

1.1. Making the Bioeconomy Work – Business Opportunities and Value Chains

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The transition from a fossil-based to a bio-based economy is among the key objectives of the European innovation landscape. It is recognized as a driver for regional competitiveness, high value-added businesses and jobs, and a crucial contribution to the objectives of the European Green Deal.^[2] The shift towards a bio-based economy represents a particular opportunity for the regions of the Alpine Space with its important reservoir of biomass resources and knowledge and technology excellence in the development of sustainable solutions in sectors such as green chemicals, biopolymers or bio-based materials.^[3]

The benefits of reducing dependency on fossil-fuel based resources are manifold and the shift towards bio-based solutions widely accepted as an indispensable contribution to overcoming the environmental and social challenges of the 21st century.

At the same time, the awareness of the business opportunities associated with the bioeconomy is steadily growing within business and industry communities, stakeholders of RDI ecosystems and at various policy levels. At the outset of the European Green Deal, the interest in the bioeconomy and circular solutions has, at least in the European context, reached previously unknown heights – to the point where the term "bioeconomy" is getting in danger of entering the treacherous backwaters

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[2] See, inter alia, the resources published by the European Commission's Knowledge Center for Bioeconomy: https://ec.europa.eu/info/research-and-innovation/research-area/bioeconomy_en

[3] An inventory of capacities for a bio-based economy in the Alpine Space has been drawn up in the different reports produced during the AlpLinkBioEco project and can be downloaded from the project results section of the project website: <https://www.alpine-space.eu/projects/alplinkbioeco/en/home>

As a basis for the AlpLinkBioEco Bioeconomy Masterplan, the most important facts and figures are summarized in chapter 3 of this publication.

of buzzwords, with its business opportunities being reduced to the indisputable advantage the term currently represents in the pursuit of public funding or to facile marketing strategies.

In order to come to fruition, to translate into increased competitiveness of businesses and regions, the business opportunities associated with bio-based solutions need to be understood in a fuller sense. If the "bioeconomy" is to live up to its promises, it is insufficient to be contended with the term as an attractive go-to slogan for research proposals or a fancy selling argument for old wine in new bottles. If the concept is to prove successful as an economic principle (as its terminology suggests), the undisputable environmental and societal benefits of turning away from a fossil-fuel based economy need to be coupled with the potential for value creation at the business level.

Ten years ago, when Michael Porter of the Harvard Business School introduced the concept of Creating Shared Value (CSV), he described the core of the challenge, which now shows to be fully relevant in the context of the European bioeconomy: "A big part of the problem lies with companies themselves, which remain trapped in an outdated approach to value creation that has emerged over the past few decades. They continue to view value creation narrowly, optimizing short-term financial performance in a bubble while missing the most important customer needs and ignoring the broader influences that determine their longer-term success" (Porter and Kramer, 2011, p. 1).^[4] The concept of CSV intends to reconnect "social progress" with "company progress" by addressing societal and environmental needs and challenges "in a way that also [creates] economic value." Instead of overlooking the "depletion of natural resources vital to their businesses", companies should put the creation of shared value at the center of their business operations (Porter and Kramer, 2011, p. 1).

At the core of how value is created lies the concept of the value chain. Economic value is created by economic actors - "businesses" in the broad sense, encompassing the range from one-woman / man operations to large multinational companies. At the lowest level of an individual economic actor, the

[4] Michael Porter and Mark Kramer (2011). *The Big Idea: Creating Shared Value*. Harvard Business Review.

value chain describes a company's "technologically and economically distinct activities [performed] to do business" (Porter, 2011, p. 75).^[5] Actors process inputs into outputs and a business is profitable if the value it creates along this process exceeds the cost of performing the activities. The created value as such is expressed by the amount other economic actors are willing to pay for the company's output. Thus, in order for value creation to exist at all, there need to be at least two economic actors willing to engage in an economic interaction based on shared business opportunities. In this sense, a company's value chain is always embedded in a larger value system of at least two, but typically many more actors and their individual process of turning inputs into outputs. The value system consists of the value chains of a company linked to the value chains of its suppliers and its buyers. Outputs created by economic actors are used by other actors as inputs for additional processes, et cetera.

It is as a designation of this complete value system that the term "value chain" is understood in the context of the AlpLinkBioEco Value Chain generator (VCG) - as a series of complementary activities (input – process – output) of economic actors. To put it simply, such a value chain "exists" when actors are linked together through mutual benefits. In this sense, an established, observable value chain can be considered at the same time as the means to create value, and the demonstration of the technological and economic feasibility of business opportunities.

What to take away from this in the context of the bioeconomy? As discussed above, to make "bio" work in and for the "economy", the undisputable environmental and societal benefits of turning away from a fossil-fuel based model need to be coupled with the potential for value creation at the business level. "Bioeconomy" needs to move from a buzzword to the core of companies' value creation processes as a real business opportunity. What we are looking for, in fine, is the generation of bio-based value chains – value systems of mutually beneficial economic interactions construed around bio-based resources, bringing together actors as diverse as bio-feedstock producers, intermediate processors, product developers, brand-owners, retailers or product end users.

The Alpine Region is indeed recognized as having huge potential for the development of bio-based value chains. But to move from lofty opportunities to action and value creation often turns out to be a complex practical exercise. The implementation challenges are manifold. Traditional ways of operating in a linear economy, where a product necessarily ends as waste, impede alternative, circular end of life solutions. There is a lack of understanding of the natural resources as alternative, unexploited bio-based inputs. In a globalized economy interregional opportunities and solutions based on locally available resources often remain untapped. Due to a missing holistic cross-regional approach many actors in bio-based industries operate in a disconnected mode. To summarize it in the terms of an economist, opportunity for value creation is not realized because of information asymmetries and unexploited positive externalities. As a result, business opportunities for producing high value applications lie idle and value chains that address critical environmental and societal needs, such as ecologic durability, local employment and quality of life remain untapped.

It is precisely the objective of the Value Chain Generator (VCG), developed during the AlpLinkBioEco project under the lead of the Institute of Complex Systems (iCoSys) at the School of Engineering and Architecture of Fribourg, to provide a hands-on, data-driven approach to overcome existing information gaps and to unearth unexploited business opportunities for bio-based value chains. The VCG, presented in further detail in the next section, is a software tool based on natural language algorithms allowing to match actors from a knowledge base into value chains. The VCG knowledge base can be understood as a set of descriptive data ("descriptors") containing information on individual actors dealing with bio-based activities and how they create value (input – process – output), on the business opportunities that link them to other actors, and on their complementarities in larger chains of value creation. The VCG methods, the algorithms applicable to the data of the knowledge base, allow to learn from successful existing value creation processes, to scale up business opportunities and adapt them to new contexts, to discover value chains and expand them through similarities and complementarities between economic actors.

[5] Michael Porter (2011). *On Competition*. Harvard Business Press.

CHAPTER 1

"The Value Chain Generator Tool: Generating Value Chains"

To sum up, the VCG is a tool designed to embed the shift from fossil-fuel-based to bio-based economies into a context of shared value creation, to overcome information gaps and to unearth business opportunities for the generation and expansion of bio-based value chains. In short, it is a contribution to making the bioeconomy work.

1.2. The VCG Tool – Knowledge Base and Methods

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The value chain generator (VCG) is a novel software tool that aims to facilitate the discovery of value chains among actors in the bio-based economy of the Alpine Region. The primary users of the VCG are the stakeholders of innovation ecosystems, companies, researchers, policymakers, but also cluster managers who want to innovate new value chains in collaboration with the actors of their cluster. Both intra-regional as well as cross-regional value chains can be envisaged if data is shared among several cluster managers, as it was the case during

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