

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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Discover the AlpLinkBioEco Value Chain Generator



The VCG Software Tool

<https://alplinkbioeco.tic.heia-fr.ch/>



Web-based Demo VCG

A web-based demonstrator version of the software gives interested parties an insight into the functionalities of the tool, based on the knowledge base built up during the AlpLinkBioEco project. The demo version allows to access all entries of the database in an anonymized format. No real actor names are disclosed and map entries have been relocated randomly. A practical user guide explains the functionalities of the tool.



Personalized Access and Live Version

Until at least April 2023, the live version of the web-based software tool will be hosted by the Institute of Complex Systems at the School of Engineering and Architecture of Fribourg (iCoSys). Project Partners can continue to use the software and expand the database with a personalized access. New users are invited to join the venture with own data. Each user group has access to its own data in the database. Proprietary data of other user groups is anonymized. Nevertheless, all entries of the database indicate the user owning the respective data, in order to facilitate the generation of value chains across regions and clusters.



Source Code

The source code of the VCG software is available under a permissive software license.



Developers and Contact

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the AlpLinkBioEco project.

In the following, we describe the required knowledge base of the VCG, elaborate the methods used for generating new value chains and provide a conclusion and outlook to future work.

The VCG Knowledge Base

In order to create value chains, the VCG requires data about the actors in the bio-based economy. Figure 1.1 illustrates the data used for the proposed method in the form of a pyramid, reflecting the decreasing amount of available data when going from the bottom to the top of the pyramid.

At the "Actors" level, the knowledge base contains publicly available information about the actors, including their name, address, website, type (SME, large enterprise, research organization, ...), categories (agro, chemistry, packaging, wood, ...), as well as several NACE codes. The NACE codes (Nomenclature des Activités Économiques dans la Communauté Européenne) are a European industry standard to describe the activity of a company. Each code is accompanied by a brief explanatory phrase. Typically, only one NACE code is assigned to a company at the time of its formation. For providing the VCG with more detailed information, we have assigned several NACE codes to an actor to reflect different business activities known to the users.

In addition, the knowledge base also contains entries on clusters - groups of connected companies co-locating within a geographic area, and organized in some sort of formal effort (cluster initiative, regional network, etc.) – relevant for the bio-based economy.

The "Descriptors" level contains expert knowledge about the activities of an actor in the form of natural language, i.e. phrases that do not follow a standardized codification, such as NACE, but instead allow experts to use their own vocabulary to describe what inputs an actor receives, how they are processed, and what outputs are produced. An example of a descriptor is provided in Figure 1.2.

Finally, the "Biolinks" level contains concrete links between two actors. What holds value chains together is an indeterminate number of such bilateral interactions between actors ("biolinks") based on shared business opportunities. Biolinks thus reflect business opportunities between two actors, typically based on the output of an actor that can be used as an input for another. The knowledge base allows to document biolinks ranging from simple ideas for potential new business opportunities to established and proven economic interactions between two actors of the knowledge base. In between these two extremes, it allows to record progress and follow-up actions that have been observed while

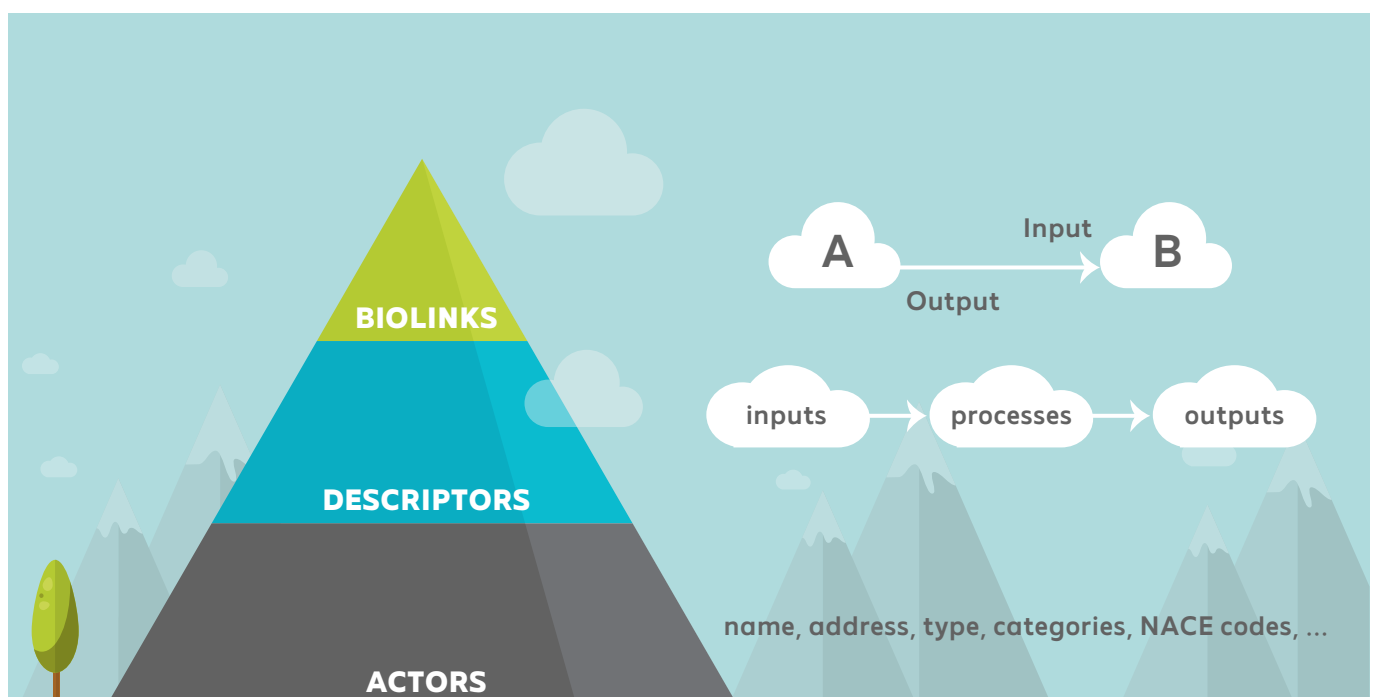


Figure 1.1: The VCG data pyramid

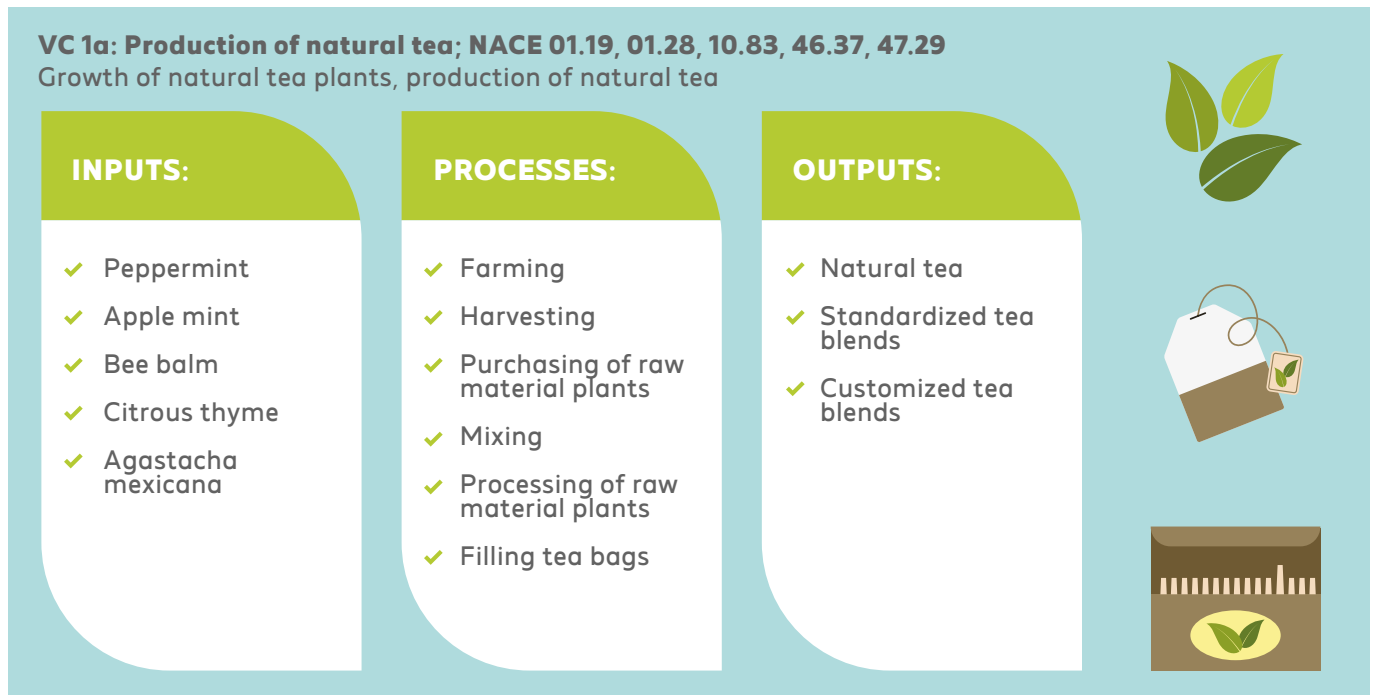


Figure 1.2: Input-Process-Output descriptor of an actor using natural language

working on a particular biolink in the real world.^[3] In practice, business opportunities can prove to be technologically and economically feasible and be validated as a commercial success. But they can also turn out to be completely unsuccessful, or, mid-

way, lead to necessary adaptations of a base idea that is confirmed in principle but requires additional actions to lead to value creation.

The VCG Methods

At the most basic level, the VCG knowledge base can be browsed with different search options to discover and get inspiration from the data gathered in the knowledge base. The lists of actors and clusters are available both in a standard list and interactive map view. The biolink lists allow to browse the documented biolinks, ranging from

[3] Chapter 2 of this publication gives an insight into the real-world experience triggered by the development of the VCG software during the implementation of the AlpLinkBioEco project.

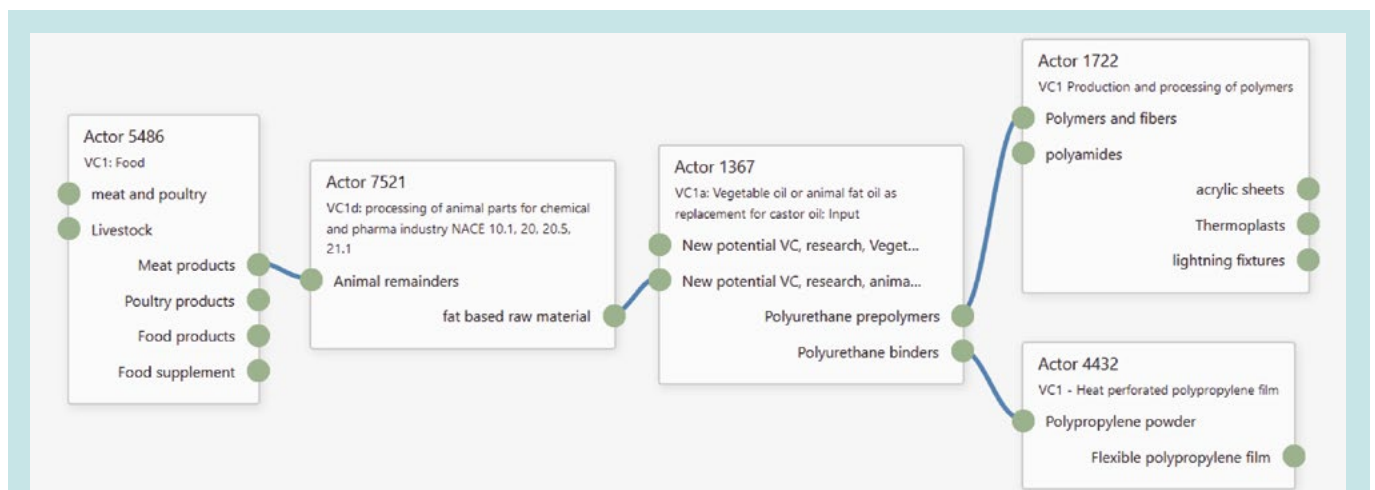


Figure 1.3: VCG interface for creating and editing new value chains

ideas for new business opportunities to confirmed business cases. The biolink lists also include a direct access to the identification of similar actors for which the documented business opportunities might be relevant as well, and that could contribute to scale up the underlying value creation process (see details below).

At a more elaborate level, the VCG provides a graphical user interface for creating and editing value chains in the form of graphs, as illustrated in Figure 1.3.

The nodes of a value chain graph are descriptors from the knowledge base, which have been created for specific actors. Note that the actor names are anonymized in Figure 1.3 for demonstration purposes. The edges of the value chain graph are biolinks based on matching inputs and outputs.

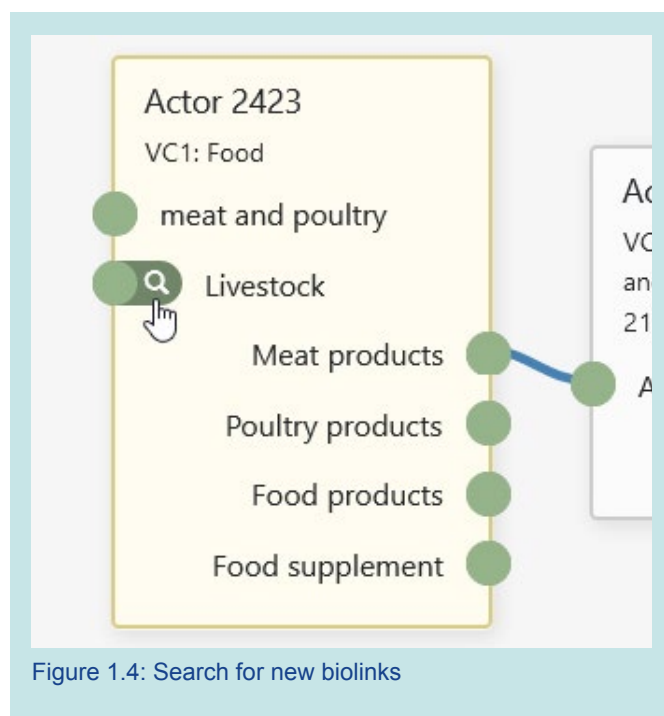


Figure 1.4: Search for new biolinks

Find descriptor with related input

13 descriptors corresponds to the input "Livestock". (Remove this filter)

Actor's name

NACE code

Categories

Regions

ActorTypes

Actor 4277 (Slovenia)

VC1: Food

Inputs:

Whole grain cereals

grains and seeds

Water

Flour

Outputs:

Baked goods

Pasta

Livestock fodder

Actor 0717 (Canton de Fribourg)

VC5, olive oil

Inputs:

olive oil

Outputs:

olive oil

Side stream: filtration cake, high of proteins, food approval

Similarity

Similarity

Close

Add

Figure 1.5: Proposed biolinks sorted by textual similarity

A value chain is a series of complementary activities of economic actors. Actors process inputs into outputs, used in turn by other actors as inputs for additional processes. The VCG interface allows to generate value chains in two steps.

In the first step, the user can expand a value chain horizontally by discovering new biolinks - links between two actors with matching outputs and inputs – and adding ever more actors to the chain. When clicking on an input or an output, a search is performed that identifies matching outputs for an input, or matching inputs for an output. This is illustrated in Figures 1.4 and 1.5.

The search interface lists potentially matching descriptors, sorted according to their similarity with the input or output the user is looking for. Taking into account the fact that descriptors are created using natural language, the similarity reflects a

knowledge base.

In the second step, the user can expand a value chain vertically, scaling up biolink ideas so to speak, by finding actors that are similar to those already

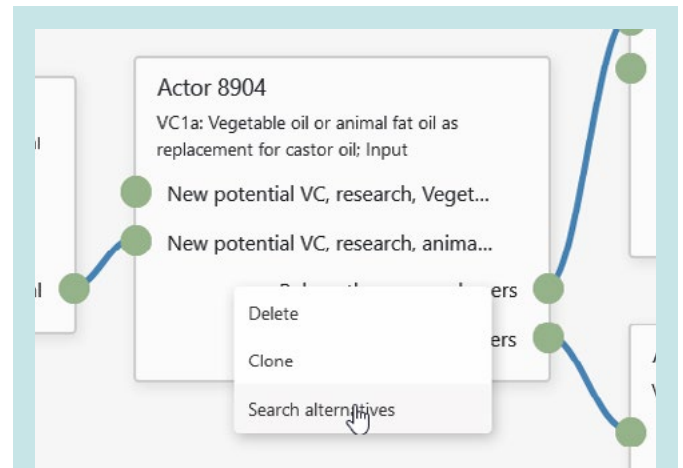


Figure 1.6: Search for similar actors

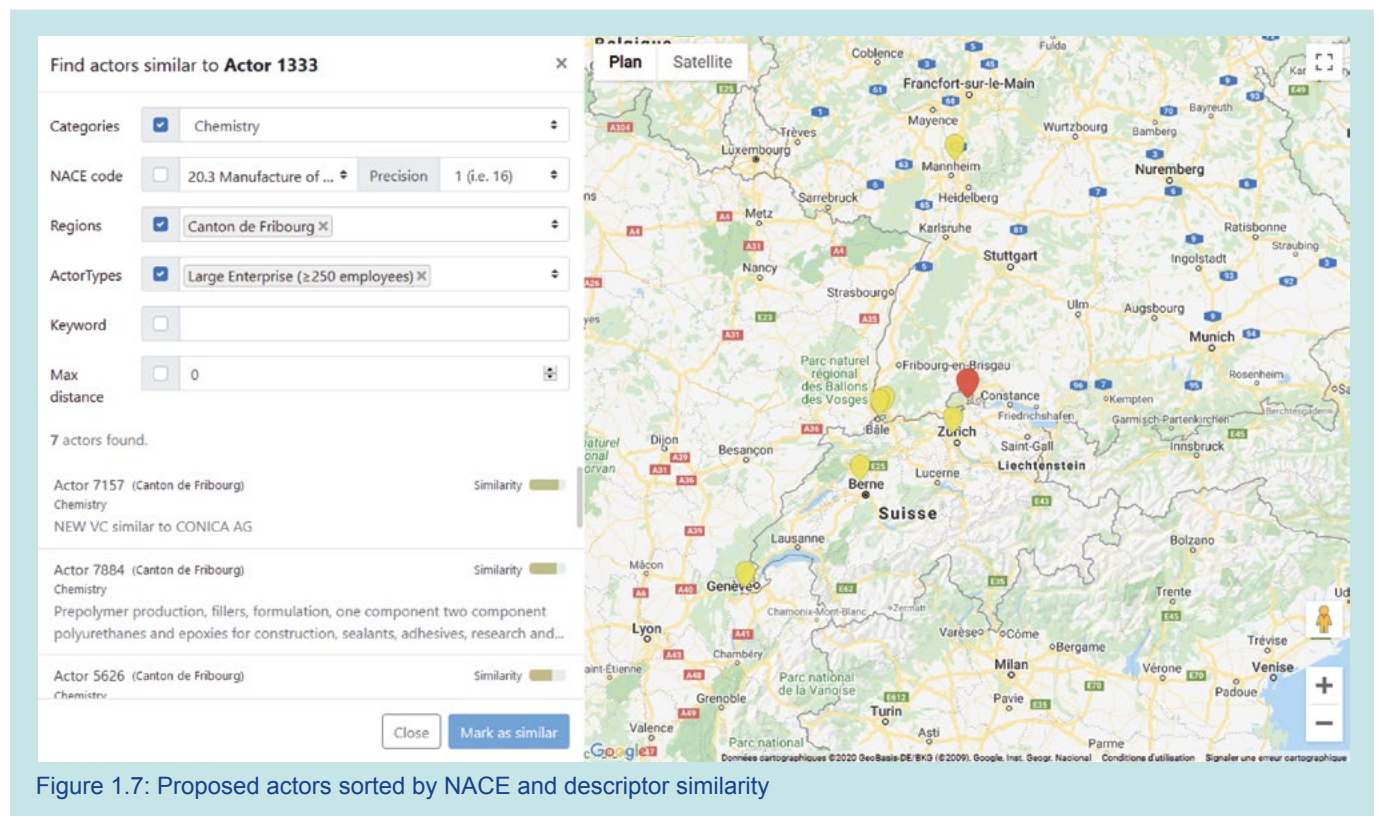


Figure 1.7: Proposed actors sorted by NACE and descriptor similarity

fuzzy match between the terms, e.g. stemming from slight differences in the terminology or typos in the text. Several filters are provided to narrow down the search results, e.g. by NACE codes. By clicking on "Add", a descriptor can be linked and added as a new node to the value chain. Biolinks discovered in this way can be added to the biolink list of the

added to a chain. When clicking on a descriptor, a search is performed to find alternatives that are similar to the actor of the descriptor. This is illustrated in Figures 1.6 and 1.7.

The alternative actors are sorted by similarity. In the VCG, we define the actor similarity as the sum

of the NACE similarity and the descriptor similarity. The NACE similarity is the intersection over union (Jaccard index) of the two sets of NACE codes and the descriptor similarity is cosine similarity between the term frequency vectors of the descriptor texts. The alternatives are displayed on a map and several filters are provided to narrow down the search, e.g. by means of geographical distance. A particularly useful filter is the "keyword search" that does not only include texts in the knowledge base but also searches for keywords on the website of the actor. By clicking on "Mark as similar", the actor is added as an alternative to the node of the value chain graph as illustrated in Figure 1.8. The functionalities of the similarity search are also directly available in the biolink list of the knowledge base.

contexts by changing its knowledge base. There are also several promising ways of further improvement of the VCG methods themselves. For instance, it would be interesting to automatically add actors of a specific region to the knowledge base by means of an intelligent web search. Also, the similarity search between inputs and outputs could be improved by implementing semantic similarity measures in addition to the textual similarity. Finally, an automatic translation or multi-lingual search capabilities would be helpful to apply the VCG in a larger context.

It is hoped that clusters, companies and researchers from different regions and backgrounds will team up in the future to exchange data and generate value chains with the help of the VCG software application.

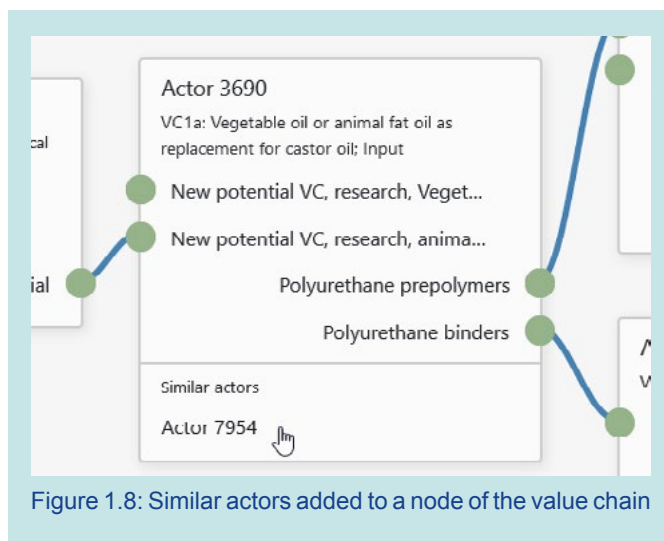


Figure 1.8: Similar actors added to a node of the value chain

Outlook

By using horizontal and vertical expansion, the VCG allows the generation of complex value chains, both intra- and cross-regionally, including several actors that may implement concrete business opportunities. During the AlpLinkBioEco project, several bio-based value chains were indeed successfully initiated in the geographic context of the Alpine Space and based on the specific data gathered during the project on relevant actors related to wood-based and agro-based industries, packaging and chemistry (see chapter 2).

Over and above that, the VCG is a general tool for building value chains that can also be applied to other domains, e.g. to the context of circular economy more broadly, and other geographical