Bachelor Thesis
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Certification of biofuels within the Directive 2009/28/EC:

A comparative analysis of certification schemes

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Abstract:

The climate change is one of the biggest challenges on the global agenda. Renewable energy and especially bioenergy is seen as promising option to cope with the global climate change. Simultaneously concerns about negative environmental impacts have increased, connected to the global increase in biofuel production and trade. In 2009, with implementation of the Directive 2009/28/EC, the European Union underlined the necessity to monitor and assess the impacts of biofuel production and created a harmonized legal basis for certification of biofuels. Certification of biofuels via private voluntary certification schemes has become one of the most important tools to move towards sustainability in this sector. Today numerous different private voluntary certification schemes have been developed. This thesis provides a detailed comparative analysis of three different voluntary certification schemes and argues that certification of biofuels, in the current state is a key tool to ensuring sustainability in the biofuel production, which needs to be further improved.

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1. Part I: Introduction

This chapter shall provide a general overview of this thesis. The preamble within part 1 introduces the reader to the general context and background, while section 1.2 explains the objective of this work and is finalized in section 1.3 through the main research question and the associated sub-questions.

1.1 Preamble

One of the biggest challenges on today´s global agenda is the climate change and global warming, causing environmental problems on a great scale. In the last decades, all over the globe, attempts have been made to counteract this threat, caused by the massive use of fossil fuels in the last century, releasing greenhouse gas (hereafter: GHG) emissions into the atmosphere.

Energies from renewable sources, especially biofuels, are seen as a promising alternative to conventional fossil fuels. The expectations towards renewable energies are high, as they are considered vital to facilitating the shift `[…] from the current carbon-intensive economy to a modern and competitive low carbon economy in the near future´ (Romppanen, 2013a, p. 1).
Main drivers of this shift, especially in favor of biofuels, are major contributions towards GHG emission savings and are assumed to have potential advantages on the carbon footprint as a substitute for fossil fuels (Gamborg, Anker, & Sandøe, 2014, p. 326; Meyer & Priess, 2014, p. 151). Especially in the transport sector, biofuels take an essential part to achieve climate change mitigation aims, not only within the European Union (hereafter: EU) but also on a global scale (Eurostat, 2015b; Linares & Pérez-Arriaga, 2013, p. 166). Within the borders of the EU, particularly the demand and production for biofuels in the transport sector is continuously increasing over the last decades (Eurostat, 2015a). The transport sector constitutes for one `[…] third of all EU energy and is responsible for 25% of the European greenhouse gas (GHG) emissions´ (Linares & Pérez-Arriaga, 2013, p. 166). McBride et al. (2011, p. 1277) state that the renewable energies sector is `[…] expected to expand in the coming decades […]´. The citation before underpins the assumption, towards a positive trend on the global market and indicates that the demand and production of biomass feedstock, needed for the production of biofuels, is likely to increase in the near future.
Besides the intention to reduce GHG emissions, energy security also plays a role in the development process, regarding renewable energies. As a substitute for conventional fossil energy sources, renewable energies, especially biofuels, are seen as a solution towards the energy supply

security through diversification of the energy supply (Meyer & Priess, 2014, p. 152). Potential threats to the energy supply security of the EU are for example, international conflicts, as visible in the Ukrainian crisis (taz, 2014) or simply the fact that fossil fuels are physically limited.

This raises the question, where the necessary amount of biomass feedstock should come from and under which condition the biomass is produced, in order to satisfy the increasing demand, especially in terms of sustainability. The EU, with its limited territory, is incapable of supplying the demand for biomass on its own territory. According to Ponte and Daugbjerg (2015, p. 105), around 40% of the biomass feedstock need to be covered by imports. These imports are necessary, to supply the demand of biomass feedstock in order to substitute fossil fuels. In consequence the global trading volume and especially imports of biomass by several Member States of the EU will increase, as `[…] a necessary precondition for meeting the self-imposed targets´ (Jinke van Dam et al., 2008, p. 750). Either the biomass feedstock needs to be imported from other Member States or alternatively from areas outside the EU territory. Increasingly, the countries of the southern hemisphere produce and export biomass feedstock, since they possess the necessary fertile cultivable land, favorable climatic conditions for the cultivation and low manufacturing costs.

Nevertheless, the increase in biomass production, use and trade is not only connected to positive effects. After the initial upswing in the renewable energies sector, doubts regarding the positive effects of bioenergy increasingly arose and led to a controversial debate about the sustainability of this form of energy. According to Buchholz, Luzadis, and Volk (2009, p. 86) `[…] the use of biomass does not automatically imply that its production, conversion and use are sustainable´.

Within sustainable development, renewable energies are a promising option, in order to meet the needs of future generations in terms of energy supply security and ecological sustainability, but with limitations. These limitations are formulated into negative consequences, triggered by biomass feedstock production. In order to deal with these challenges, good governance is a necessity, to deal with these negative effects. As Gamborg et al. (2014, p. 326) state: `the sector needs to be steered and regulated in a way that maximizes claimed benefits, such as climate change mitigation, and minimizes any negative impacts, […] and all this must be done in an efficient, fair and transparent manner´.

One attempt, on a legal basis, to safeguard sustainability and thereby to respond to key environmental and social concerns, is the `[…] widely perceived need for the regulation […]´ (Lin, 2012, p. 44).

According to Levi-Faur (2011, p. 9):

`[…] regulation is the promulgation of prescriptive rules as well as the monitoring and enforcement of these rules by social, business, and political actors on other social, business, and political actors´.

The EU was one of the first, committing to cut the GHG emissions significantly in the near future and to take legislative measures in form of mandatory and non-mandatory sustainability requirements. These were established together with sustainability criteria, as part of the DIRECTIVE 2009/28/EC of the European Parliament and of the Council (hereafter: RED), implemented in 2009, all under the objective to promote energy from renewable sources (WWF, 2013, p. 10). A standard, including sustainability principles translated into criteria for biofuels was set. Through this criteria, the process of biomass production and its use can be guaranteed to be sustainable a least to the (minimum) standard. This body of legislation `[…] promulgates a set of bio-fuel sustainability criteria with which economic operators must comply for bio-fuels to contribute towards the 2020 target´ (German & Schoneveld, 2012, p. 766).

When the biofuels comply with the criteria, they apply towards the national targets of renewable energy obligations and are eligible for financial support. One way for operators to comply with the criteria laid down in the above-mentioned directive, is via voluntary certifications schemes that are officially recognized by the European Commission (hereafter: EC) (Commission, 2009, p. 23). Voluntary certification schemes of biomass are seen as one solution for the quest of sustainability and efficiency in the biofuel production process. International applicable certification schemes would have the potential to `[…] influence positively direct environmental and social impact of bioenergy production´ (Scarlat & Dallemand, 2011, p. 1630) and also simplify the monitoring and control process.

1.2 Objective of this thesis

This thesis is devoted to the complex topic of biofuel certification, in context to long-term decarbonization objectives via biofuels. Certification of biofuels through voluntary certification systems is seen as a solution to avoid potential negative environmental effects, which come along with the production of biofuels. The question that comes up here is, if these certification schemes indeed are a solution towards the risk and negative effects of biofuels production, when it comes to ecological sustainability and if certification schemes represent a suitable tool for the regulation of the biomass feedstock production. This work shall focus on the assessment of voluntary certification systems for biofuel production via ecological sustainability criteria, which are in line with the normative objectives of the RED. For the creation of criteria, the concept of sustainability will be explained in terms of the RED, as legal basis and will be extended by extensive criteria in order to compare the schemes on this background. A basic requirement for sustainability during the production of biomass is the compliance with sustainability objectives. Therefore an evaluation of the certification schemes, that certify and monitor the production process of biomass for biofuel production, is conducted. This evaluation shall be done via scoring and comparing of pre-selected schemes and the assessment of their standard quality, using a standardized self-designed criterion catalogue with indicators concerning environmental impact categories. The results will be analyzed in the last part of this thesis.

1.3 Research Question

After having introduced the field of interest, the following leading research question is formulated:

`To what extent are voluntary certification schemes enhancing ecological sustainability in context to the production of biomass feedstock for biofuel production within the normative objectives of the RED?´

This research question shall identify to what extent voluntary certification schemes, on the basis of a pre-selected set, will enhance ecological sustainability, by complying with the statutory provisions of the Renewable Energy Directive (2009/28/EC).

When answering this policy relevant question, it allows drawing conclusions with respect on how sustainable the selected schemes are. A standardized criterion catalogue, based on the RED criteria itself and on criteria, based on the conceptualization of ecological sustainability, will allow for scoring and ranking of certification schemes under study. Subsequently conclusions can be drawn, on how sufficient the criteria within the RED reflect sustainability. In order to find adequate answer to the main research question, the following sub-questions will guide through the thesis:

1. *What is the legal policy setting as institutionalized in RED?*
2. *What are biofuels and how are they defined in RED?*
3. *What is sustainability and how does RED relate to this concept?*

4. What type of regulation is certification?

5. How, i.e. by which criteria, can sustainability of certification schemes implementing RED be best evaluated?

6. How do 'three certification schemes (that fit RED)' score in terms of sustainability criteria?

7. Which conclusions can we draw from our findings and what recommendations can we add?

The sub-question are designed, to generate the necessary information and knowledge, that is needed to conceptualize and operationalize the theoretical concept of this thesis and are meant to find an adequate answer to the main research question. Sub-questions are describing a chain of reasoning which provides the necessary inputs to explain the selected methods and data. In other words, the answers of these sub-questions build the basis for the creation of the theoretical framework and give insights to find an adequate answer of the main research question.

2. Part II: Theory

The following passage shall deal with the theory. First, the legal development shall be illustrated in 2.1, from first international commitments, related to global climate change mitigation and sustainability, up to concrete legal actions within the EU, addressed to ensure ecological sustainability in the biofuel production. In section 2.1.1 the RED is introduced with the relevant points, regarding the sustainability of biofuel production, as legal point of reference within this work. In 2.2 contains an overview and definition of renewable energies and is introducing into the terms of biomass and biofuels. Potential negative effects in context to biofuel production will be discussed in section 2.3. After that 2.4 refers to sub-question 3, while outlining sustainability in the biofuel context. Section 2.5 is dedicated to voluntary certification schemes, by introducing the theory of co-regulation, followed by a definition and finally the case selection for the analysis part. 2.6 provide the necessary list of criteria, as basis for the analysis in part 3.

2.1 Development and Status Quo of the energy policy within the EU

With the production and use of biofuels, sustainability concerns, which come along with the production of biomass, have increased. In response, many regions all over the globe have developed and implemented various governance instruments and sustainability requirements with the purpose to ensure sustainability in biomass production. These mechanism may appear in different forms, e.g. in `[…] form of legislation, international agreements, jurisdictional guideline, company policies or market-based certification schemes´ (WWF, 2013, p. 10). The biofuels governance in general `[…]

consists of agreed-upon principles, norms, rules, decision-making procedures and programs that govern the interactions of actors […]´ (Lin, 2012, p. 46) and fall under the broad term *sustainability regulatory regime*. One of the first considerable international commitments, towards limiting the increase of the global average temperature and simultaneously initiating the global climate change mitigation, was back in 1992. At that time, the United Nations Framework Convention on Climate Change (hereafter: UNFCCC) (UNFCCC, 2014) was adopted by several countries worldwide. The UNFCCC formulated the ultimate objective `[…] to stabilize greenhouse gas concentration in the atmosphere at a level that will prevent dangerous human interference with the climate system´ (UNFCCC, 2015) which is a commonly known synonymous for limiting the global temperature increase to less than 2 °C, in relation to the pre-industrial level. The UNFCCC itself represents a treaty without specific biding objectives or limits on GHG emissions and does not possess any enforcement mechanism, since it has no legal obligation to its signatories. These obligations were later addressed in the Kyoto Protocol. The `[…] commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol […]´ (EEA, 2014, p. 17) were signed in 1997 and entered into force in 2005. Currently 192 parties signed the Kyoto Protocol (United Nations, 2016). Retrospectively, the Kyoto Protocol can be seen as cornerstone in the development towards climate policy. The Kyoto Protocol had the collectively declared objective to limit the `[…] average global temperature increase and the resulting climate change´ (EEA, 2014, p. 17).

In line with the international efforts and negotiations towards GHG emission mitigation, the EU established domestic objectives corresponding with the international ambitions. In 2002, according to the European Environment Agency (hereafter: EEA), `[…] the 15 pre-2004 Member States (EU-15) agreed to differentiated emission limitation or reduction targets for each, under a EU accord known as the Burden-Sharing Agreement´ (EEA, 2014, p. 8), to be in line with the Kyoto Protocol commitments in the first period.

In 2009, the European Union adopted the climate and energy package. It consists of four complementary legislative acts, contributing to reach the `20-20-20´ targets and as a commitment to the objectives of the Kyoto Protocol from 1997. These `20-20-20´ targets are part of the `Europe 2020´ strategy, consisting of 5 targets for the European Union until 2020 and addresses not only environmental issues, but rather represent the leading objectives by 2020 for the whole Union in areas of employment, research & development, climate change and energy sustainability, education, fighting poverty and social exclusion. The `20-20-20´ targets express the EUs intended course of action, to combat the global climate change and in the same time to `[…] increase the EU´s energy security and strengthen its competitiveness´ (Commission, 2015b). This reflects their importance, as one of the major aims within the Europe 2020 strategy. The following three key objectives have been formulated, to reach energy policy related goals:

1. 20 % reduction of the EU's GHG emissions compared to 1990

2. 20 % share of renewable energy sources (RES) in the EU's gross final energy consumption

3. 20 % saving of the EU's primary energy consumption compared to projections

(EEA, 2014, p. 8)

2.1.1 DIRECTIVE 2009/28/EC of the European Parliament and of the Council

The EU pioneered in promotion of renewable energies and especially of biofuels, by implementing the DIRECTIVE 2009/28/EC in April 2009, also widely known as Renewable Energy Directive. This Directive embodies `one of the most significant and comprehensive […] initiatives to promote the incorporation of renewable energy sources (including biofuels) […]´ (German & Schoneveld, 2012, p. 765) in the European legislation, regarding biofuels. The RED mandates, that a share of at least 20% of the energy consumption within the EU has to be covered by renewable sources until the year 2020. It also imposed a mandatory share of at least 10% of renewable sources in the transport sector, as part of the Renewable Energy Road Map of 2007 (German & Schoneveld, 2012, p. 765). The adoption of the RED was an amendment and subsequent repeal to the DIRECTIVE 2001/77/EC on the promotion of electricity produced from renewable energy sources in the internal electricity market and the DIRECTIVE 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport, that had prescribed a share of 5,75% on all transport fuels until the end of 2010 (Commission, 2003).
The implementation of the RED was the first legislative act, that incorporated legal binding targets for all Member States and simultaneously comprised a `[…] list of sustainability requirements to be complied with when fulfilling the 10% target´ (Gamborg et al., 2014, p. 329) in transport by 2020. Article 17 of the RED defines the ecological sustainability criteria, `[…] with the purpose of ensuring that the environmental objective of the directive is met when biofuels are cultivated´ (Romppanen, 2013a, p. 8). Article 18 and 19 of the RED, together set out the verification of compliance with the sustainability criteria and the Calculation of the GHG impact. The set of

criteria within the RED is fully harmonized. With the implementation of these criteria for biofuels, the RED opened up a stage for voluntary certification schemes, simultaneously the harmonization ensures EU wide application and compatibility of standards of these schemes. This means, that biofuels or biomass feedstock, which applied to the criteria of the RED, regardless of origin, are eligible to count towards the national renewable energy targets.

However, it is not illegal to import and use types of biofuels in the EU, that do not comply with the criteria of Art. 17 RED. But these biofuels, neither are eligible for financial support (e.g. tax benefits) or state aid nor do they count towards national or EU wide renewable energy targets (Commission, 2009, pp. 36-38). This precondition creates a strong incentive to ensure that the sustainability criteria for the biofuels are met. As a consequence, the majority of biofuels that are produced within the area of the EU, comply with the sustainability criteria, whereas the responsibility for the compliance lies within the individual economic operator. The economic operators, can demonstrate compliance with the RED sustainability criteria via three options: First via `[…] bilateral or multilateral agreements containing provisions on sustainability that the European Community is committed to reaching with other jurisdictions ´ (Lin, 2012, p. 54). The term `other jurisdictions´ means states outside the EU jurisdiction, but such agreements do not exist yet. The second option refers to a national system, which all Member States have to set up, `[…] to verify that this sustainability system created by the economic operator actually complies with the sustainability requirements [of the RED]´ (Romppanen, 2013b, p. 345). Thereby the economic operators have to provide the relevant data to the national authority, in order to verify compliance with the RED criteria. The third option is via voluntary certification schemes.

In the following passage, Art. 17 of the RED is listed and summarized. Article 17 `Sustainability criteria for biofuels and bioliquids´ outlines within paragraph 2-6 a set of ecological sustainability criteria, characterized as a `[…] mixture of broad principles, hard targets, and rules´ (O'Connell et al., 2009, p. 34). Paragraph 6, is only applicable to producers within the EU and is covering certain farming practices, rather than cover sustainability issues in the sense of the conceptualization of ecological sustainability within this work. Therefore this paragraph is regarded as irrelevant for the evaluation of the certification schemes in a later stage.

- 17[1]: The criteria set out in Art. 17 (Commission, 2009, p. 36) must be met by biofuels, irrespective of its origin, no matter if the biomass feedstock is cultivated inside or outside the territory of the EU, in order to be eligible for:

´(a) measuring compliance with the requirements of this Directive concerning national targets;

(b) measuring compliance with renewable energy obligations;

(c) eligibility for financial support for the consumption of biofuels and bioliquids´

Biofuels produced from waste and residues, except agricultural, aquaculture, fisheries and forestry residues, need only fulfill the sustainability criteria set out in Art. 17 [2].

- 17[2]: sets the GHG emission minimum savings target from the use of biofuels and other bioliquids at initially 35%, (from 01.01.2017 onwards rising to 50% and finally from 01.01.2018 to at least 60%). Therefore Art. 19 includes a particular methodology, on how the GHG impact on biofuels is calculated (Commission, 2009, pp. 36-37).

- 17[3]: biofuels shall not be produced from biomass feedstock that is obtained from land with high biodiversity value. This includes areas as: ´primary forest and other wooden land […]´ , protected areas according to (c) to and ´[…] highly biodiverse gassland […]´ (Commission, 2009, p. 37), that had this status in or after 01.01.2008.

- 17[4]: sets out that biofuels ´[…] shall not be made from raw material obtained from land with high carbon stock […]´ (Commission, 2009, p. 37). This includes areas, that had the following status in or after 01.01.2008, laid down in Art. 17 [4] (a-c).

- 17[5]: sets out that biofuels ´[…] shall not be made from raw material obtained from land that was peatland in January 2008, unless evidence is provided that the cultivation and harvesting of that raw material does not involve drainage of previously undrained soil […]´ (Commission, 2009, p. 37). Land with high carbon stock refers to land as such as peatland, wetlands or continuously forested areas.

- 17[6]: requires that agro-environmental practices shall be adhered with minimum requirements in the cultivation of biomass feedstock, that are laid down in Council Regulation (EC) No 73/2009. This relates only to producers within the EU (Commission, 2009, p. 37).

The sustainability requirements of the RED, concerning the production of biomass are equally applicable to products irrespectively of their origin (EU or non-EU), except of Art. 17 Paragraph 6.
After introducing the legal policy setting, concerning the bioenergy and especially biofuel production in form of the RED within the EU, an answer to the first sub-question can be formulated by resume the previous passage.
The RED, as the central legal document, regulates the general framework, regarding the use and production of biomass within the EU. The document introduced mandatory and non-mandatory sustainability requirements in form of criteria for liquid biofuels and bioenergy production. The fulfillment of the criteria is a necessary condition, in order to count toward the MSs renewable energy targets and be eligible to receive financial support. It created an incentive for voluntary certification schemes, as profit seeking organizations, to enter the market.

2.2 About biomass feedstock and biofuels

The next passage, shall introduce to the \`techno-legal´ perspective of biofuels and the therewith connected terms. In this step, the necessary information and theory will be acquired, in order to build a basis for responding to the second sub-question and give the reader a technical overview about the different types of biofuels. The terms will be explained on the basis of related scientific literature. Furthermore the terms biofuels and biomass will be explained via the legal definition, stated in the EU legislative context of the RED.

2.2.1 Background

According to Almeida & Silva \`Energy is the lifeblood of present human societies´ (2009, p. 1268). This citation clearly exemplifies the importance of energy as driver for development and progress in humankind, especially \`[…] for the economic growth and social development of human societies´ (B. E. Dale & Ong, 2014, p. 1)
Energy-related use of biomass is not a new phenomenon and has been used as source of energy since the Stone Age, e.g. for heating or illumination. Even today, in developing countries, raw biomass contributes to a certain extent to the generation of energy, for example in form of simple firewood (McKendry, 2002, p. 37).
The significance of biomass has decreases with the breakthrough of fossil energy sources as coal and crude oil during the industrial revolution. Without a question, fossil fuels are since decades the supremacy among all forms of energy. The turning point in this development, back to renewable energies, besides the climate change, is the finite nature of the resource (de Almeida & Silva, 2009,

p. 1268). According to the Bundesanstalt für Geowissenschaften und Rohstoffe (BPB, 2010, p. 31), the amount of crude oil, which is consumed within one single year, took approximately between 500.000 and 1.000.000 years to emerge within the bowels of the earth. This fact illustrates the limited nature of fossil energy sources.

In this context, the *Peak-oil*[1] theory was developed by the geologist M. King Hubbert, which implies that the global conveying capacity will increase until half of the natural resources are consumed and then will irreversible decline (BPB, 2010, p. 31). In the Peak-oil theory, the point where half of conveying capacity is approached, is the so-called *Depletion Midpoint* (Bundesministerium für Umwelt, Naturschutz, & Bau und Reaktorsicherheit, 2009, p. 12)

Even though the Peak-oil theory is generally well accepted , `the time frame for that peak, however, is still under discussion´ (B. E. Dale & Ong, 2014, p. 2; de Almeida & Silva, 2009, p. 1267). The Depletion Midpoint is difficult to predict, due to new technologies in the oil production, that enables the exploitation of oilfields, that where initially not of economic interest or geographically and technically unreachable. Another influencing factor will be the discovery of unknown oilfields in the future. The predictions say, that these unknown or untouched fields are unequally distributed over the globe (see Table 1). The same theory is applicable to coal (Peak Cole) or gas (Peak Gas) (BPB, 2010, p. 31).

The theory above, demonstrates the limitedness of fossil energy sources and the need for alternative energy sources in the near future. Industrial countries all over the globe are searching for supplements and on the long run for substitutes. Particularly when it comes to sustainability, renewable energies are identified as promising alternatives. In simplified terms, the family of renewable energies is composed of solar and wind energy, hydro power and of course energy generated out of biomass. A mayor part, in replacing the declining oil reserves, is assigned to biofuels. Therefore, `[…] it is important to note that liquid biofuels in particular *are not optional´* (B. E. Dale & Ong, 2014, p. 2). Some of the above-mentioned alternative renewable energy sources, are mostly available for the generation of heat or electricity. When it comes to the transport sector and commercial mobility, in terms of aviation or ocean transport, we are dependent on high-density biofuels, `[…] whereas liquid biofuels provide drop-in fuels that can be used directly in the transport sector, without a change in infrastructure´ (Kazamia & Smith, 2014, p. 615)

The growth of biofuels within the EU is not only beneficial of an ecological standpoint. Another

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[1] In common usage the Peak-oil is know as the moment where the maximum of oil production in history is reached, or in other words, the maximum amount of oil production per year

[2] Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, Art. 17 (2)-(5)

[3] For a detailed overview see: https://ec.europa.eu/energy/sites/ener/files/documents/voluntary schemes overview table to publish.pdf

[4] The description of the scheme is based on the official homepage of the ISCC, therefore it was renounced to mark individual references; see: (ISCC, 2016) http://www.iscc-system.org/en/iscc-system/about-iscc/iscc-in-short/ - c4763

relevant factor in the promotion of biofuel within the EU is surely the EU´s claim for global leadership. Biofuel production promotes the renewable energy sector, which contributes to rural development and strengthening the global position of the EU, since the EU has the `[…] expert knowledge, technology and thus export opportunities for EU industries as world leaders´(Levidow, 2013, p. 214)

2.2.2 Definition

Article 2 of the RED covers general definitions and terms of renewable energy notions and concepts within the legislative context. First the term `*energy from renewable sources*´ shall be explained, since it functions as an umbrella term, while all following terms belong to this type of energy. According to Art. 2 (a) energy from renewable sources means:

`[…] energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases´

(Commission, 2009, p. 27)

This definition of renewable energy sources, as stated in Art. 2 of the RED, explains the origin of energy and how it is generated or converted from the naturally occurring resources. Also an important characteristic of renewable energies is the time constant. There is a difference concerning the time constant, between biomass, as a form of renewable energy, and fossil energy sources. What is meant here is the time of the origination process of the particular initial state of the source. Strictly speaking, fossil fuel is just `old´ biomass that was transformed over millions of years under physical and chemical influence (McKendry, 2002, p. 38). While `renewable energy can be defined as energy obtained from the continuous or repetitive currents of energy recurring in the natural environment´ (Regelous & Meyn, 2011, p. 1), fossil fuels need millions of years to develop beneath the earth´s surface and `[…] are not renewable within a time-scale mankind can use´ (McKendry, 2002, p. 38). This leads to another angle, which is the consistency of an energy source. Renewable energies are way more consistent than fossil fuels, since the `[…] energy storage reservoir, […] is being refilled at a rate comparable of that of extraction´ (Sørensen, 1991, p. 386). Additionally Dale & Ong stated that `a sustainable bioenergy system is one that we can reasonable expect to operate indefinitely´ (2014, p. 2). The former two characteristics shall highlight the contrast between current fossil energy resources and renewable energies. While fossil energy is physically limited, renewable energies are unlimited. Nevertheless the supply is dependent on sustainability in the production side of biomass feedstock, as well as on an active reforestation of the used biomass feedstock. To sum up, the advantage of biofuels in contrast to fossil fuels is that, the amount of available biomass stays constant, if the processing of biomass is held constant to the cultivation of biomass. This was explained in a very simplistic and theoretical manner and presupposes optimal conditions, but helps to illustrate the differences between these two sources of energy and also to emphasize the importance of sustainability.

Biomass represents the most common form of renewable energy, with a share of `[…] about two-thirds of all renewable energy consumption in the EU´ in 2014 (Commission, 2015a). Art. 2 (e) of the RED explains the notion *biomass* in the legal context of the Directive. Biomass means:

`the biodegradable fraction of products, waste and residues from biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste´

(Commission, 2009, p. 27)

According to McKendry, the stored energy within the chemical bonds of biomass and its fractions is produced via photosynthesis, where `[…] the plant material derived from the reaction between CO_2 in the air, water and sunlight […] to produce carbohydrates that form the building blocks of biomass´ (2002, p.37). The natural process of photosynthesis is relatively inefficient, with approximately less than 1%, at the conversion of solar energy into chemical stored energy, compared to other kinds of biomass converted into secondary energy (e.g. electricity). Due to continuously technology development in the last decade, new methods have increased the efficiency of energy conversion. The chemical energy, which is stored in the bonds, can be released by combustion, decomposition or digestion. Also waste and residues are used to produce energy. In the legal sense, according to Art. 2 (i) of the RED, biofuels

`[…] means liquid or gaseous fuel for transport produced from biomass´

(Commission, 2009, p. 27).

The citation shows two important points. Biofuels, sometimes also known as agrofuels, are converted forms of biomass, either liquid or gaseous. Even though biofuels have several possible

applications, they are basically used in the transportation sector, with the purpose to operate in combustion engines (Fachagentur Nachwachsende Rohstoffe e.V., 2015).
For the production of biofuels, nearly every kind of biomass can be used. Nowadays, a wide spectrum of biofuels is available on the market, which can be roughly categorized into: *first generation, second generation* and *third generation* biofuels. This classification is mostly based on the type of biomass feedstock used for production, the conversion technology and the characteristics of the fuel molecules (European Biofuels Technology platform, 2015a). First generation biofuels are produced directly from food crops, as sugarcane or corn e.g. maize or wheat for bioethanol and e.g. soy or oil palm for biodiesel (Blaber-Wegg, Hodbod, & Tomei, 2015, p. 180). Biomass feedstock of the first generation biofuels are considered to be in direct competition with food. Second generation biofuels, take this problem into consideration and are a response to the increasing controversy about first generation fuels (Mohr & Raman, 2013, pp. 114-115). They are produced from e.g. `[…] agricultural, foresty [sic!] waste or residues, or purpose-grown non-feedstocks […]´ (European Biofuels Technology platform, 2015a). Third generation biofuels are derived from aquatic autotrophic organism, mostly algae, but are still under research.

The conversion of biomass into biofuels requires, a pretreatment by physical, chemical, thermochemical or biochemical methods, dependent on the desired form of biofuels (European Biofuels Technology Platform, 2015c). The detailed description of the different types of biofuels is quite technically and not necessary to proceed. Therefore the main types of biofuels will only be shortly introduced in the following.

- Biodiesel: *`Biodiesel is produced through a process in which organically derived oils are combined with alcohol (ethanol or methanol) in the presence of a catalyst to form ethyl or methyl ester. The biomass-derived ethyl or methyl esters can be blended with conventional diesel fuel or used as a neat fuel (100% biodiesel). Biodiesel can be made from any vegetable oil, animal fats, waste vegetable oils, or microalgae oils. Soybeans and Canola (rapeseed) oils are the most common vegetable oils used today.´* (Boundy, Diegel, Wright, & Davis, 2011)

- Bioethanol: *`Ethanol is most commonly made by converting the starch from corn into sugar, which is then converted into ethanol in a fermentation process similar to brewing beer. Ethanol is the most widely used biofuel today with 2010 production and consumption at* *over 13 billion gallons based primarily on corn.´* (Boundy et al., 2011)

- Biogas: `*Biogas is a mixture of biomethane CH_4 (65-70%) and CO_2 (30-35%) and small amounts of other gases. It is created by anaerobic digestion of organic wastes such as sewage, manure, food wastes, landfill, etc. This is an established technology. After removal of contaminants, biomethane is the same as natural gas, and can be used as a transport fuel in the form of Liquid Natural Gas (LNG) or Compressed Natural Gas (CNG).´* (European Biofuels Technology Platform, 2015b)

2.3 Potential negative effects and risks of biofuel production

2.3.1 Introduction

After the initial enthusiasm, in favor of renewable energies and energy from biomass, also critical voices have been raised. Several negative effects relate to this progress, which is seen out of an ambiguously perspective within the academic world (Lin, 2012, p. 44; Popp, Lakner, Harangi-Rákos, & Fári, 2014, p. 571; Romppanen, 2013a, p. 1). Especially NGO´s have contributed to the growing consciousness, regarding sustainability concerns in biomass production for biofuels. Particularly biofuels of the first generation, `[…] have been strongly debated due to their sometimes doubtful potential for reducing GHG emissions and the increasing threat to biologically valuable areas´ (WWF, 2013, p. 9).

There is a value disagreement, as Gamborg et al. (2014, p. 326) called it, about the values and concerns connected to bioenergy. While some effects are driving forces for the development of biofuels as climate change mitigation aims or energy security concerns, other negative side effects are summarized under the term sustainability concerns. A uniform action plan or legislation to prevent negative effects is still not sufficiently developed. The field of sustainability concerns is very broad and so are the negative effects, caused by biofuel production. While some effects are addressed by the sustainability criteria in Art. 17 of the RED, as reducing GHG emissions, other concerns, are not covered properly by these criteria. On the one side, the assumption among global experts and governments, is dominating that this type of energy has a positive effect on the climate change mitigation. On the other side, there is evidence, that the biomass production and use is causing negative ecological and also social impacts of individual magnitude and nature, that trigger according to Gamborg et al. `[…] potentially negative side-effects like threats to biodiversity and global food security´ (2014, p. 326). Especially in areas outside the EU jurisdiction, the biomass production may not be regulated and therewith increasing `[…] the risk of unsustainable, overexploitation of natural resources´ (Pavanan, Bosch, Cornelissen, & Philp, 2013, p. 385).

In the scope of this thesis only potential environmental risks and consequences, shall be further elaborated in the next passage.

2.3.2 GHG emissions:

The mayor purpose behind the RED objectives is to reduce the overall GHG emissions within the EU, while `[…] biofuels production through carbon sequestration during plant growth is one of the main reasons for replacing fossil fuels by biofuels´ (Scarlat & Dallemand, 2011, p. 1631). In simplified terms, biofuels are considered as carbon neutral, since the released CO_2 during the combustion, is compensated while absorbing CO_2, during the growth of the feedstock. Unfortunately this is just a wishful dream. Critical voices even doubt the ability of biofuels to mitigate the GHG problem and share the opinion, that biofuels have a negative GHG emission balance, which implies that they release more GHGs during their life cycle than fossil fuels would do. `In reality, GHGs may be released during any phase of the biofuel production process […]´ (Koh & Ghazoul, 2008, p. 2452). From the field to the end consumer is a long way and many stages are in between. When estimating the net benefit in GHG emission savings, it is necessary to conduct a full lifecycle analysis (LCA). The LCA evaluates the environmental sustainability of each unit of biofuel on the basis of `[…] occurring environmental effects, such as GHG emissions or air pollutants, along major steps of the supply chain´ (Meyer & Priess, 2014, p. 152). The amount of GHG emission savings, compared to conventional fossil fuels varies greatly and depends on various characteristics, as the type of feedstock, the methods of cultivation, the conversion technology and how the biofuels are distributed to the end-consumer (Dufey, 2006, p. 40). After conducting the LCA for the individual unit of biofuel, it can be compared to the amount of GHGs that would have released from the use of conventional fossil fuels. Also the used methods of production and different types of biofuels can be assessed. The LCA helps to improve the production process in the future, by identifying the weak points in the biofuel production process.

2.3.3 Land use change

To cultivate biomass feedstock, land is required. The land can be acquired via two possible options: `[…] use of currently productive land or/and the conversion of unproductive land´ (Popp et al., 2014, p 571), called land-use change (LUC) effects. These effects are one of the most controversial and complex critics in the calculation of GHG emissions from biofuel production, since these LUC effects are very complex and hardly to include in the LCA. According to J. van Dam, Junginger, and Faaij (2010, p. 2461) these LUC effects can be direct (dLUC) or indirect (iLUC), which are especially hard to calculate. dLUC effects are directly linked to one individual unit of biofuel during the supply chain. It occurs when unproductive land is converted to grow biofuel crops, whereas unproductive land means `[…] land without any agricultural or forestry production, such as natural areas […]´ (Popp et al., 2014, p. 571). iLUC effects `[…] are the effects that are caused by the introduction of a bioenergy product, but cannot be directly linked to the production unit (J. van Dam et al., 2010, p. 2460). For example when currently productive land is converted, e.g. when a replacement of food crops through biofuel relevant feedstock takes place. This would represent iLUC effects, since the LUC occurs, but does not directly leads to the conversion of natural areas, but indirectly, since the food crops have to be grown somewhere else, in order to provide a stable amount of food supply. A problem is then, that iLUC effects `[…] could result in large releases of GHG emissions and these releases could be eroding the low carbon benefits […]´ (Linares & Pérez-Arriaga, 2013, p. 167). An ideal solution to this problem would be greater efficiency in farming technics, to generate more harvest on the same agricultural space or a decrease in the demand for biofuels or food, which is unlikely to happen in the near future. Therefore it is important to include the LUC effects in the biofuel policy.

While the RED already covers the dLUC effects in Art. 17, iLUC effects are not properly included. Even though there are considerations to include iLUC into biofuels policy, the inclusion of iLUC factors is highly complex and the science is uncertain and methodologies remain inaccurate (Lin, 2012, p. 49). Mohr and Raman (2013, p. 118) came to the conclusion, to address iLUC effects via `[…] dedicated policies that remove perverse incentives for biofuel production and reduce deforestation (wherever it occurs) through the development of strategies for sustaining forests and protecting biodiversity, rather than inclusion in GHG calculations for biofuels ´.

2.3.4 Loss of biodiversity

Closely connected to the LUC effects is the risk of loss of biodiversity. According to McBride et al. (2011, p. 1282) `biodiversity can relate to any type of organism, including plants, animals, fungi and microbes´ and is therefore a valuable indicator to measure ecological sustainability. When natural areas, e.g. forests are converted into agricultural farm land, for the purpose of cultivating biofuel feedstock, this can lead to negative ecological consequences for the ecosystem or local species. While Art. 17 of the RED only takes these effects into account, by prohibiting the production of biofuels produced from biomass feedstock that is obtained from land with high biodiversity, iLUC effects, affecting biodiversity are not included (Popp et al., 2014, p. 571). If for example tropical rainforest is converted, this can have a negative influence on the local biodiversity, by causing `[…] loss of species, changes in abundance of species, and habitat degradation or loss´ (McBride et al., 2011, p. 1282). Especially the rapidly expanding agricultural biofuel feedstock production, contributes to the destroying of large parts of tropical rainforest in Southeast Asia (Koh & Ghazoul, 2008, p. 2454)

2.3.5 Environmental degradation

Another negative side effect is environmental degradation, associated with biofuel feedstock production. The world´s population is continuously growing and the demand for agricultural production, especially the food and energy supply will increase too. The effects of environmental degradation are very broad and can appear in many forms, as for example erosion, salinization, pollution of water or soil by the use of fertilizers and agrochemicals. Already `[…] a quarter of all agricultural land has already suffered degradation, and there is a deepening awareness of the long term consequences of a loss of biodiversity with the prospect of climate change´ (Popp et al., 2014, p. 560). Environmental degradation means a disturbance in the function of the ecosystem and for sustainability of the ecosystem. According to O'Connell et al. (2009, p. 6) the effects of degradation of resources, as water, soil or air are not instantly evident, but rather `[…] incremental in some cases, with the ecosystem still able to maintain key functions - albeit at a lower level´.

2.4 Sustainability

2.4.1 Introduction

This section shall introduce the concept of sustainability in context to the objectives of the thesis and focuses on the conceptualization of sustainability, as an essential step towards answering the third sub-question *`What is sustainability and how does RED relate to this concept?´*
The above explained potential negative effects of biofuel production are threats to sustainability, especially ecological sustainability. In order to find an answer to the main research question, it is necessary to understand and elaborate the concept of sustainability in the legal context of the RED. The RED stated that `[…] it is essential to develop and fulfill effective sustainability criteria for

biofuels and ensure the commercial availability of second-generation biofuels´ (Commission, 2009, p. 17). In the scope of this thesis, the issue of ecological sustainability shall be focused.
The sustainability criteria of the RED, listed above, serve as the basis for the conceptualization of sustainability. The RED relates to the concept of sustainability through these criteria, while they represent the minimum requirements towards sustainability in context to biofuel production. But in line with the main research question, it is necessary to extend the concept of sustainability, as to elaborate to what extent voluntary certification schemes are enhancing this concept of ecological sustainability.

A short explanation of what is meant by conceptualization is following. According to Babbie (2015, p. 127), conceptualization is the process of specifying notions and to assign a term, which defines the explicit meaning to a set of conceptions within the scope of the work at hand. In order to conceptualize, a term is assigned, which represents a collection of evidently related phenomena or conceptions. Whereas conceptions, `[…] summarize collections of seemingly related observations and experiences´ (Babbie, 2015, p. 129) and the sum of conceptions is called concept. A notion (e.g. sustainability) is associated with concepts and creates the basis for agreement of a term. So the term is defined through the conceptualization and made explicit what is meant, in terms of the work at hand.

Before the conceptualization, some terms regarding the dimensions of sustainability shall be defined for the sake of clarity. Especially for the creation of sustainability criteria, this model is helpful. Therefor the structure of the classification is explained in the following:

1. Categories: categories of concern, e.g. ecological sustainability

2. Principles: Topics within the category, e.g. GHG emission or biodiversity. Principles are translated into criteria.

3. Criterion: a detailed goal which can be of quantitative or qualitative nature, that describes or measures the condition of the given principle, e.g. positive carbon footprint or protection of biodiversity within a standard of the individual scheme.

4. Indicator: the specific value of a given criterion, e.g. mentioning of the relevant issue in question or numeric value. It indicates, if a criterion is met. According to V. H. Dale, Efroymson, Kline, and

Davitt (2015, p. 1) indicators `[…] provide a practical and accepted way to assess relative sustainability´.

2.4.2 Definition

`While much of the current literature describes the necessary conditions for sustainability, or ways of achieving sustainability, or what sustainability is not, few writers actually define the term´

(Brown, Hanson, Liverman, & Merideth, 1987, pp. 713-714)

The quote above reflects the complexity, connected to the conceptualization of sustainability. A large amount of studies and research within the expert literature already deals with the question, what sustainability actually means in the biofuels context. Also ambiguity remains about the relevant criteria and objectives regarding the design and assessment of certification schemes in the bioenergy sector. An essential question in this context is about what measures shall be taken into account in order to fulfill the objective of ensuring sustainability, especially when `[...] the vision of various stakeholders on what sustainability means is quite different and sometimes shows divergent points of view´ (Fritsche & Iriarte, 2014, p. 6826)

Before the detailed conceptualization of sustainability, a pre-classification is carried out to avoid misconceptions of the meaning. When dealing with the term sustainability in context to biomass feedstock production for biofuels, it is reasonable to bear in mind the general objective and the research question, of this thesis. Especially `due to the typical non-linear effects of change to complex systems, pinpointing cause effect linkages is challenging´ (V. H. Dale et al., 2015, p. 1). This problem is visible in the RED itself, since it neither exactly defines, what sustainable produced biofuels are, nor does it include an explanation of the explicit concept sustainability in context to the directive. Rather the RED contains a set of minimum criteria, which serve as guideline with do´s and don'ts about how to operate in the biofuel production process. As outlined in the introduction, the dimension of sustainability, which is of interest for the purpose of this thesis, is narrowed to sustainability out of an ecological perspective in the biomass feedstock production for biofuels. When we talk about sustainability, in the wider context of biofuel production and the connected concepts, it shall be noted that this is closely linked with economic activity. Hence the term sustainable development will be introduced. This has to be mentioned, since the concept of sustainability in this thesis refers to sustainability within economic actives and therefore the conceptualization of sustainability is partly based on concepts of sustainable development. Gro Harlem Brundtland, the chairperson of the World Commission on Environment and Development in 1987 emphasizes this point:

`The environment does not exist as a sphere separate from human actions, ambitions, and needs, and attempts to defend it in isolation from human concerns have given the very word "environment" a connotation of naivety in some political circles. The word "development" has also been narrowed by some into a very limited focus, along the lines of "what poor nations should do to become richer", and thus again is automatically dismissed by many in the international arena as being a concern of specialists, of those involved in questions of "development assistance".

But the "environment" is where we all live; and "development" is what we all do in attempting to improve our lot within that abode. The two are inseparable.´

(Brundtland Commission, 1987a)

The citation derives from the foreword of `Our Common Future´ also known as the Brundtland Report. This report was released in 1987 as the product of the World Commission on Environment and Development. Since its release, it serves as a point of reference when it comes to defining the concept of sustainability (Buytaert et al., 2011; German & Schoneveld, 2012; Gnansounou, 2011; McBride et al., 2011; Meyer & Priess, 2014; Pavanan et al., 2013; Robert, Parris, & Leiserowitz, 2005). The statement `Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs´ (Brundtland Commission, 1987b) is maybe the most essential point and clearly the most famous and cited implication within the report. It shows, that environmental sustainability integrates immediate and long-term objectives and is dependent on actions from the local to the global scale. The report includes strategic imperatives of social, economic and environmental dimensions, but as this work is focused on the category of environmental sustainability it will stick to objectives connected to that category. The conceptualization is including conceptions correlated with environmental objectives only. Therefore the most relevant core objectives are presented and then summarized, in order to demonstrate the necessary conceptions to conceptualize sustainability in biomass feedstock and biofuel production.

`9. Settled agriculture, the diversion of watercourses, the extraction of minerals, the emission of heat and noxious gases into the atmosphere, commercial forests, and genetic manipulation are all

examples or human intervention in natural systems during the course of development. Until recently, such interventions were small in scale and their impact limited. Today's interventions are more drastic in scale and impact, and more threatening to life-support systems both locally and globally. This need not happen. At a minimum, sustainable development must not endanger the natural systems that support life on Earth: the atmosphere, the waters, the soils, and the living beings. […]

13. Development tends to simplify ecosystems and to reduce their diversity of species. And species, once extinct, are not renewable. The loss of plant and animal species can greatly limit the options of future generations; so sustainable development requires the conservation of plant and animal species. […]

14. So-called free goods like air and water are also resources. The raw materials and energy of production processes are only partly converted to useful products. The rest comes out as wastes. Sustainable development requires that the adverse impacts on the quality of air, water, and other natural elements are minimized so as to sustain the ecosystem's overall integrity[…]´

(Brundtland Commission, 1987b)

The three articles above shall underline the concept of environmental sustainability and therewith extract the underlying objectives of the Brundtland report, regarding ecological sustainability objectives. In essence the citations above imply responsible use of physical resources and the ecosystem in general. The limitations are neither fixed values, nor explicit instructions, but rather set at that level, where the biosphere is able to neutralize the impacts of human activities, without irreversibly harming the atmosphere, waters, soils and biodiversity. Whereas biodiversity, according to the text of the Convention on Biological Diversity (1992) defined the term as `[…] the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems´. In other words, `[…] rates of consumption should not hinder the natural replenishment of the environmental systems on which they rely´ (Blaber-Wegg et al., 2015, p. 180).

In a later stage, the objectives of the conceptualization are converted into criteria in order to compare the objectives of interest with the selected certification schemes.

2.5 Voluntary certification schemes

In the following section, voluntary certification schemes will be introduced and a detailed examination of these schemes in the regulatory context within the boundaries of the RED will be given. First the concept called `co-regulation´ as a hybrid regulatory model will be introduced. Therewith the fourth sub-question: *What type of regulation is certification?´* shall be answered on the basis of regulatory theory. These insights further contribute to the question of what part these schemes can take to achieve the goal of enhancing sustainability in the context of the RED.

2.5.1 The theory of co-regulation

In the past decades, governments all over the globe have actively promoted biofuels production and consumption, e.g. by creating incentives for farmers to grow biomass feedstock. Back in the 1990s, the biofuel industry in producing countries, within for example, the EU or Brazil `[…] were mainly governed by public regulation through minimum mandates, tariff protection, investment incentives, and subsidy provision to farmers and processors´ (Ponte & Daugbjerg, 2015, p. 103). Nowadays this transition towards a low carbon economy, in context to the development of renewable energies and the associated ecological concerns, becomes increasingly incorporated in the agenda of public policy and regulation. An important concept regarding this new form of governance is called `co-regulation´, as a form of regulatory technique (Ugarte, van Dam, & Spijker, 2013) Co-regulation describes a `[...] regulatory technique whereby the binding legislative action of the EU institutions is combined with implementing actions by private actors in the field, capitalizing on their practical expertise´ (Romppanen, 2013b, p. 342).

The ecological sustainability challenges faced by the massive increase of biofuel production were addressed via legislation. The RED is perfect example of this new mode of governance, while showing the collaborative action between the public, represented by the EU, establishing the sustainability criteria, and the private, represented by the verifier, who is responsible to check compliance of the voluntary certification schemes, with the criteria of the RED. The RED `[…] is shaping transnational biofuel governance [and] shows deep and mutual dependence between public and private´ (Ponte & Daugbjerg, 2015, p. 96). This marks a new form of transnational governance, based on a hybrid regulatory model, where`[…] public and private come together in complex configurations that include civil society, business, and a plethora of non-traditional actors´ (Ponte & Daugbjerg, 2015, p. 96). A significant aspect of co-regulation is mutual dependence. On the one side, the private voluntary certification schemes need the legislative incentives, created by the RED, in order to expand commercially. The incentive is created trough the fact that only biofuels applying to the national targets of renewable energy obligations and are eligible for financial support, if they are in line with the RED sustainability criteria.

Another dimension of the interdependence in co-regulation is legitimacy. This refers to the normative question of what gives authority to the voluntary certification schemes as private actors that exercise governmental tasks. Even though the certification schemes are only a voluntary option to show compliance with the RED requirements, nevertheless they need to be legitimate in the legal sense, in order to apply for financial support and pertain towards the EU GHG emission mitigation targets or to be accepted by potential customers. Generally `[…] only state actors have the authority to prescribe behavior of others, and legitimacy is not simply transferable from state to non-state actors´ (Partzsch, 2011, p. 416). In case of voluntary certification schemes, as private actors, the EC authorizes the schemes via the recognition process and `[…] has outsourced verification responsibilities to certification schemes which qualify for the job by meeting, in part or whole, the Sustainability Criteria´ (Lin, 2012, p. 57) This delegation of authority is part of the co-regulation and is grounded in the output understanding of legitimacy, which is legitimate `[…] because they effectively support common welfare´ (Partzsch, 2011, p. 416)

On the other side, the EU is dependent on these private schemes, in order to address sustainability concerns, which policymakers refrain to address via binding legislation, because of potential conflicts with international trade agreements as for example of the World Trade Organization (WTO) (Gnansounou, 2011, p. 2095). Besides this, expertise and knowledge also plays a role. The EC is better off, to draw on professional `[…] private actors [who] possess resources and have developed competencies and expertise that public regulators can use to better reach their regulatory objectives´ (Schleifer, 2013, p. 534). While they are already skilled with the subject matter and familiar with the local conditions, it is especially advantageous when it comes to biomass feedstock or biofuel production in countries outside the EU. Important benefits are also lower demands of public resources and the flexibility of private actors. Dependent on the level of application of the individual voluntary certification scheme, biofuel producer can certify the imported biomass feedstock or biofuels from third countries, if the scheme has global application (Pacini & Assunção, 2011, p. 596).

To sum up, co-regulation is a hybrid form of regulation between public and private actors, which means the outsourcing of regulatory functions to market-based private actors and is based `[…] on the premise that private actors possess resources and have developed competencies and expertise that public regulators can use to better reach their regulatory objectives´ (Schleifer, 2013, p. 534).

Certification of biofuels through voluntary certification schemes is located within the regulatory framework of co-regulation within the legal boundaries of the EU RED.

2.5.2 Introduction

In response to the various sustainability concerns in the legislative boundaries of the RED, a great number of certification schemes has developed, with different scopes and purposes (Scarlat & Dallemand, 2008, p. 2). Today voluntary certification schemes have become the main instrument used to verify compliance with the RED sustainability criteria. Today the list of approved certification schemes contains 19 voluntary certification schemes (Commission, 2016). The involved stakeholders in certification schemes do not originate only from government but also from the public and private sphere, as for example NGOs or profit-seeking corporations and academia. According to Lin `[…] biofuels certification schemes are usually the result of collaboration among NGOs, businesses, government and intergovernmental organizations concerned with sustainability in biofuels production´ (Lin, 2012, p. 50). These have to be officially `[…] recognized by the Commission for their certification to bear meaning under the EU biofuels regulatory regime´ (Lin, 2012, p. 46).

In the recognition process, the EC assesses the individual scheme on the quality of its standard. The certification scheme `[…] should cover, in part or whole, the sustainability criteria laid down in the Directive[2]´ (Commission, 2010, p. 3) (e.g. minimum level of GHG emission savings compared to fossil fuels) and also meet the following points:

`- all companies in the supply chain are audited before making any claims about sustainability under the scheme;

- a follow up audit of the companies in the supply chain takes place at least once a year;

- the auditors are competent and independent;

- the administrative system is protected against fraud´

(Commission, 2015c)

In order to apply for recognition, the individual scheme submits the application to the EC. In the

[2] Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, Art. 17 (2)-(5)

next step an outsourced contractor, called verifier or auditor, performs an audit, where the verifier `[…] analyzes in detail how the sustainability criteria are fulfilled through the particular sustainability system´ (Levi-Faur, 2011, p. 345). In case of missing points, these are communicated to the scheme, which then has to amend these points and gets assessed again by the contractor. When all necessary points are successfully modified, the Commission´s decision is officially published in the Official Journal of the European Union. Therewith the certification scheme is officially recognized for 5 years and approved within all Member States. After this period, the scheme needs to pass this recognition process again. Nevertheless, the EC can revoke the decision, in case the scheme does not apply to the standard. The detailed process of recognition via the EC is illustrated in Figure 1 (see appendix).

2.5.3 Definition

Certification describes the process, `[…] whereby an independent third party (called a certifier or certification body) assesses the quality of management in relation to a set of predetermined requirements (the standard). The certifier gives a written assurance that a product or process conforms to the requirements specified in the standard´ (Lewandowski & Faaij, 2006, p. 84). With this written assurance in form of a certificate, the operator, who seeks for certification of its products through the certifier, can show the sustainability performance to the authorities or the consumers. According to Romppanen voluntary certification schemes are `[…] non-State, privately operated compliance and control systems certifying the sustainability of biofuels´ (2013b, p. 341). They are called `voluntary´, since they are not set directly in regulation and not mandatory for the producer or other actors in the supply chain (Ponte, 2013, p. 261). According to Pols the idea of biofuels certification standards is that it goes `[…] beyond existing (inter)national legal requirements´ (2015, p. 669).

Certification schemes generally are constituted of three institutions (Ugarte et al., 2013, p. 11). The *standard holder, accreditation body* and *certification body*. The standard holder is establishing the standard, where objectives or principles are translated into sustainability criteria for the production of biofuels and feedstock and creating the general rules and procedures as necessary components to build up a certification scheme. These principles define the aims of the standard, `[…] which biofuel production has to adhere to in order to be classified as `sustainable´ (Pols, 2015, p.669). The certification body acts independent from the accreditation body and conducts the audits. The audit is the practical work of the certification scheme on the individual firm, that applies for certification and means to check, `[…] all the documents and do controls on the spot´ (Commission, 2015c). Finally the accreditation body, which is also independent to the standard holder, guarantees that the certification body is having the necessary competence and that the different certification bodies comply with the standard. In essence they guarantee for quality assurance across all certification bodies of the same scheme.

According to Schleifer (2013, p. 538) the certification schemes have in common, that they are functioning as clubs, while `firms striving for membership have to implement the club´s code of conduct in their operations´. According to the WWF, the `[…] schemes recognized under EU RED vary greatly in their scope, organizational structure and intention´ (WWF, 2013, p. 12). They differ in their field of application, while some have various objectives and offering their service for a wide range of biomass feedstock, others are just developed for one specific sector or type of biomass feedstock, e.g. only soy or palm oil. To put it in a broader perspective, some schemes have, for example, specified on the agriculture sector, while others covering the forestry sector (Scarlat & Dallemand, 2011, p. 1638). Also the specific purpose can be a distinguishing feature (fair-trade, organic agriculture, ensuring human rights). Furthermore, some operate only on the national level, while others are internationally operating (Jinke Van Dam & Junginger, 2011, p. 4051). A given certificate is assigned to a certain batch of product or biomass raw material, which is granted over the supply chain. This leads to traceability of the batch over the whole supply chain. Whereas `[…] traceability describes the possibility, to trace production, use or location of a certain element. For final products this can cover the origin of material and parts as well as the production history´ (ISCC, 2015b, p. 5).

Also might interesting is the question of who is bearing the costs for certifying the products via certification schemes. Before answering the question, a characterization and explanation of costs is necessary. The first type of costs is connected to the establishment and official recognition via the Commission and includes the cost of adjustment to the RED requirements. The second type of costs, is the audition fee for the technical assessment, via an outsourced contractor, called verifier or auditor. The auditor verifies the compliance of the certification scheme standard with the RED requirements (Ugarte et al., 2013, p. 7). The two types of cost are cost accrue by setting up the scheme. These compliance cost are, according to Levi-Faur (2011, p. 5), the most significant cost and `[…] are born not by the government budget but mostly by the regulated parties´. Finally the certification costs, are `[…] split into two components, a membership fee (mandatory or optional or bundled to benefits depending on the certificate) and a quantity-dependent fee (e.g. USD cents per tonne/gallon/litre of certified product)´ (Pacini & Assunção, 2011, p. 596). Since the certification of products via certification schemes is optional for the company, the cost for the audit is paid by the company, which is importing or producing biofuels (Commission, 2015c). This leads to the question, if and to what extent the certification schemes are transferring the cost to the end-user/final consumer. And if there is a tendency towards opting for certification schemes with lower cost, even though the standard is might not that comprehensive in terms of sustainability. This could be an interesting field for further research, but shall not part of this work.

2.5.4 Case selection

The 19 officially recognized certification schemes differ in their scope and application. The official website of the EC (Commission, 2016), provides an overview of the official certified certification schemes (see appendix Table 2). All certification schemes are listed in the table, which provides information about the Scope, date of the EC decision and if the schemes demonstrate compliance with the Article 17 [2-5] and Article 18[1] of the RED. Also updates within the standard of the scheme are listed. The table reveals that, until today, there was a first big wave of seven schemes that were officially recognized via the EC in July 2011. After this first wave the schemes that sought for recognition, were recognized via EC decision in irregular intervals.

In the scope of this thesis, only voluntary certification schemes that are officially recognized by the European Commission until 2014 and demonstrate fully compliance (without restrictions or relying on other schemes) with the sustainability criteria of Art. 17 [2-5] of the RED shall be analyzed and evaluated. Another selection criteria is the scope. The scope is subdivided into the following indicators and the scheme has to cover these indicators in order to be selected:

1. Cover of Art. 17 [2-5] = fully covered

2. Feedstock type = wide range of feedstock's

3. Feedstock origin = global

4. Biofuel production geography = global

5. Extent of supply chain covered = full supply chain

A short explanation shall further justify the criteria selection for the case selection. With the main research question in mind, it makes sense to select only certification schemes that fully comply with the requirements of the RED, with the question in mind, to what extend are voluntary certification schemes enhancing ecological sustainability. Therefore it is necessary, that the scheme, at least fulfills the RED criteria (Art. 17 (2)-(5) and then to check to what extend and in what scope the individual scheme is enhancing ecological sustainability, further to the RED criteria. Another selection criterion is the range of feedstock, covered by the certification scheme. The selected cases are able to certify a wide range of feedstock, regardless of its origin (within and outside the area of the EU). In addition, it shall cover the whole supply chain.

This should give a detailed insight of the functioning and performance on sustainability in context to the selected certification schemes selected via the above-explained characteristics.

After checking all official recognized schemes against the above identified selection criteria, the following schemes were selected[3]:

1. International Sustainability and Carbon Certification (ISCC)

2. Roundtable on Sustainable Biomaterials EU RED (RSB EU RED)

3. Abengoa RED Bioenergy Sustainability Assurance (RSBA)

2.6 Criteria

2.6.1 Introduction

The section of potential negative effects and risks of biofuel production indicated potential threats to sustainability that exceed the scope of sustainability measures, addressed via the RED. These risks are not included properly in the RED, since they exceed the concept of sustainability within the RED framework. Together the conceptualization of sustainability and the potential environmental effects create the basis for the criteria selection for the analysis, which will be held against the individual certification scheme and enable an evaluation of voluntary certification

[3] For a detailed overview see: https://ec.europa.eu/energy/sites/ener/files/documents/voluntary schemes overview table to publish.pdf

schemes. Also this chapter shall lead to an adequate criteria catalogue and therewith provide an answer to the fifth sub-question: `*How, i.e. by which criteria, can sustainability of certification schemes implementing RED be best evaluated?*.

2.6.2 Determination

The following 4 criteria are the `minimum´ criteria, laid down in Art. 17 of the EU RED. They are listed, since it is mandatory for the certification schemes to check on these criteria in order to grant a certificate, as explained in the section of voluntary certification schemes.

<u>1. - 4. EU RED (Art. 17 [2-5]) (Commission, 2009, pp. 36-37)</u>

1. Art. 17 [2] Minimum GHG reduction threshold
2. Art. 17 [3] Protection of areas with high biodiversity
3. Art. 17 [4] Protection of high carbon stock areas
4. Art. 17 [5] Protection of areas designated as peatlands

Indicator:
- The standard takes reference to the requirements of EU RED Art. 17 (2-5): The standard includes a clear description of the requirements of the implications of EU RED Art. 17 (2-5).

Next the extended ecological criteria will be explained, that go beyond the requirements of the RED. These extended criteria build the basis for the evaluation and comparison of the individual selected schemes. Furthermore they enable a ranking between the schemes under evaluation.

Extended ecological criteria

5. <u>GHG emission reduction (exceeding the EU RED)</u>
On of the essential arguments with respect to biofuel promotion is contribution `[…] to a decarbonized economy in general and particularly to GHG emission savings in comparison with the reference´ (Fritsche & Iriarte, 2014, p. 6831) The RED criteria already include a minimum threshold, but this advanced criterion, shall check, if the individual certification scheme includes a GHG emission threshold, that exceeds the EU RED criteria in its standard. Therefore the extended GHG emission mitigation shall be incorporated in the criterion catalogue.

- Requirements of GHG emission savings (exceeding the RED minimum requirements): The standard requires GHG emission savings, which are exceeding the EU RED Art. 17 (2) and/or additional GHG emission thresholds in context to biofuels.

6. Protection of surface water and groundwater

The agro-industrial business of today is characterized by extensive application of agricultural machinery, monocultural farming and the use of fertilizer or pesticidal chemicals, which can contain climate damaging ingredients. These contents can harm the environment as the soil or the groundwater (Meyer & Priess, 2014, p. 162). Water quality is essential for the whole ecosystem, whether in streams or groundwater. Therefore water management in terms of quality and quantity is important.

Indicator:

- **Protection of surface water and groundwater:** The standard requires the water quality to improve, or at least to maintain.
- **Efficient water management:** The standard requires the producers to use the water resources efficiently, by reducing the amount of water for the production as much as possibly and to avoid water pollution.
-**Avoid water scarcity:** The standard requires that the surface and groundwater extraction do not exceed the natural freshwater recharge.

7. Soil quality

The quality of soil is important in environmental systems, since it `[...] affects the broader ecosystem, the immediate productivity of bioenergy crops, and the maintenance of productive capacity for future generations´ (McBride et al., 2011, p. 1278). Therefore the soil quality must be maintained.

Indicator:

- Avoidance or minimization of soil erosion: The standard includes detailed measures for erosion of soil (e.g. soil erosion prevention provisions and/or continuous measurements of soil loss)
- Preservation or improvement of soil quality: The standard requires that the soil quality is improved or at least maintained, regarding e.g. the pH-value or microorganisms.

8. Protection of biodiversity

Biomass feedstock production, especially palm oil or biomass, which is cultivated in tropical regions by deforestation is a threat to biodiversity. The deforestation is simultaneously a threat to the flora and fauna, as well as a carbon stock, since it converts CO2 into biomass and O2 (McKendry, 2002, p. 40; Scarlat & Dallemand, 2011, p. 1643) According to McBride et al. (2011, p. 1282) `[...] biodiversity can relate to any type of organism, including plants, animals, fungi, and microbes´. While Art. 17 (3-5) are already covering areas land with high biodiversity value and high carbon stock, it was decided to focus on the protection of endangered/rare species as a more specific indicator for biodiversity.

Indicator:

- Protection of rare and endangered species: The standard includes protection measures for rare and endangered species and safeguards the natural habitats as protected areas.

2.6.3 Summary:

Beyond question, biofuels present many opportunities for climate change mitigation. Nevertheless the production of biofuels involves threats to sustainability on several levels, not only for the environment but also for the human wellbeing. With these potential benefits and obstacles in mind, it gets clear that it becomes increasingly important to regulate the biofuel production and trade, with the key element of preventing unnecessary damage to the environment. The above-elaborated criteria contribute to the preservation of sustainability in the ecological category. Furthermore the 8 criteria above build the basis for a comparison of the sustainability of certification schemes. The first 4 basic criteria are proving the compliance with the mandatory minimum requirements of the RED, which to comply with, was a precondition in the case selection process. The 4 extended ecological criteria build the basis for a comparison of the schemes. In the comparison the performance and the extent of objectives within the individual standard of each scheme, will be evaluated.

3. Part III: Analysis

3.1 Introduction

The 3rd part of this work is dedicated to the analysis. The selected schemes will be evaluated on the basis of the criteria in section 2.6.2, simultaneously gives an answer to the sixth sub-question: *`How do 'three certification schemes (that fit RED)' score in terms of sustainability criteria?´*. The analysis will be conducted via a comparative table. Therefore the model will be introduced and the structure is explained in the next step.

3.2 The Model

In order to determine the score of the of the individual certification system, a model, in form of a comparative table is created. This table allows for an in-depth analysis of the performance of the individual certification scheme via its standard. The scheme standards are compared with the criteria set identified in section 2.6.2. The analysis framework consists of 5 principles (EU RED requirements, GHG Emission, Soil, Water and Biodiversity), whereas the principles comprise of 8 criteria. The criteria are again segmented into indicators. If the standard of the scheme in question is compliant to the indicator, it gets a match. A match signifies, that the standard implemented the sustainability criterion in question. For the sake of clarification, a criterion is simply visualized by using the colors green for a match and red for no match. So the comparative table (see Table 3), allows a quick and easy comparison of the schemes with each others and also with the applicable legislative requirements of the EU RED.

Table 3 : Model to analyze and compare certification standards

Category	Principles	Criteria	Indicator	Implementation
	EU RED REQUIREMENTS	**EU RED (Art. 17 [2-5]):**	**Covered by the standard of the individual scheme**	**YES or NO**
Ecological Sustainability		1. Art. 17 [2]: Minimum GHG reduction threshold	- GHG calculation tool/methodology - takes reference to the RED requirements	Y/N
		2. Art. 17 [3] Protection of areas with high biodiversity	-takes reference to the RED requirements	Y/N
		3. Art. 17 [4] Protection of high carbon stock areas	-takes reference to the RED requirements	Y/N
		4. Art. 17 [5] Protection of areas designated as peatlands	-takes reference to the RED requirements	Y/N
		Extended ecological criteria:		
	GHG Emission	5. GHG emission savings (exceeding the EU RED)	- Requirements of GHG emission savings (exceeding the RED minimum requirements)	Y/N
	Water	6. Protection of surface water and groundwater	- Efficient water management -Avoid water scarcity	Y/N
	Soil	7. Preservation of Soil	- Avoidance or minimization of soil erosion - Preservation or improvement of soil quality	Y/N
	Biodiversity	8. Protection of biodiversity	- Protection of rare and endangered species	Y/N

3.3 The three voluntary certification schemes compared

The following passage presents the finings, after applying the model to the three selected certification scheme standards. The outcome of each individual standard is explained gradually.

Subsequently the results of each individual analysis are compared against each other and presented in a summarized form in table 7.

3.3.1 International Sustainability and Carbon Certification (ISCC)[4]

The ISCC is a German based a multi-stakeholder initiative, developed via an open multi-stakeholder process in 2010, including 250 international associations, companies, research institutions and NGOs. The scheme is one of the leading globally operating certification schemes, with more than 10.000 granted certificates in about 100 countries. In July 2011, it was among the first seven certification systems that were officially recognized by the EU. The ISCC scheme is applicable for all kinds of agricultural crops, their derivate and renewables, along the whole supply chain.

Table 4: Assessment ISCC

Criteria	ISCC	
EU RED (Art. 17 [2-5]):	Implemenation: Yes=Y or No=N	Indicator:
1. Art. 17 [2]: Minimum GHG reduction threshold	Y	• ISCC 205: GHG Emissions Calculation Methodology and GHG Audit: `Based on the Directive 2009/28/EC ISCC requires a minimum GHG emissions saving of 35% (rising to 50% in January 2017, and 60% in January 2018 for installations in which production started from 2017 onwards). The Directive 2009/28/EC contains a methodology for calculating this saving ("actual value") as well as "default values", including "disaggregated default values" that can be used in certain cases to show compliance with the criterion. ISCC is applying this methodology.´ (ISCC, 2015b, p.4)
2. Art. 17 [3] Protection of areas with high biodiversity	Y	• ISCC 202: Sustainability Requirements for the Production of Biomass (ISCC, 2015a): PRINCIPLE 1: Biomass shall not be produced on land with high biodiversity value or high carbon stock. HCV areas shall be protected • 1.1 Biomass is not produced on land with high biodiversity value
3. Art. 17 [4] Protection of high carbon stock areas	Y	• ISCC 202: Sustainability Requirements for the Production of Biomass: • 1.3 Biomass is not produced on land with high carbon stock
4. Art. 17 [5] Protection of areas designated as peatlands	Y	• ISCC 202: Sustainability Requirements for the Production of Biomass: • 1.4 Biomass is not produced on land that was peatland in January 2008 or thereafter (Article 17(5) of the Directive 2009/28/EC)

[4] The description of the scheme is based on the official homepage of the ISCC, therefore it was renounced to mark individual references; see: (ISCC, 2016) http://www.iscc-system.org/en/iscc-system/about-iscc/iscc-in-short/ - c4763

Extended ecological criteria:		
5. GHG emission savings (exceeding the EU RED)	N	• Not applicable
6. Protection of surface water and groundwater	Y	• ISCC 202: Sustainability Requirements for the Production of Biomass: PRINCIPLE 2: Biomass shall be produced in an environmentally responsible way. This includes the protection of soil, water and air and the application of Good Agricultural Practices • 2.5.1 Mineral oil products and plant protection products are stored in an appropriate manner, which reduces the risk of contaminating the environment • 2.5.3 Application of good agricultural practices to reduce water usage and to maintain and improve water quality • 2.6.1 During the application of fertilizers with a considerable nitrogen content care is taken not to contaminate the surface and ground water • 2.6.6 Fertilizers are stored in an appropriate manner, which reduces the risk of contamination of water courses • 2.8.9 Surplus application mix or tank washings are disposed of in a way not to contaminating the ground water • 2.9.1 Plant protection products are stored in accordance with local regulations in a secure, appropriate storage. Potential contamination of the ground water must be avoided
7. Preservation of Soil	Y	• ISCC 202: Sustainability Requirements for the Production of Biomass: • PRINCIPLE 2: Biomass shall be produced in an environmentally responsible way. This includes the protection of soil, water and air and the application of Good Agricultural Practices • • 2.3 Soil conservation and avoidance of soil erosion degradation • 2.3.2 Field cultivation techniques used to reduce the possibility of soil erosion • 2.4.1 Soil organic matter is preserved • 2.4.4 Techniques have been used that improve or maintain soil structure and avoid soil compaction
8. Protection of biodiversity	Y	• ISCC 202: Sustainability Requirements for the Production of Biomass: • PRINCIPLE 2: Biomass shall be produced in an environmentally responsible way. This includes the protection of soil, water and air and the application of Good Agricultural Practices • 2.1.2 Avoidance of damage or deterioration of habitats • `Legal requirements relating to the protection of species and habitats must be met, any constraints must be followed and damage to or deterioration of habitats or species is avoided. Illegal or inappropriate hunt- ing, fishing, trapping or collecting activities in these areas are controlled as far as possible and, if necessary, prohibited´ (ISCC, 2015a, p.14)

As illustrated in the table above, the standard of the ISCC is matching 7 out of 8 criteria. Only the 5th criterion: *GHG emission savings (exceeding the EU RED)* is not covered. The ISCC standard contains extensive and detailed requirements and procedures for the protection of surface and groundwater, as well as for the preservation of soil. The 2nd criterion: *Art. 17 [3] Protection of areas with high biodiversity* raises some concerns. Even though the criterion is fulfilled, this criterion is a question of interpretation. The ISCC is referring to `areas for nature protection purposes [which] comprise areas that are designated by law or by the relevant competent authority to serve the purpose of nature protection as well as areas that have been acknowledged by the European Commission as areas for the protection of rare, threatened or vulnerable ecosystems or species´ (ISCC, 2015a, p. 8). The point of reference is the established law of the particular country in question. So it is a matter of location, what areas are under protection and therefore can be used for biomass feedstock production. For example, one country can have very detailed and extensive laws for areas for nature protection, while other countries have poor laws on this issue. In the worst case, countries withdraw the protection status of protected areas for economic reasons or do not designate certain areas for nature protection a priori. Therefore a specific definition of those areas with high biodiversity, created by the ISCC itself would be desirable in order guarantee a constant protection of areas with high biodiversity. Nevertheless, with 7 out of 8 matches, the ISCC standard provides an extensive coverage of the created criteria catalogue.

3.3.2 Roundtable on Sustainable Biomaterials EU RED (RSB EU RED)[5]

The RSB EU RED is an independent multi-stakeholder initiative, located in Switzerland. The RSB was originally established in 2007 as `Roundtable on Sustainable Biofuels´ to guarantee the sustainability of biofuels, initiated by the Ecole Polytechnique Fédéral de Lausanne (EPFL). In 2013 the RSB expanded its scope, to cover all types of biomass feedstock with global application along the whole supply chain. The RSB is now formally an autonomous non-profit organization, based on a multi-stakeholder governance system, where representatives are elected from one of the seven RSB membership chambers, representing sectors of business, civil society, trade unions, government, academia and multi-lateral organizations as NGOs.

Table 5: Assessment RSB EU RED:

Criteria	RSB EU RED	
EU RED (Art. 17 [2-5]):	Implemenation: Yes=Y or No=N	Indicator:
1. Art. 17 [2]: Minimum GHG reduction threshold	Y	• RSB-STD-11-001 (Version 2.6): 3. 6. 4.the GHG emissions savings of the final biofuels/bioliquids product are at least: 3. 6. 4. 1. 35%,or 3. 6. 4. 2. 35 % on 1 April 2013, if the production of the biofuels/bioliquids involved facilities which were in operation on 23 January 2008, or 3. 6. 4. 3. 50% on 1. January 2017, or 3. 6. 4. 4. 60% on 1. January 2018, if the production of the biofuels/bioliquids involved facilities which started operation on or after 1 January 2017 (RSB, 2015) • 4.1 The calculation of GHG emission savings of biofuels/bioliquids against fossil fuels shall follow the methodology detailed in the RED
2. Art. 17 [3] Protection of areas with high biodiversity	Y	• RSB-STD-11-001(Version 2.6): • 2. Specific land use requirements for primary production • Point 2.1 fully covers the mandatory RED requirements
3. Art. 17 [4] Protection of high carbon stock areas	Y	• RSB-STD-11-001(Version 2.6): • 2. Specific land use requirements for primary production • Point 2.2 fully covers the mandatory RED requirements
4. Art. 17 [5] Protection of areas designated as peatlands	Y	• RSB-STD-11-001(Version 2.6): • 2. Specific land use requirements for primary production • Point 2.2.4 fully covers the mandatory RED requirements

[5] The description of the scheme is based on the official homepage of the RSB, therefore it was renounced to mark individual references; see: (RSB, 2016) http://rsb.org/about/what-is-rsb/

Extended ecological criteria:		
5. GHG emission savings (exceeding the EU RED)	Y	• RSB-STD-11-001-01-001 (Version 2.1): • Principle 3: Greenhouse Gas Emissions • Criterion 3c. Biofuel blends shall have on average 50% lower lifecycle greenhouse gas emissions relative to the fossil fuel baseline. Each biofuel in the blend shall have lower lifecycle GHG emissions than the fossil fuel baseline (RSB, 2011)
6. Protection of surface water and groundwater	Y	• RSB-STD-11-001-01-001 (Version 2.1): • Principle 9: Water • Biofuel operations shall maintain or enhance the quality and quantity of surface and ground water resources, and respect prior formal or customary water rights • Criterion 9.b Biofuel operations shall include a water management plan which aims to use water efficiently and to maintain or enhance the quality of the water resources that are used for biofuel operations • Criterion 9.c Biofuel operations shall not contribute to the depletion of surface or groundwater resources beyond replenishment capacities • Criterion 9.d Biofuel operations shall contribute to the enhancement or maintaining of the quality of the surface and groundwater resources
7. Preservation of Soil	Y	• RSB-STD-11-001-01-001 (Version 2.1): • Principle 8: Soil • Biofuel operations shall implement practices that seek to reverse soil degradation and/or maintain soil health • Criterion 8.a Operators shall implement practices to maintain or enhance soil physical, chemical, and biological conditions.
8. Protection of biodiversity	Y	• RSB-STD-11-001-01-001 (Version 2.1): • Principle 7: Conservation • Biofuel operations shall avoid negative impacts on biodiversity, ecosystems, and conservation values • Criterion 7a defines \`no-go areas´, which shall not be uses for biofuel operations after the 01.01.2008, with reference to: UNESCO's World Heritage Site & Ramsar Site, whereas these institutions designate areas of high biodiversity value • Hunting, fishing, ensnaring, poisoning and exploitation of rare, threatened, endangered and legally protected species shall not occur on the operation site.

The RSB standard offers the maximum of coverage with 8 out of 8 matched criteria. In the RSB standard the same problem arises, as with the ISCC standard, regarding the 2nd criterion, therefore it will be not further elaborated. Also noteworthy is the fact, that the 5th criterion is covered. In principle 3: Greenhouse Gas Emissions it is required that \`biofuels blends shall have on average 50% lower lifecycle greenhouse gas emissions relative to the fossil fuel baseline´ (RSB, 2011, p. 11). This threshold shall increase over time, in order to further enhance the standards ability to safeguard sustainability in line with the 5th criterion.

3.3.4 Abengoa RED Bioenergy Sustainability Assurance (RSBA)[6]

The Red Bioenergy Sustainability Assurance (RSBA) scheme was developed by the Abengoa Bioenergy company. Abengoa Bioenergy is a European-based and global operating producer for biofuels, chemical bioproducts and raw material for the production of biofuels.

Initially the RSBA was developed under consideration of the EU RED, for use by the company´s own biofuels supply chain, including production and retail operations. The scheme scope covers all

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[6] The description of the scheme is based on the official homepage of the RSBA, therefore it was renounced to mark individual references; see: (Bioenergy, 2014) http://www.abengoabioenergy.com/export/sites/abg_bioenergy/resources/pdf/acerca_de/en/Informe_RBSA_2013_2014_eng.pdf

kind of feedstock's, without geographic restrictions. The RSBA is called an industry scheme, because it is managed, other than in a roundtable approach, by a company internal management board, without any stakeholder participation.

Table 6: Assessment RSBA

Criteria	RSBA	
EU RED (Art. 17 [2-5]):	Implemenation: Yes=Y or No=N	Indicator:
1. Art. 17 [2]: Minimum GHG reduction threshold	Y	• RBSA_001: General Scheme • 3.3 Greenhouse Gas emission threshold • All batches of biofuel under this scheme will have a GHG emission obtained according to Annex V of the RED and EC communications (reference 2010 / C 160 / 01, and reference 2010 / C 160 / 02) in this matter When biofuel batches are to be dispatched in the point where the energy application is accounted to the purposes referred to Article 17.1 of the RED, the GHG saving issued according to this RBSA scheme will have to comply with thresholds established in Article 17.2 of the RED. This GHG saving shall be at least 35%. With effect from January 1, 2017, the GHG emission saving shall be at least 50%. And from January 1, 2018, GHG saving shall be at least 60% for biofuels produced in facilities where production started on or after January 1, 2017. The only exception permitted is for those batches of biofuel with a production pathway including facilities that were in operation on January 23, 2008 (grandfathering clause), for which the 35 % saving threshold is only applicable from April 1, 2013. No RBSA claim shall be made by any facility after this date without meeting the applicable GHG threshold. (Abengoa Bioenergy, 2011a) • RBSA_003: GHG Emission Methodology • 4 GHG emission calculation methodology description • GHG emissions must be calculated according to the general formula included in Annex V point C.1 in RED (Abengoa Bioenergy, 2011b)
2. Art. 17 [3] Protection of areas with high biodiversity	Y	• RBSA_004: Sustainable Maps Methodology • RED restrictions: • 4.1.1 Biodiversity requirement (RED, Article 17.3) • Point 4.1.1 fully covers the mandatory RED requirements
3. Art. 17 [4] Protection of high carbon stock areas	Y	• RBSA_004: Sustainable Maps Methodology • 4.1.2 Carbon stock requirement (RED, Article 17.4) • RBSA fulfillment: Point 4.1.2 fully covers the mandatory RED requirements
4. Art. 17 [5] Protection of areas designated as peatlands	Y	• RBSA_004: Sustainable Maps Methodology • 4.1.3 Peatland requirement (RED, Article 17.5) • Point 4.1.3 fully covers the the mandatory RED requirements
Extended ecological criteria:		
5. GHG emission savings (exceeding the EU RED)	N	• Not applicable
6. Protection of surface water and groundwater	N	• Not applicable
7. Preservation of Soil	N	• Not applicable
8. Protection of biodiversity	N	• Not applicable

The RSBA scheme as an industry scheme only covers the internal supply chain of the Abengoa Bioenergy company. After comparing the standard with the model, it turned out that, only the minimum requirements of the EU RED are covered by the RSBA, namely criteria 1. – 4. of the model. Therefore the same issue occurs with the 2nd criterion as in the ISCC and the RSB standard before. The extended ecological criteria are not covered at all.

3.4 Results of the analysis - An Overview

After the description of the results of each individual scheme standard, an answer to the sixth sub-question: *`How do 'three certification schemes (that fit RED)' score in terms of sustainability criteria?´* shall be provided in the next step. Therefore a table (see table 7) is created, in order to simplify a comparison of the schemes with each other, the legislative requirements of the RED and the extended ecological criteria. Furthermore a ranking of the performance of each scheme standard is done.

Table 7: Summary of results

Principles	Criteria	ISCC	RSB EU RED	RSBA
EU RED REQUIREMENTS	**EU RED (Art. 17 [2-5]):**	Implemenation: Yes=Y or No=N	Implemenation: Yes=Y or No=N	Implemenation: Yes=Y or No=N
	1. Art. 17 [2]: Minimum GHG reduction threshold	Y	Y	Y
	2. Art. 17 [3] Protection of areas with high biodiversity	Y	Y	Y
	3. Art. 17 [4] Protection of high carbon stock areas	Y	Y	Y
	4. Art. 17 [5] Protection of areas designated as peatlands	Y	Y	Y
	Extended ecological criteria:			
GHG Emission	**5. GHG emission savings (exceeding the EU RED)**	N	Y	N
Water	**6. Protection of surface water and groundwater**	Y	Y	N
Soil	**7. Preservation of Soil**	Y	Y	N
Biodiversity	**8. Protection of biodiversity**	Y	Y	N
Score		**7 out of 8**	**8 out of 8**	**4 out of 8**
Rank		**2nd**	**1st**	**3rd**

The selected schemes reflect example cases of the already existing and officially accredited schemes. The table gives an overview about the performance and scope of ecological sustainability criteria covered within the individual standards of voluntary certification schemes. Based on the results, it turned out that the selected schemes scored different in terms of the model, since their comprehensiveness on the extended ecological criteria varies greatly. While all standards under study matched the four EU RED requirements, the scores on the extended ecological criteria are making all the difference. Both, the RSB EU RED and the ISCC have a detailed criteria catalogue, regarding ecological sustainability on biofuel production. The RSB EU RED took the first place with a maximum of 8 out of 8 matched criteria. The second place, with 7 out of 8 matched criteria goes to the ISCC. The RSBA lags behind with only 4 out of 8 matched criteria, with only matching the EU RED requirements, as minimum requirement.

Part IV: Conclusion

4. Conclusion

The thesis dealt with the complex topic of bioenergy, specifically biofuels and its certification via voluntary certification schemes in context to long-term sustainability objectives within the EU and the legal context of the RED. Thereby the main research question was formulated: *`To what extent are voluntary certification schemes enhancing ecological sustainability in context to the production of biomass feedstock for biofuel production within the normative objectives of the RED´*, to catch up the objective of this thesis again, explained in section 1.2.

In order to answer this research question, it was sub dived into seven minor sub-questions, which were chronologically answered in the course of the theory in Part II. From section 2.1 on, providing an overview of the development and status quo of the energy policy within the EU, up to section 2.6 where the criteria were designed and elaborated, used for the analysis in Part III. Therewith the basis was build, in order to create a model for the analysis and to compare and rank the three selected voluntary certification schemes. Thereby the potential and efficiency of voluntary certification schemes was examined in form of a comparative table, presented in table 3. Table 7 illustrated the result and gave an overview, how the individual schemes performed in terms of the self-designed criteria, examined in 2.6.2.

In this last section the last sub-question: *Which conclusions can we draw from our findings and what recommendations can we add?´* shall be answered, as part of the main research objective.

The most important finding, revealed by the analysis is that there are great differences in performance and scope among the selected certification schemes and its standards. A positive finding was that all private voluntary certification schemes, as a form of co-regulation, implemented the minimum ecological requirements in their standards, as laid down in the RED.

Nevertheless the analysis revealed remarkable differences regarding the extent of the extended sustainability criteria covered, between individual voluntary certification scheme standards under study. With reference to the sustainability criteria, designed in section 2.6.2, only the RSB EU RED covered all criteria, while the ISCC covered 7 out 8, by missing the extended GHG emission saving criteria. The RSBA is missing all extended criteria, by only covering the legal minimum, as set out by the RED sustainability criteria.

Another finding was that the extent to what voluntary certification schemes enhancing ecological sustainability is depending on the standard of each individual voluntary certification scheme. It turned out, that the multi-stakeholder schemes (ISCC & RSB EU RED) showed a more comprehensive criteria catalogue, compared to the industry scheme (RSBA). The RSBA, as a so-called industry scheme for the internal supply chain of the Abengoa enterprise, is not directly subject to values external to Abengoa, as for example multi-stakeholder schemes involving NGO´s. The RSBA only covered the minimum sustainability requirements, laid down in the RED. Stakeholder participation is therefore identified as an important factor for the performance of a certification scheme.

The sustainability criteria designed in section 2.6.2, are not sufficiently covered by the RED and the individual scheme standards, except of the RSB EU RED. This insufficiency can be founded generally by two reasons. First, lack of multi-stakeholder involvement and second because of competitive pressure.

A balanced representation of interest via multiple stakeholders is important to comprehensiveness of a standard is important, since there exists no uniform and widely accepted legal framework that identifies all relevant objectives and/or contextually meaningful indicators, which are easy to measure and not to cost intensive. A reasonable explanation could be, that objectives are value-driven and are dependent on multiple stakeholders of different nature (e.g. NGOs, scientists, policymakers, industry representatives, etc.). The analysis of the three certification standards supports this statement. Stakeholders have differing perspectives about sustainability priorities and goals. The other possible reason is the competitive pressure for the certification schemes on the market. The certification schemes as private economic competitors on the market, only survive if they make profit on the market. This creates an incentive for the schemes, only to include the required legal minimum standards, in form of the RED criteria, in order to get officially recognized by the EC and enter the market or to certify products only by minimum requirements, as for example the Abengoa company.

Multi-Stakeholder participation is a key recommendation, while multi-stakeholder is ensuring a balanced representation of interests from different perspectives representing sectors of business, civil society, trade unions, government, academia and multi-lateral organizations as NGOs.

In general voluntary certification, as co-regulation, can be said to be a key tool in ensuring ecological sustainability in the biofuel production, by minimizing the negative ecological impacts. Nevertheless no certification standard is perfect and there is always room for improvement. Therefore further studies could promote certification schemes and improve the criteria for more efficient certification systems. The EC should expand its sustainability requirement on the entire field of biofuels and renewable energies in general. Further research in the field of biofuels, especially third generation biofuels is necessary and research of possible alternatives should be made in order to avoid negative ecological effects to the global ecosystem and to fight the global warming.

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Appendix:

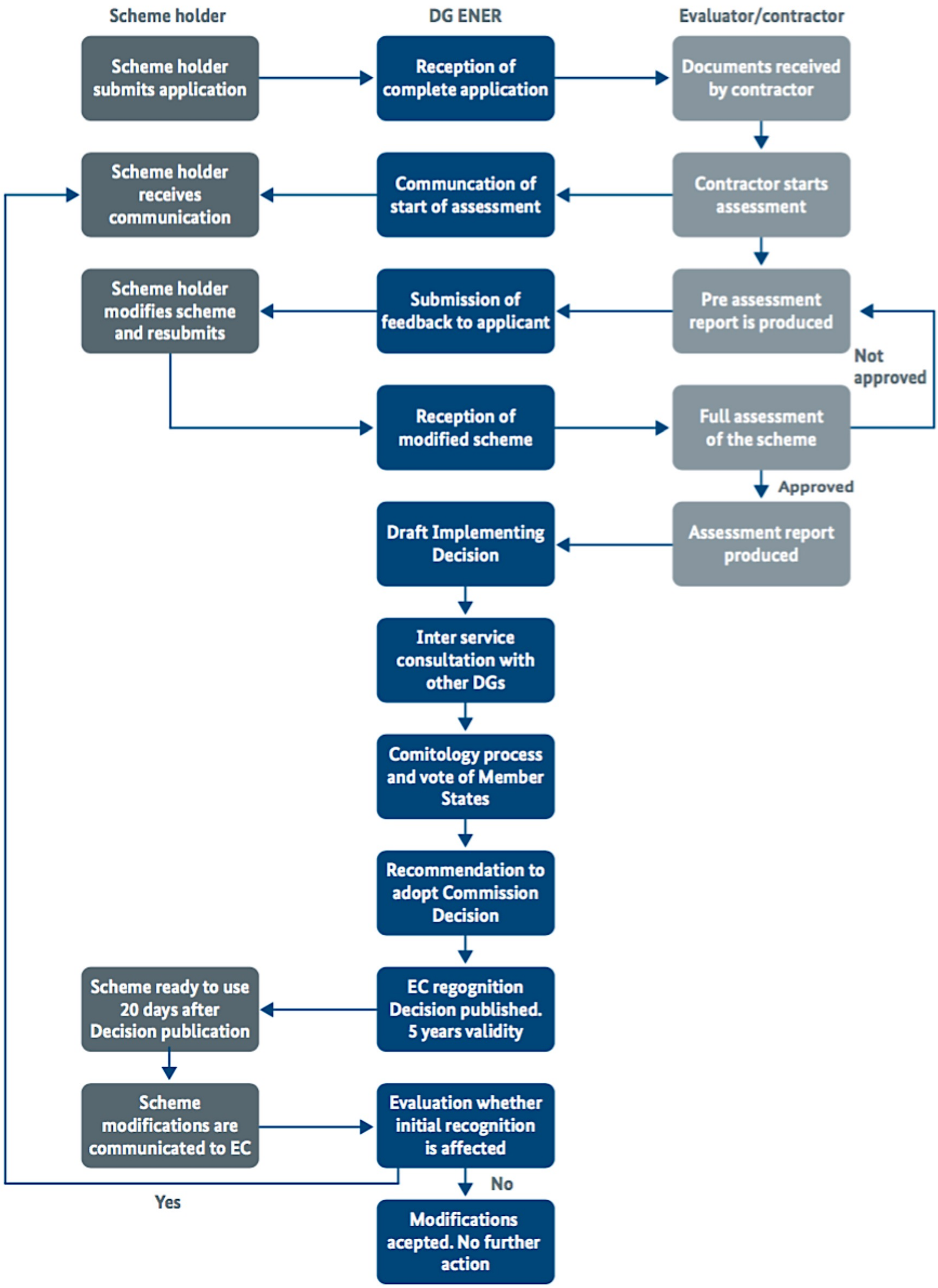
Table 1: Distribution of proved reserves of oil in total numbers & share in percent (2013*)

	Thousand million tonnes	Share of total %
	2013	**2013**
Asia Pacific	5.6	2.5
Africa	17.3	7.7
Middle East	109.4	47.9
Europe & Eurasia	19.9	8.8
North America	35.0	13.6
South & Central America	51.1	19.5
World	238.2	100

* at the end of the year

Source: (British Petroleum, 2014)

Figure 1: Process of European Commission recognition of certification schemes



Source: (Ugarte et al., 2013)

Table 2: Overview of recognized schemes (2016)

Name	Origin / Scope
International Sustainability and Carbon Certification (ISCC)	German (state-funded) multi-stakeholder certification schemes for all types of feedstock.
Bonsucro EU	Roundtable initiative for biofuels on the basis of sugar cane.
Round Table on Responsible Soy EU RED (RTRS EU RED)	Roundtable initiative for biofuels on the basis of soy.
Roundtable on Sustainable Biofuels EU RED (RSB EU RED)	Roundtable initiative for all types of feedstock.
Biomass Biofuels voluntary scheme (2BSvs)	French agribusiness initiative for all types of feedstock.
Abengoa RED Bioenergy Sustainability Assurance (RBSA)	Management scheme for the Abengoa supply chain for all types of feedstock.
Greenergy Brazilian Bioethanol verification programme (Greenergy)	Management scheme for the Brazilian company Greenery with the focus on sugarcane.
Ensus Voluntary Scheme under RED for Ensus Bioethanol Production (Ensus)	Ensue only applies to the production of bioethanol from Ensus Limited as economic operator only. The scheme covers feed wheat as feedstock and the fuel chain of custody from farm up to local Ensus bioethanol storage.
Red Tractor Farm Assurance Combinable Crops & Sugar Beet (Red Tractor)	British scheme, established by the entire food industry of the UK for combinable crops and sugar beet.
Scottish Quality Farm Assured Combinable Crops Limited (SQC)	Scottish scheme for all combinable crops.
Roundtable on Sustainable Palm Oil RED (RSPO)	Multi-stakeholder scheme with the focus on palm oil. Based in Zurich.
REDcert	German scheme, for all types of feedstock. Established by various stakeholder from the agribusiness and biofuels sector.
NTA 8080	Dutch certification scheme, based on the cramer criteria from 2007. Multi-stakeholder approach. For all types of feedstock.
Biograce GHG calculation tool	Dutch calculation tool for GHG emissions of biofuels.
HVO Renewable Diesel Scheme for Verification of Compliance with the RED sustainability criteria for biofuels	Scheme with global application, developed by Neste Oil, with the focus on all feedstock types, suitable for Hydrotreated Vegetable Oil biodiesel.
Gafta Trade Assurance Scheme	Scheme is established by the Grain and Feed Trade Association, as an international Trade Association for economic operators. For a wide range of feedstock.
KZR INiG System	Polish certification scheme, established by the Oil and Gas Institute in Poland (IniG) for a wide range of feedstock.
Trade Assurance Scheme for Combinable Crops	British chain of custody system for combinable crops, owned and managed by the Agricultural Industries Confederation.
Universal Feed Assurance Scheme	British chain of custody system for agricultural raw materials owned and managed by the Agricultural Industries Confederation.

Source: own representation, see: https://ec.europa.eu/energy/sites/ener/files/documents/voluntary schemes overview table to publish.pdf