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Deliverable 5.4

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1 Introduction

The BECOOL project aims to develop innovative and sustainable value chains for producing advanced biofuels based on lignocellulosic biomass. An important element of this project is the development of biomass-to-advanced fuel value chains while combining and integrating the different key research activities of the project into a consistent framework. Throughout the project, an integrated sustainability and market framework assessment will help to flag opportunities for an optimisation of the biomass-to-advanced fuel value chains based on economic and environmental criteria and to identify the most promising value chains under current and future market conditions.

Following this approach, the BECOOL Deliverable D5.2 described the current market framework conditions for advanced biofuels in the sectors of road transportation and aviation in the European Union. The overview included in D5.2 presents the potential market size for the development of advanced fuels under the RED II directive framework as well as the potential competitors for the BECOOL advanced fuel technologies. While the discussion of the market size development is an important information for potential investors and the general perspective of technology developments, the later can provide insights into the criteria and important benchmarks, which need to be fulfilled by BECOOL technologies in order to be competitive within the described markets. The description of these benchmarking values and their reflection with the environmental and economic performance of the BECOOL technologies will be subject of the upcoming BECOOL deliverables. However, to complement and deepen the understanding of the current framework conditions and the potential drivers for future changes, this deliverable is focussing on the market players and stakeholders and their positions towards the use of advanced biofuels in the future transport system of the EU.

Figure 1 presents an overview on the different deliverables and their content. WP5 deliverables are organised in order to support a threefold approach, including i) the preconditions for the utilisation of harmonised assessment and data collection methods, ii) the organisation of a concerted assessment approach which is coherent across BECOOL WPs and iii) the development of strategies aiming to support the market implementation of promising BECOOL technologies and value chains.

In this sense, D5.4 is part of the WP5 effort to define the methodological basis for the two following steps of assessment and strategy development.

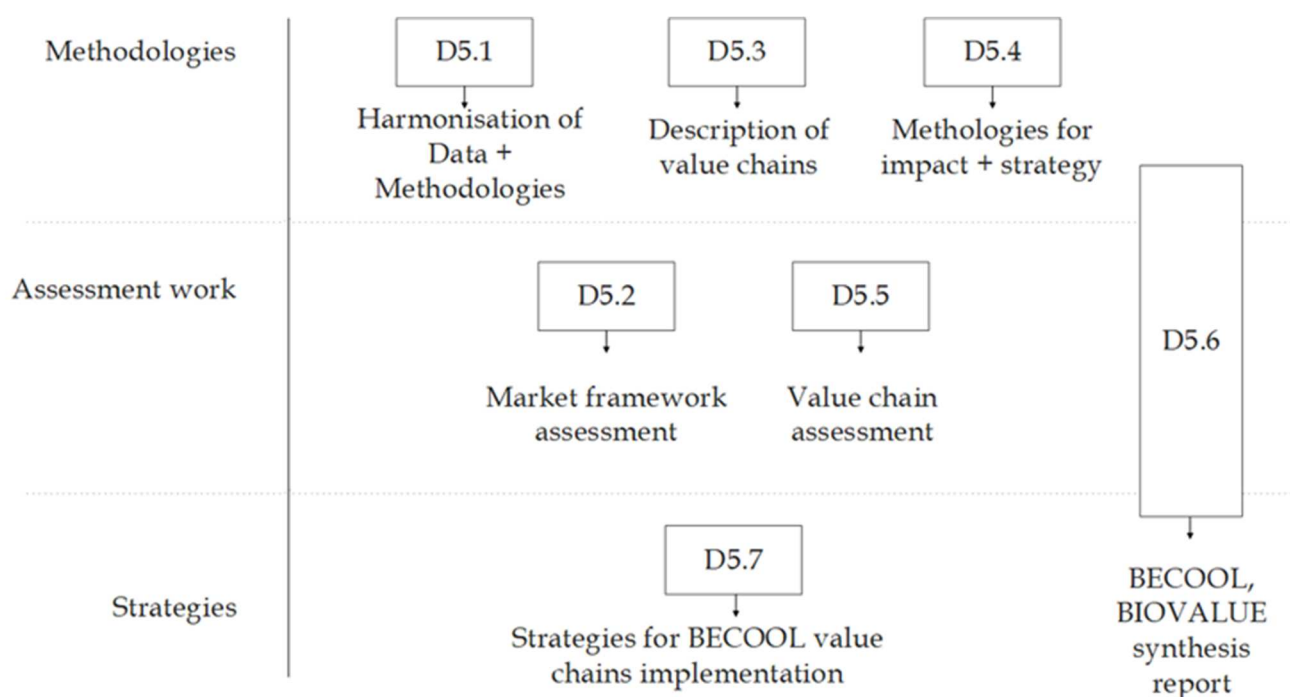


Figure 1 Overview of BECOOL WP 5 deliverables and their content

1.1 Objective and Scope of this Deliverable

The objective of this deliverable is to gain a better understanding of the “big picture” of biofuels for aviation and road transport in the European Union. In order to do so, market mechanism, market drivers and impacts on other sectors as well as market players are studied. Hence, the aims of the deliverable are to:

- (1) develop a methodological approach which could also be used by the partners of the BioValue project with the aim to later compare results,
- (2) get a clear understanding of market players for biofuels for aviation and road transport,
- (3) get a clear understanding of market mechanisms, drivers and impacts on other sectors,
- (4) determine the opportunities and threats for biofuels and the biofuels market,
- (5) develop market strategies based on the insights from (2) to (4),
- (6) provide recommendations for the biofuel market for aviation and road transport.

Insights gained within other tasks (especially from D5.2) of WP5 are considered, as well as insights from the project partners. As this deliverable is two-tiered (the second part of this task will be presented in D 5.7), this first submission focuses on the methodological approach and preliminary results, while the submission at the end of the project presents the overall results and provides strategies and recommendations. Hence, the focus of this submission is to:

- (1) describe the methodological approach and how this tasks fits within the overall scope of WP5
- (2) describe the options for collaboration with the BioValue consortium
- (3) provide preliminary results

2 Methodological Approach to Market and Player Analysis

The methodological approach, which was chosen for data collection and analysis, is results oriented and aims to study the different aspects of this deliverable with the most suitable methods. When developing the methodological approach, it was considered what input data is available or will be made available from other deliverables of the same work package, which data needs to be collected as part of this deliverable and where insights and inputs of the BECOOL partners are necessary.

Figure 2 shows the overall methodology including inputs and the desired output.

A four-step approach is taken:

- (1) the different players of the biofuel market for aviation and road transport are mapped and later divided into share- and stakeholders as well as categorised.
- (2) Porter’s Five Forces Analyses are utilised to study the biofuel market from different angles with the aim to determine market opportunities and threats.
- (3) This data is then incorporated into a SWOT analysis with the overall aim to
- (4) develop strategies for the biofuel market. For strategy development it is essential to integrate both, internal and external factors, which are summarised in SWOT (Bell und Rochford 2016). In this case, (2) provides the external factors, while the internal factors are added are derived from D5.5 and added within the SWOT analysis of (3).

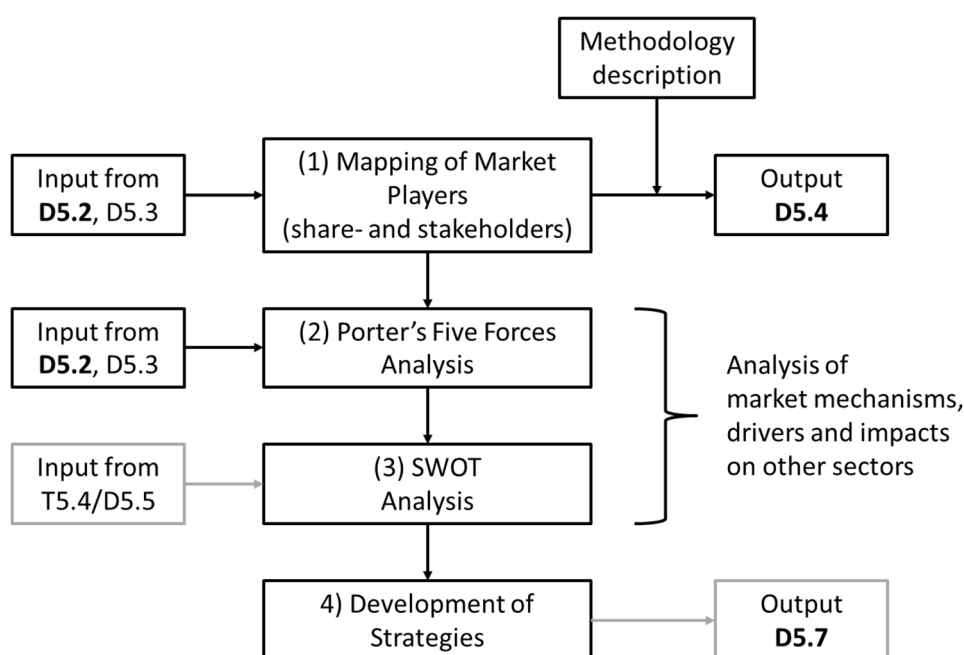


Figure 2 Methodological approach to market and player analysis
black: methodology & existing inputs, grey: future input/output

The analyses distinguish between biofuels for aviation and road transport where necessary. Based on differences in policy (see D5.2), aviation and road transport are analysed separately. The primary geographical focus is the European Union; however, market players outside Europe or the European Union are also

considered if they are crucial for the market as a whole or have a significant influence on the European market for biofuels.

2.1 Market Player Analysis

Prior to studying a market and its mechanisms and drivers, an understanding of the different players within this market needs to be established (Fawzy und Componation 2014). This is accomplished through mapping the market players. Initially, market players of the biofuels for aviation and road transport industry were collected through a brainstorming session of the DBFZ research team and collected in a mind-map. A mind-map can be seen as an useful method to provide an overview about complex structures (Çoban und Selçuk 2017). The created mind-map is not intended to be exhaustive but instead provides a starting point for further analysis. All partners are given the opportunity to add to this mind-map. Based on this mind-map, the different market players were categorised and differentiated into share- and stakeholders. As this process is iterative, it is possible to add market players later on in the process even though they were not considered initially.

2.1.1 Market Player Categories

Five categories, based on the initial mind-map and insights from other projects as well as literature (Fawzy und Componation 2014), help to further analyse and cluster the different market players. This differentiation into categories helps to understand the influence certain share- and stakeholder groups have on the industry and the biofuel market.

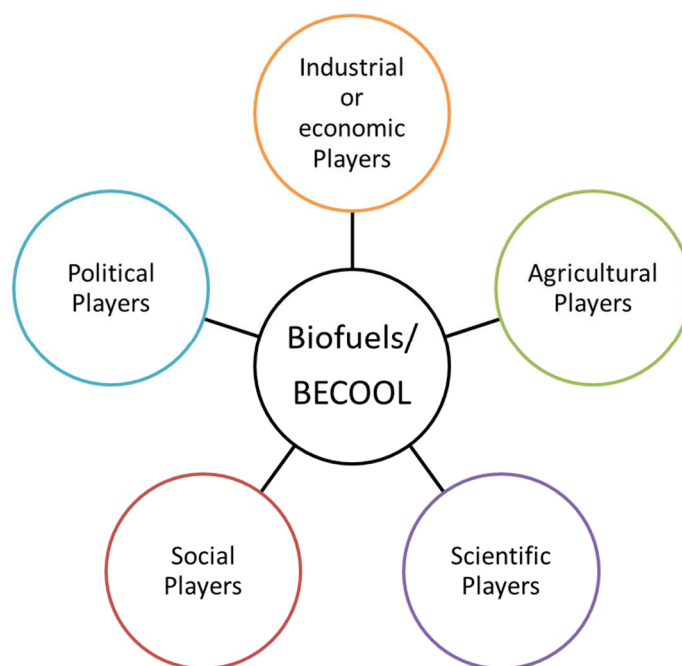


Figure 3 The five categories of market players

2.1.2 Share- and Stakeholders

Besides being categorised, the players are differentiated into either share- or stakeholders. This may influence the impact they can have on the market as their stake in biofuels varies. Everybody who has an interest in biofuels is considered a stakeholder. This group of players can show an interest in biofuels or in any parts of their value chain (Schillo et al. 2017). Opposed to having “only” an interest, shareholders have a financial share

in the matter studied – here biofuels – or an aspect of the accompanying value chain (Boeger 2018). Differentiating between share- and stakeholders can help to guide the analyses of market influences, drivers and the impact a player may have on the market, as a shareholder, based on their financial share, can often more drastically affect a market (Ruf et al. 2001).

2.2 Porter’s Five Forces & Industry Impact

Once the share- and stakeholders for the matter in question – biofuels and their market in the European Union – are established, it is necessary to understand the interactions and dynamics between them and, based on that, dynamics of the market as a whole. Porter’s Five Forces is a framework commonly used to better understand an industry by considering factors that drive market competition and with it the success of the studied industry. Figure 4 visualises the Porter’s Five Forces framework, indicating the four external forces (new entrants, suppliers, substitutes and buyers) and the internal force of market rivalry (Lee et al. 2012). The market rivalry is often driven by a set industry benchmark (e.g. fuel standard, policy framework: REDII, GHG-abatement costs); hence, the grey box “industry benchmark” was added (Wu et al. 2012).

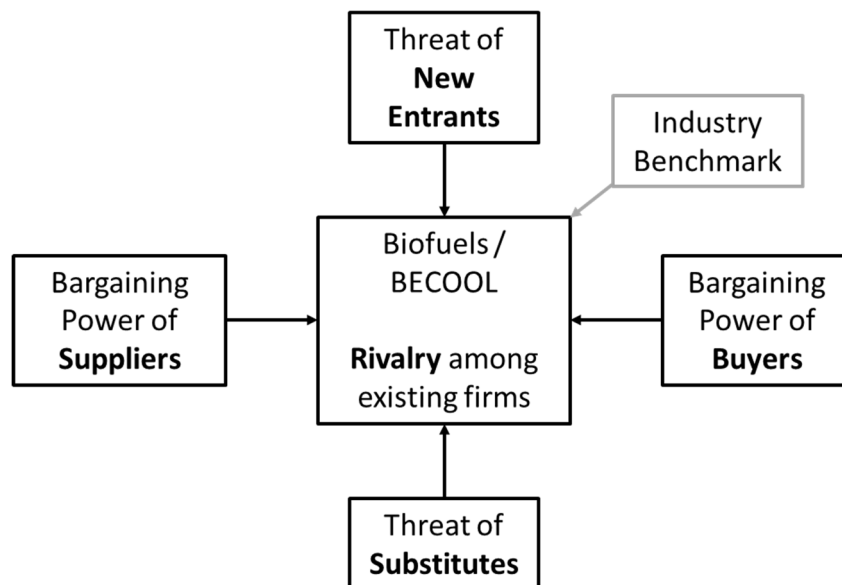


Figure 4 Porter's Five Forces Framework (based on Grant and Jordan, 2012)

As Figure 4 already indicates, the industry needs to be selected prior to the analysis as this influences who and what the other forces of competition are. Within this Porter’s Five Forces analysis, actually four analyses will be conducted. First, biofuels as a whole are studied. Here, biofuels are considered one industry among the entire energy/fuel industry. Secondly, BECOOL and its conversion technologies is considered as one sub-industry within the broader biofuel industry. Distinguishing between the two will lead to insights regarding the role of biofuels in the energy/fuel mix overall as well as the importance of BECOOL within biofuels. Secondly, within each of these two industry definitions, a differentiation between aviation and road transport is necessary (see D5.2) because of the different policy and market frameworks. This leads to four separate analyses, which will later be considered for strategy development.

2.3 SWOT and Strategy Development

A SWOT analysis in the first instance is a mapping of the internal strengths and weaknesses as well as the external opportunities and threats of a product, an organisation or an industry (Bell und Rochford 2016). Paschalidou et al. (2016) show that a SWOT analysis can be a helpful tool to study dynamics in the biofuels market by applying it to the regional context of Greece. Their works shows the importance of setting the boundaries for an analysis, hence, here the focus of this SWOT analysis is biofuels based on BECOOL technologies with a regional focus on the European Union. The external opportunities and threats are derived from the four different Porter’s Five Forces analyses described in Chapter 2.2 while the internal strengths and weaknesses are obtained from D5.5 (description of the most promising value chains). However, a SWOT analysis itself does not allow strategy development. Therefore, by utilising the results of the preceding SWOT analysis, a TOWS matrix can be developed for defining targeted strategies (Gottfried et al. 2018). In a TOWS matrix, the external factors are matched against the internal factors to allow the development of suitable strategies, as illustrated in Figure 5.

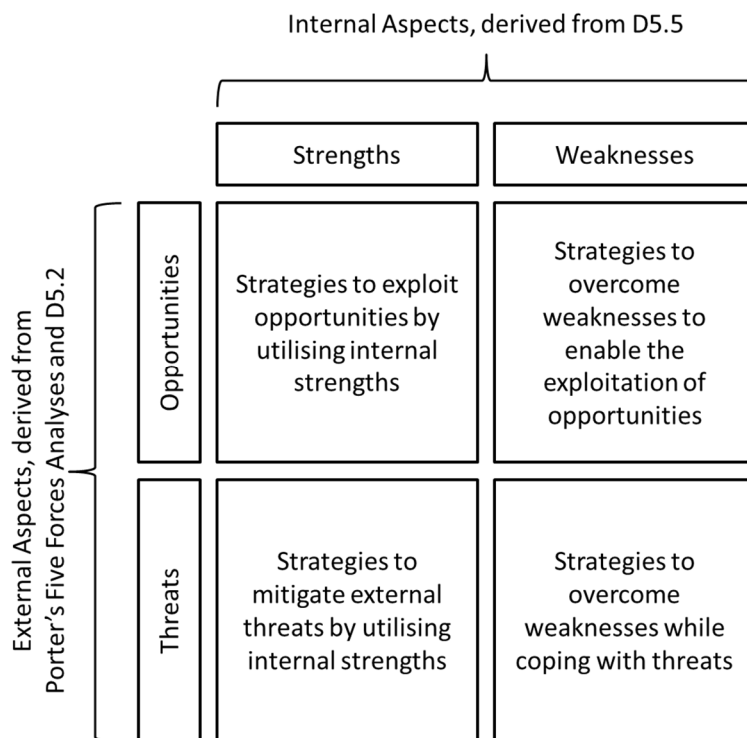


Figure 5 TOWS Analysis for Strategy Development

It is the aim of the final version of this deliverable to provide suitable strategies which can guide the decision making process of governing bodies and policy makers with regard to biofuels and BECOOL biofuels in particular.

2.4 Collaboration with Brazilian Partners of BioValue

The methodological approach described in the previous chapters is a clearly structured systematic approach to gain a better understanding of market mechanism and to develop strategies for biofuels and BECOOL biofuels in particular. This approach was selected as it can be transferred to different regional context and also guide the market analysis work of the BioValue consortium. This transfer helps to later study how the work of

the two consortia / projects influences each other and whether there may be any competition of BECOOL and BioValue. Furthermore, the results can be compared to not only enable the derivation of specific strategies in the European and Brazilian contexts but also enable cross-regional strategy development to support the market uptake for biofuels. A workshop to discuss the transferability and application of this methodological approach is anticipated to take place at the next BECOOL and BioValue project meeting in December 2019.

3 Preliminary Results

The preliminary results focus on the market player mapping and analysis. As Figure 3 already shows, the players being part of the researched market can be differentiated into five categories: industrial or economic, agricultural, scientific, social and political players. Giving the preliminary nature of these results, market players are not mentioned by name but are summarized through subcategories. The starting point for the categorisation was the mind-map presented in Figure 6, which shows relevant actors of the biofuel market. Therein, they are not listed in a specific order or grouped according to their importance; also, the mind-map makes no claim to completeness.

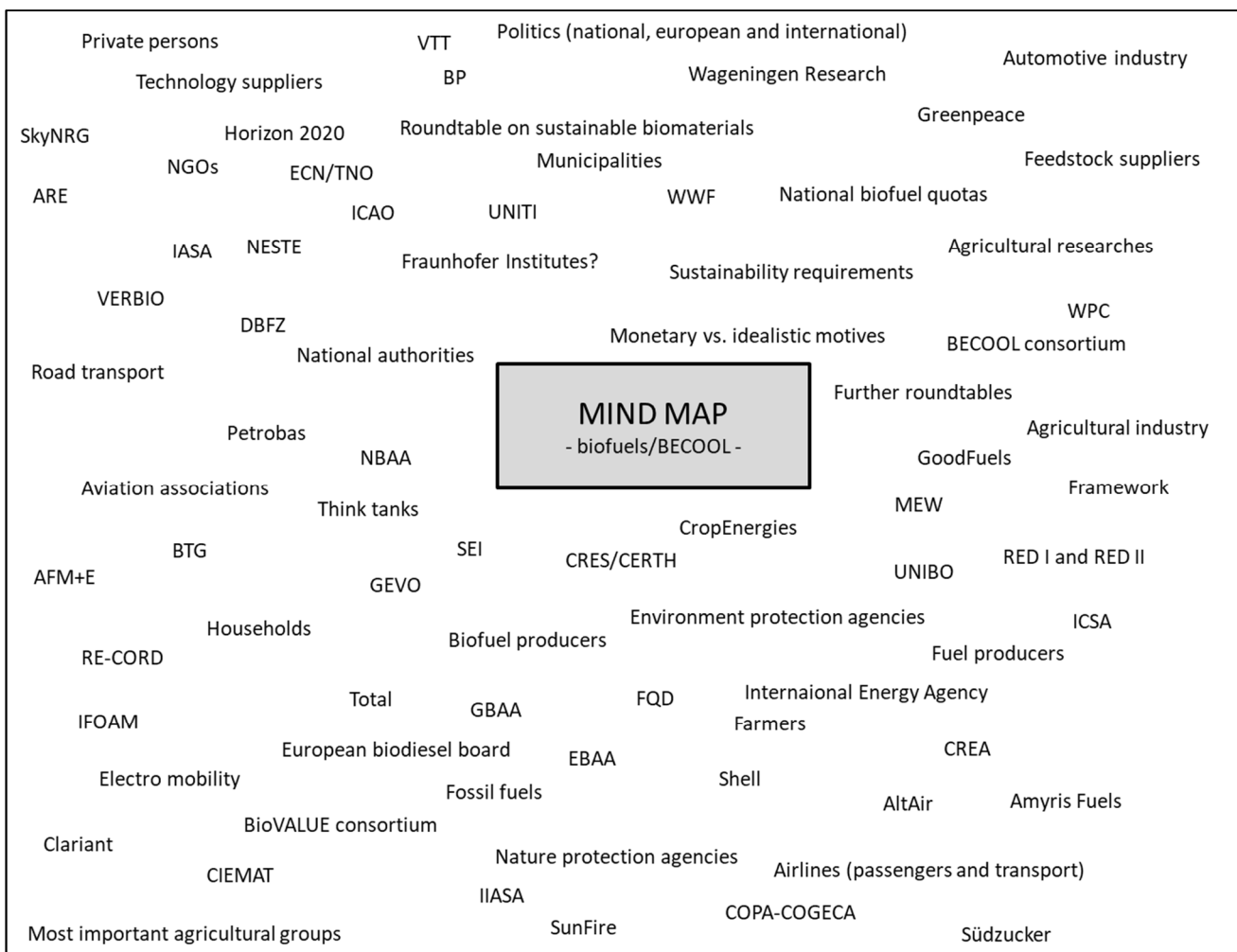


Figure 6 Mind-map of biofuel/BECOOOL market players, standards and influencing (legislative) frameworks

Based on this mind-map the market players are categorised as follows:

The first category represents industrial or economic players. This category summarises a broad variety of share-and stakeholders. This category can be organised in different ways to prepare for the Porter's Five Forces analyses. Firstly, this category includes players which are part of the biofuel or BECOOL value chain while competing industries or producers of alternative, or fossil fuels are also considered here. The latter will later have a strong market influence in regard to power of competitors or substitutes. Secondly, a distinction can be made between individual organisations and associations. In many cases, the individual organisations in this category represent the players along the biofuel value chain and hence are shareholders. Some partners of the BECOOL and BioValue consortia are part of this sub-category. Associations can either be supportive of biofuels and their application, e.g. representing biofuel technology providers or end-consumer groups, such as aviation or road transport, or opposing associations, such as associations of the petroleum industry. While some associations act on regional, national or EU level, other, especially for aviation, operate on a global scale which is subject to the nature of the organisations and the geographic focus of their core business. Furthermore, within aviation, it may be necessary to distinguish between freight and passenger transport, as these sectors within aviation may have different interest in and drivers for the application of biofuels. While this rather global perspective and influence exists for aviation, road transport often receives much more national attention. As for road transport, players of the automotive industry also need to be considered within this category as they provide the product which utilises the biofuels for different types of road transport (e.g. individual, freight and communal such as buses). Furthermore, financial institutions such as banks or are part of this category as they often provide the finances or financial services enabling the market access of biofuels. Finally, other industries, such as the food industry or waste management organisations, also need to be considered part of this category, as they can influence the availability of feedstock, as it may be a by-product of core processes or its provision is in some sort of competition with other goods and services from these industries. This sub-category of industrial or economic players is hence closely linked to the next category.

The second category summarises different kinds of agricultural players. As with industrial or economic players, here a distinction needs to be made between the individual organisation and associations representing interest of a selection of organisations. The organisations and association of this category represent the feedstock suppliers and their interests. The primary geographical focus of these players is the European Union; however, considering intra-European and international trade markets for lignocellulosic biomasses and residues, players from other regions or global players are part of this category. Hence, if transport, logistics, and the overall prices for the feedstock are within financial reason for their application, supplier selection may not be limited by the boundaries of the EU and leads to the consideration of many more market players. Furthermore, the power and influence of large agricultural associations will be later considered within the Porter's Five Forces analyses, as these can shape the overall market dynamics. Associations often consider aspects such as promoting farmers' rights, or the sustainability of agriculture while optimising cultivation. These aspects can directly influence the availability of a feedstock and with it the willingness to sell.

The third category describes political players and with that their policy instruments. As the geographic focus is set on the European Union, the political focus also resembles this. In terms of political and policy elements, the Fuel Quality Directive (FQD) as well as the Renewable Energy Directive (RED) and its successor (REDII) strongly influence the market for biofuels as they provide the overall framework and an initiative (e.g. in terms of climate targets) to venture into this industry. Besides the EU legislation, their translation into national quotas, regulations and legislation is also considered an aspect of this category. Furthermore, standards and regulations by third-party organisations (e.g. ISO, ICAO or IATA) may be considered within this category. Even

though they are not political policies in their traditional sense, they provide an overall (binding) framework for the market players. The here mentioned policies and regulations were analysed in depth in Deliverable 5.2.

The fourth category is called social players. This category includes all players which do not fit any of the other categories and which may have a diverse impact on the biofuels market. Firstly, non-political players which inform political decision making processes are included in this category. This includes environmental and other lobbyist groups or non-governmental organisations (NGOs). Apart from environmental NGOs, think tanks, associations and institutions focusing on different aspects of environmental protection or sustainability are considered within this category. Besides the group of players influencing the political category, certain end-consumers are placed here. Depending on the nature of the biofuel, this group of end-consumers can be diverse. Considered are members of the general public who may use airplanes or road transport as a matter of transportation and municipalities (e.g. for communal road transport/buses). The latter may also play a role in regards to local business development and establishing a supportive environment for players from the industrial or economic and the agricultural categories. Municipalities could also be considered feedstock suppliers, e.g. for municipal green waste or sewage sludge.

The fifth and final category is scientific players. This category summarises academia, research institutions and other organisations conducting research in the field of bioenergy and biofuels. Furthermore, organisations conducting research in the areas of (bio)energy and the environment, sustainability as well as political science and supply chain and logistics research may be considered here. The research may focus on one application of biofuels, in this context road transport or aviation, the role of biofuels within the broader context of the bioeconomy or the energy system or a certain technology. The scientific partner institutions of the BECOOL and BioValue consortia can be considered such players. This player category has a rather high interest but does not directly shape the market. Instead, they influence or inform other player categories who have a direct influence or financial share, e.g. policy makers or technology providers. This way, research institution can have an indirect impact on market development processes.

In some cases, organisations cannot be placed in one category alone. This is often the case for larger organisations with different core businesses, e.g. industry and agriculture, or when an organisation conducts technological research with the aim to eventually provide that technology at commercial scale. Additionally, it became apparent that the individual categories highly influence each other and that different players have different interest, financial or otherwise. These relationships of players within categories and across categories as well as their different levels of interest will play a crucial role in the Porter's Five Forces analysis to better understand the resulting market impacts and dynamics.

Furthermore, a distinction into share- and stakeholders can be made. Every player or categorisation of players previously mentioned is considered a stakeholder as they have an interest (positive or negative) in biofuels in general or BECOOL in particular. In addition to having an "interest" or "stake", shareholders also have a "financial stake" or "share". Shareholders in this context are (potential) feedstock suppliers, suppliers of technology solutions and logistics concepts as well as the biofuel conversion plant owners and operators. On the down-stream supply chain, anyone purchasing a biofuel and/or its by-product can be considered a shareholder. This includes operators of petrol stations and fuel service providers, organisations (aviation as well as road transport) which purchase biofuels as well as private car owners. Investors also are considered shareholders, as they may not actively handle the product (here biofuel) but provide the finances to implement and maintain the technology.

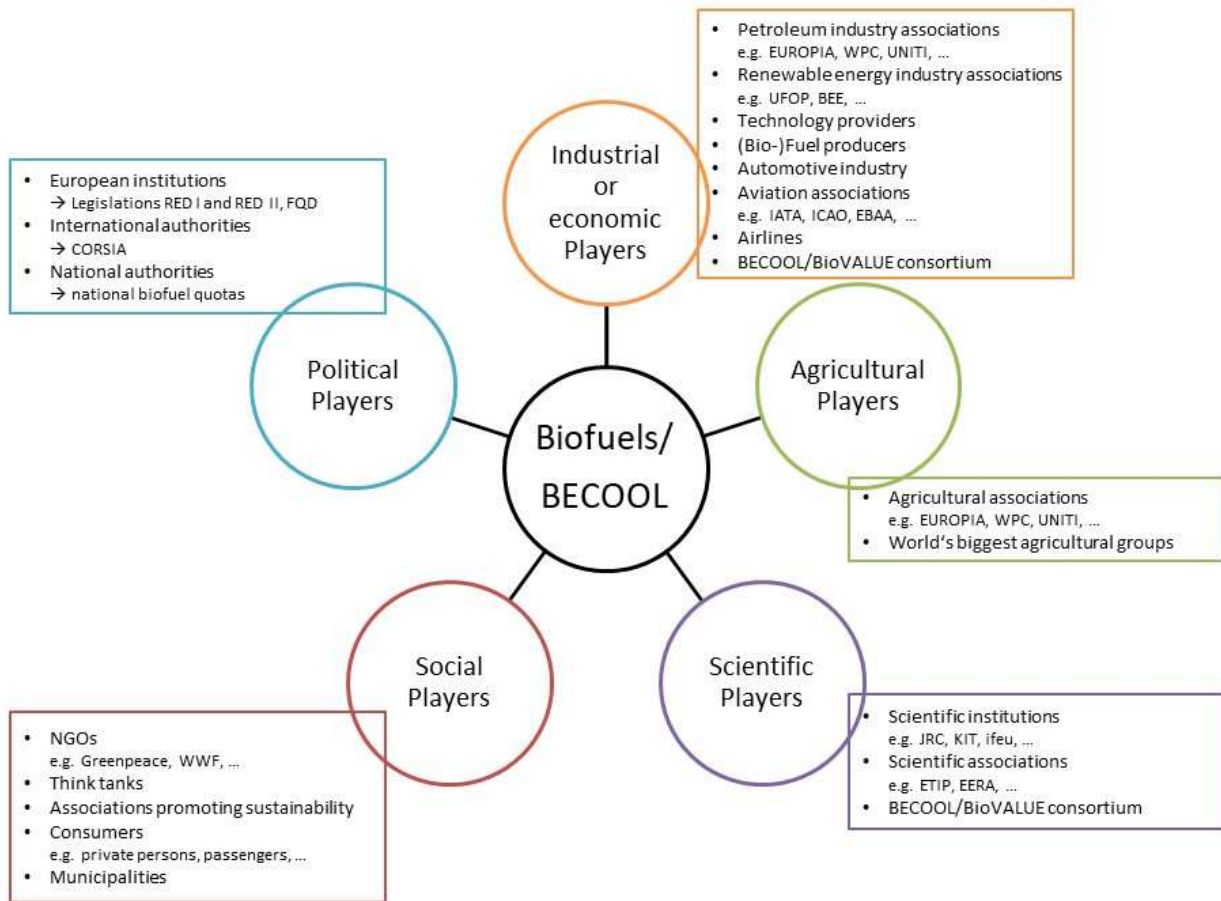


Figure 7 Market player categories and selection of subcategories and individual players

Figure 7 visualises the previously described categorisation of market players. It illustrates how the unstructured market players from the mind-map in Figure 6 can be organised in the five categories and different subcategories within. Even though the figure names some concrete market players, there is no claim to completeness. The players may change or shift categories or can be part of two different categories. A prime example for the latter is the BECOOL consortium itself, which has primarily a research interest and hence classifies as a scientific player but organisations within the consortium, e.g. the technology developers, may have a more industrial or economic interest, hence are represented in that category as well. These first insights regarding categorisation, share and stake of players and player categories feed into the influence illustration of Figure 8.

Based on the work of Fawzy und Componation (2015), the following relations and influences between the different stakeholders can be derived. Figure 8 shows how the players may interact, without considering the power or impact the individual player may have. When conducting the Porter's Five Forces analyses, the power or impact of the individual market players will be considered to gain a better understanding of the market dynamics overall and the influences of the individual player(s).

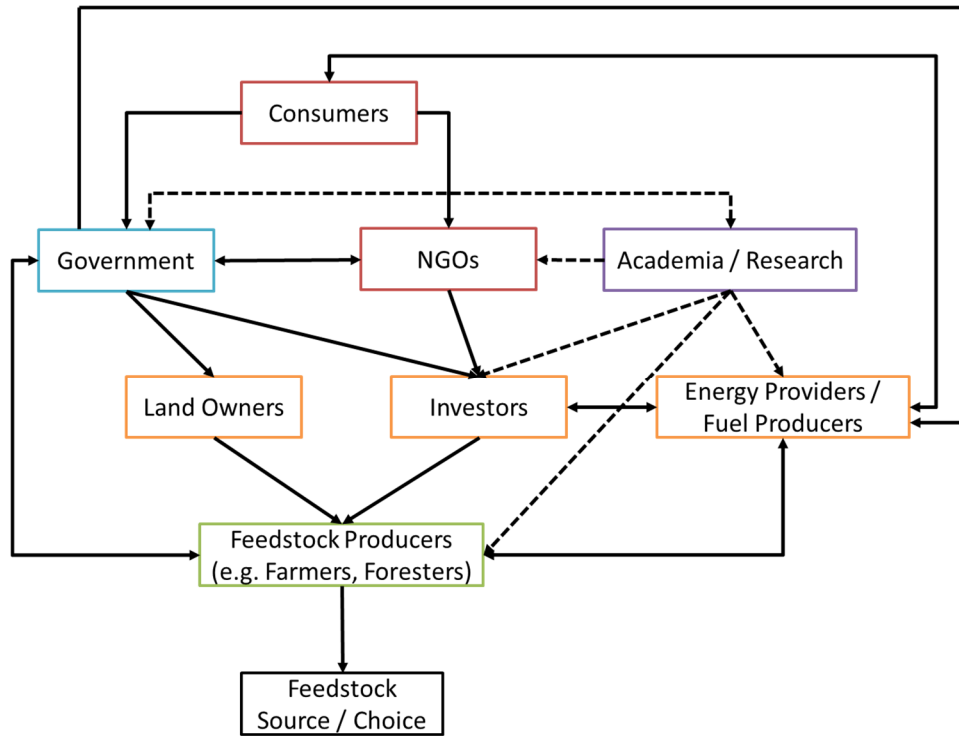


Figure 8 Influences of Market Players (adapted from Fawzy und Componation, 2015 and based on the preliminary results)

4 Proof of Concept and Outlook

Chapter 3 provides the preliminary results and demonstrates the successful application of the methodology. Hence, a proof of concept is provided illustrating that the combination of market player mapping, Porter’s Five Forces and SWOT helps to gain a thorough understanding of market mechanisms. Until the end of the project, the Porter’s Five Forces analyses will be conducted; furthermore, the input from D5.5 and the external factors derived from Porter’s Five Forces, strategies for biofuels and BECOOL fuels in particular will be derived, while considering developments in the coming months. Finally, based on the collaboration with the BioValue consortium, a comparative analysis of the Brazilian and European market mechanism can be conducted.

Figure 9 illustrates the upcoming tasks and relates them back to the project time line. Hence, it provides a comprehensive overview of the upcoming workflow for Task 5.3.

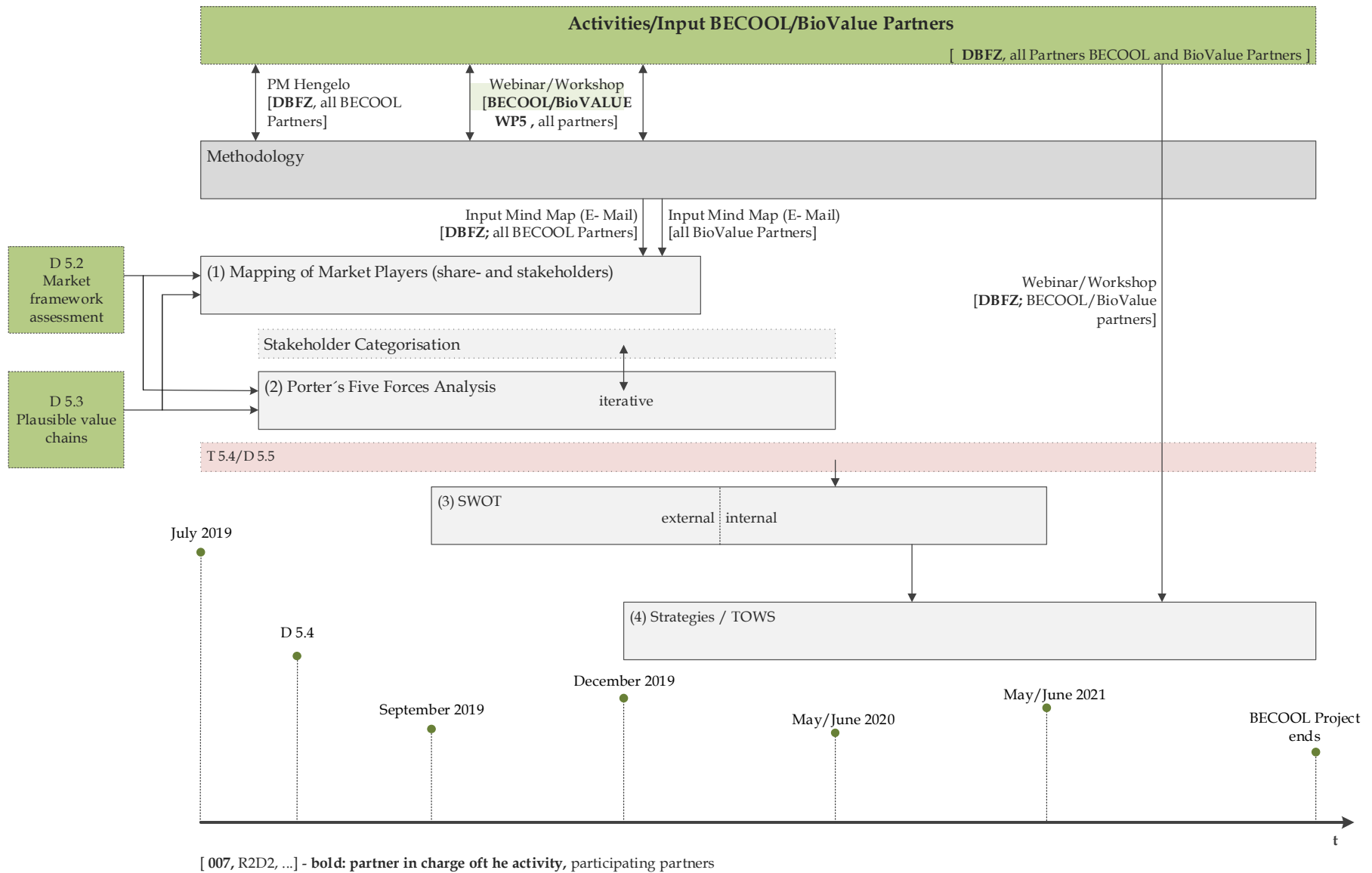


Figure 9 Workflow of Task 5.3

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