yet been exhausted or even developed yet. However, the incentives to push forward strategic change in this direction are weak. There is an attachment to the status quo in the business community and the political framework has done little to overcome vested interests in business-as-usual. That said, positive examples of pilots and demonstrations exist. The regional level increasingly plays a larger role to this end, as it is where innovation happens, and highlights the importance of regional and local policies.

The circular bioeconomy is a concept that is just starting to emerge on the regional, national and European level. Whereas circular economy and bioeconomy concepts have separately become more mainstream concepts alone, much potential for reaching overarching sustainability aims exists by working towards synergies possible within a circular bioeconomy. The region of Saxony-Anhalt appears well suited to experiment, innovate and drive such a transition, which could be replicated in other parts of Germany, the EU and the rest of the world. Evidence points to the Bioeconomy Cluster as having a key role to play in fostering innovation to this end, by bringing different types of actors together to exchange ideas and co-develop visions for business and for the region that are in keeping with sustainability concepts. With over six years of experience, the Cluster has built up a knowledge basis that is valuable for future management and operations. The Cluster's goal to make value networks out of value chains could help to bring the right stakeholders together toward developing both cascades for biomass use and toward circular loops as well as industrial symbiosis processes that help turn "waste" into valuable resources. The efforts of the Cluster to increase their international presence also speaks to high potential not only for international learning, but also for linking regional activities to international efforts to stay competitive toward developing a lead bioeconomy chemical market, potentially as a first step toward fostering a circular bio economy.

Policy must play a greater role in steering such a transition. Currently, different sectors are subject to respective sectoral laws and regulations (e.g. for forestry, agriculture, manufacturing, products, waste management and recycling), which hinders strategic, cohesive and integrated development of a circular bioeconomy. According to Hagemann et al. (2016a) three key changes are needed in the policy framework. First, examination and adaptations are needed across the set of sector-oriented policies to promote circularity in a consistent way. Second, innovative bio-based products must be promoted, e.g. by supporting research and development and the creation of niche markets (through public procurement and awareness raising). Finally, policy frameworks must provide a level playing field for bio-based products, in particular by getting the price of competing, fossil-based alternatives right. Altogether, it can be concluded that much potential exists, but the opportunities must be seized to promote a circular bio economy in Saxony-Anhalt, Germany and the EU. When transferring the Bioeconomy Cluster to

another region, it is particularly important that the policy provides incentives, in addition to the commitment of local companies and networks.

6.11 References

BMBF (2010). Nationale Forschungsstrategie BioÖkonomie 2030: Unser Weg zu einer biobasierten Wirtschaft. Bundesministerium für Bildung und Forschung, Referat Bioökonomie, Bonn, Berlin.

BMEL and BMBF (2014). Bioökonomie in Deutschland - Chancen für eine biobasierte und nachhaltige Zukunft. Bundesministerium für Bildung und Forschung and Bundesministerium für Ernährung und Landwirtschaft, Bonn, Berlin.

Carus, M. and Dammer, L. (2018). The Circular Bioeconomy - concepts, opportunities and limitations. Nova paper #9 on bio-based economy 2018-01.

FNR [Agency of Renewable Resources] (2014): Market- analyse nachwachsende Rohstoffe. Schriftenreihenachwachsende Rohstoffe 2014, 34. Available at: http://fnr.de/marktanalyse/marktanalyse.pdf.

Hagemann, N., Gawel, E., Purkus, A., Pannicke, N., Hauck, J., Köck, W., Ludwig, G. (2016a). Possible Futures towards a wood-based bioeconomy: A scenario analysis for Germany. Helmholtz Centre for Environmental Research.

Hagemann, N.; Gawel, E.; Purkus, A.; Pannicke, N.; Hauck, J. (2016b). Possible Futures towards a Wood-Based Bioeconomy: A Scenario Analysis for Germany. Sustainability 8(1): 98. Online: http://www.mdpi.com/2071-1050/8/1/98/htm.

Hildebrandt, J., Budzinski, M., Bezama, A., O'Keeffe, S., Thrän, D., Jähkel, A. (2015): SUMINISTRO - Sustainability Monitoring Index for assessing regional bio-based Industry Networks. Online: http://www.ufz.de/export/data/2/206874_Ergebnispapier%20AP%203%20und%206.pdf.

Landesverwaltungsamt Sachsen-Anhalt (2017): Abfallwirtschaftsplan für das Land Sachsen-Anhalt. Fortschreibung 2017. Teilplan Siedlungsabfälle und nicht gefährliche Massenabfälle. Online: https://lvwa.sachsen-anhalt.de/fileadmin/Bibliothek/Politik_und_Verwaltung/LVWA/LVwA/Dokumente/4_landwirtschaftumwelt/401/abfall/awp_tp_siedlungs.pdf.

Mantau, U. (2012): Holzrohstoffbilanz Deutschland. Entwicklungen und Szenarien des Holzaufkommens und der Holzverwendung von 1987 bis 2015. Hamburg.

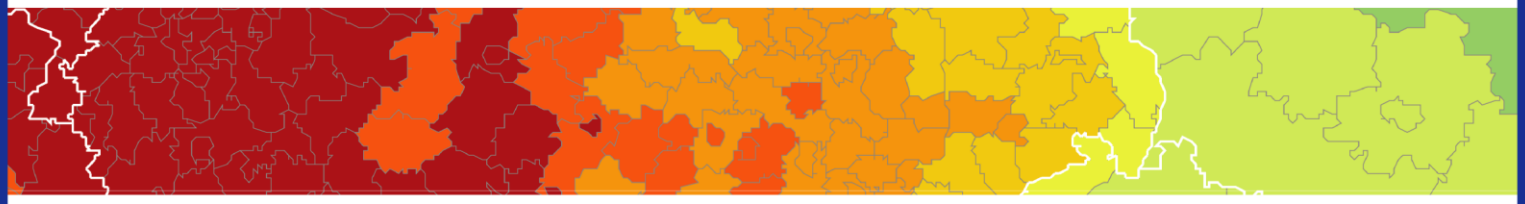
MW Sachsen-Anhalt (Ministerium für Wissenschaft und Wirtschaft des Landes Sachsen-Anhalt) (2014). Regionale Innovationsstrategie Sachsen-Anhalt 2014-2020. Online: https://mw.sachsen-anhalt.de/fileadmin/Bibliothek/Politik_und_Verwaltung/MW/Publikationen/RIS/Regionale_Innovationsstrategie_2014-2020_final.pdf.

MW Sachsen-Anhalt (Ministerium für Wissenschaft und Wirtschaft des Landes Sachsen-Anhalt) and IMG (Investitions- und Marketinggesellschaft Sachsen-Anhalt mbH) (Hrsg.) (2014). REGIONALE INNOVATIONSSTRATEGIE SACHSEN-ANHALT 2014 – 2020. Hier ist Zukunft Strategie. Online: https://mw.sachsen-anhalt.de/fileadmin/Bibliothek/Politik_und_Verwaltung/MW/Publikationen/RIS/Regionale_Innovationsstrategie_Lesefassung_2014.pdf.

MW Sachsen-Anhalt (Ministerium für Wissenschaft und Wirtschaft des Landes Sachsen-Anhalt) (Hrsg.) (2013). Grundlagen einer Regionalen Innovationsstrategie Sachsen-Anhalt 2014 – 2020. Online: https://mw.sachsen-anhalt.de/fileadmin/Bibliothek/Politik_und_Verwaltung/MW/Publikationen/RIS/2013-04-8_Grundlagen_einer_Innovationsstrategie_LSA.pdf.

Thrän, D., Bezama, A., Gawel, E., Purkus, A., Hagemann, N., Köck, W., Ludwig, G., Moesenfechtel, U., Zeug, W., Jähkel, A. (2018). Veröffentlichung der Ergebnisse von Forschungsvorhaben im BMBF- Programm. Spitzencluster-BioEconomy: TG 5, Begleitforschung: Nachhaltige wettbewerbsstrategische Handlungskonzepte und Steuerungsinstrumente des BioEconomy-Clusters in Mitteldeutschland. Schlussbericht.

Umweltbundesamt (UBA) (2014): Regelungen der Bundesländer auf dem Gebiet der umweltfreundlichen Beschaffung. Online: https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/texte_44_2014_regelungen_der_bundeslaender_beschaffung_korr.pdf.



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ESPON EGTC
4 rue Erasme, L-1468 Luxembourg - Grand Duchy of Luxembourg
Phone: +352 20 600 280
Email: **info@espon.eu**
www.espon.eu, **Twitter**, **LinkedIn**, **YouTube**

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