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Review

PRISMA Statement for Reporting Literature Searches in Systematic Reviews of the Bioethanol Sector

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Abstract: The bioethanol sector is an extremely complex set of actors, technologies and market structures, influenced simultaneously by different natural, economic, social and political processes. That is why it lends itself to the application of system dynamics modelling. In last five years a relatively high level of experience and knowledge has accumulated related to the application of computer-aided system modelling for the analysis and forecasting of the bioethanol sector. The goal of the current paper is to offer a systematic review of the application of system dynamics models in order to better understand the structure, conduct and performance of the bioethanol sector. Our method has been the preferred reporting items for systematic reviews and meta-analyses (PRISMA), based on English-language materials published between 2015 and 2020. The results highlight that system dynamic models have become more and more complex, but as a consequence of the improvement in information technology and statistical systems, as well as the increasing experience gained they offer an efficient tool for decision makers in the business and political spheres. In the future, the combination of traditional system dynamics modelling and agent-based models will offer new perspectives for the preparation of more sophisticated description and forecasting.

Keywords: PRISMA statement; bioethanol; biofuel; review

1. Introduction

This paper summarizes the key results of the dynamic economic modelling of the bioethanol sector. We define the bioethanol sector as a set of economic activities and entities producing raw material for industrial production of bioethanol, the processing of these agricultural products to biocarburants, and the distribution of bioethanol and the by products of production to users.

As with many disciplines in various scientific fields, the future prospects of the bioethanol sector are very difficult to forecast [1]. This can be explained by the fact that the sector's economic positions are heavily dependent on processes occurring: (1) in the market of agricultural raw materials, which in itself is very turbulent in an era of global climate change [2] and oil price fluctuations [3]; (2) technological innovation in production [4]; (3) the market relations of by-products [5] and (4) the varying economic policies of different states [6]. It follows from this complexity that the bioethanol sector lends itself to the application of system dynamics [7], which is an emerging field of science, widely applied in modelling the economic aspects of energy supply systems [8]. Our aim has been to present the current approaches and results, because this can serve as a starting point for future model-building efforts. Numerous modelling studies have discussed how to delineate possible scenarios with given variables [9,10]. There are many ways to deal with the subject, including optimization models, discrete event simulation, network modelling and system dynamics. To fully cover the discipline's branches, a more advanced reporting system is needed to overview the topic. The preferred reporting items for systematic reviews and meta-analyses reporting guideline (PRISMA statement) is an appropriate method to include the relevant literature with adequate accuracy, and it is able to exclude any that is not relevant. This method of reporting is required in order to assess several treatments so as to gain a comprehensive understanding of the relative effectiveness, or possible harms, of the different treatment options [11].

The paper aims to target the available review articles on the current trends of the bioethanol sector, with special focus on the system dynamics literature. Our aim is to review the relevant studies by applying the PRISMA statement. This study is unique in the discipline since no such study (to the authors' best knowledge) has been done in this field. The consideration of a network of multiple assessments is essential to the study since the bioethanol sector has numerous modifying factors and stakeholders who operate from a wide range of perspectives. The variety of the network is also apparent in the fields related to the bioethanol sector; to name just a few: the sustainability of bioethanol, the feasibility of bioethanol in a country's economy, the environmental effects of various bioethanol production methods, the economic effects of the introduction of a new bioethanol production method, etc. In this paper the literature on the latter method of reporting will be discussed. To describe the process of transitioning towards biofuels (with an accentuated focus on bioethanol) a set of variables needs to be implemented and examined in nonlinear and complex equations [12].

2. Methodology

This research is based upon the assessment structure of the PRISMA statement presented in the Appendix A [3]. This reporting standard is widely used in the medical and health-care fields [13,14], and it is commonly accepted as a useful reporting guideline in those disciplines in order to enhance the completeness of the reporting of systematic reviews [15,16]. Numerous extensions have been added since the year it was published, to enable the reporting of different types of systematic reviews.

These extensions are as follows:

(1) PRISMA for abstracts
(2) PRISMA equity
(3) PRISMA harms (for reviews including harm outcomes)
(4) PRISMA individual patient data
(5) PRISMA for network meta-analyses
(6) PRISMA for protocols
(7) PRISMA for diagnostic test-accuracy
(8) Other extensions in development [17].

For this study we have applied the PRISMA-A extension [18]. Since this reporting guideline is primarily used in the healthcare and medical disciplines, the terminology used for the statement is sector oriented. To give an example, the term "treatments" is solely used to refer to actual physical (medicinal, etc.) treatments; however, in the focus sector of this paper this terminology is not applicable. To avoid any misunderstanding, an interpreted definition is provided by the authors. The related terminology use can be found in the appendices, in Table A1.

The studies considered for inclusion in our research must be eligible for a set of criteria, such as the required discipline(s) of science, publication period and languages. The types of studies considered eligible were systematic review publications of the bioethanol or biofuel sector by investigating the different scopes of said fields. One of the characteristics of the report included the time range in which the published literature was viewed. The publication year was set between 2015 and 2019 in order to work with the most recent data available, although earlier studies are also included because of the search for literature references in previously examined studies. We focused on the 2015–2019 time range, because—on the basis of an in-depth analysis of different electronic databases (Scopus, Web of Science, Google Scholar)—it became obvious that the overwhelming majority of relevant publications have appeared during this period. This can be explained by the fact that both the bioethanol sector and system dynamic modelling have achieved a certain level of maturity during this time, which has made a more detailed analysis possible.

The field is typically a multidisciplinary one. We made a preliminary analysis in the Web of Science (WoS), without setting a time limit, applying the search word system: (TS = "biethanol" or TS = "biodiesel" or TS = "bioetanol" or TS = "biofuel" AND TS = "system dynamics"), and obtained 113 results. The number of appearances of different articles according to different WoS categories (Figure 1) shows a wide range of disciplines covered by articles which could be potential candidates. Of course, we have to take into consideration the fact that a considerable proportion of these publications applied system dynamics to the analysis of the technological of physical distributional processes. One publication may appear more than once in one category.

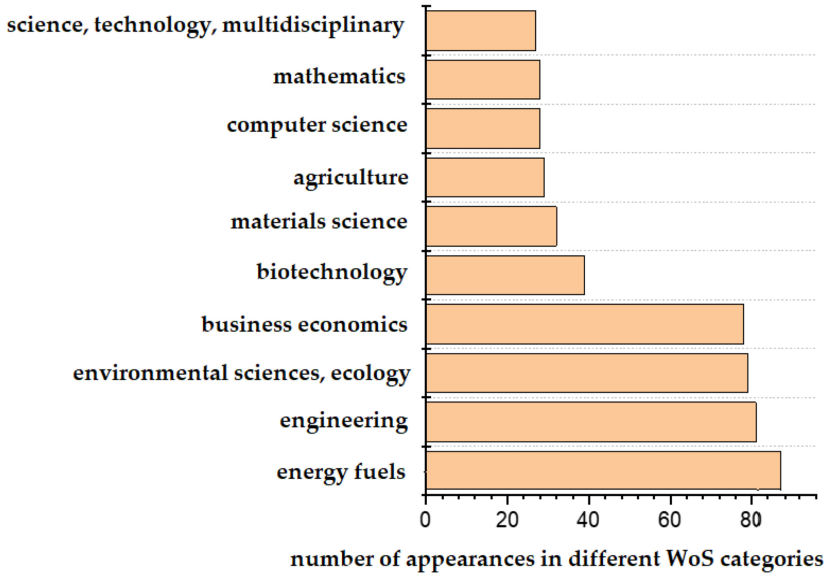

Figure 1. Number of articles concerning biofuel and system dynamics in Web of Science publications, appearing in different WoS categories (source: own research, 2020).

We applied both Scopus and Web of Science databases, but as a consequence of the rapidly developing characteristics of the discipline we tried to embrace as many academic resources as possible (including, for example, Ph.D dissertations), which is why our standard search tool was Google Scholar, although at each step we took into account the weaknesses of this search engine [19]. The dates of coverage were from 2015 to 2020. Other highlighted literature was selected through the reference lists of the extracted literature. The additional literature used in the study was extracted using several search engines: ScienceDirect, Science and Technology of Advanced Materials, PLOS ONE and the Directory of Open Access Journals. Further literature was found by using the reference lists of previously observed papers. The search for the highlighted literature for review in Table A2 was carried out using the following strategy: Keywords = (bioethanol"; "system dynamics", "model"). Language = (English). Time range= (2015–2020). This keyword system was formulated on the basis of the following procedure: we applied different keyword combinations in the Web of Science system, to search for publications on the results of the application of system dynamics in various economic fields; then the results were analysed by the natural language processing algorithm Chen et al. [20] of the Biblioshiny package (Biblioshiny, 2.0, University of Naples Frederico II. Italy, Authors: Aria M. and Cuccurullo, C. (2017)) [21]. On this basis the best results were obtained by constructing a query which consisted of three parts: the product, (in our case bioethanol), and the two most characteristic words of the method applied: "system dynamics" and "model". The Google string used in the basic search was the following: https://scholar.google.com/scholar?as_q=&as_epq=&as_oq=&as_eq=&as_occt=any&as_sauthors=&as_publication=&as_ylo=2015&as_yhi=2020&hl=hu&as_sdt=0%2C5.

It is only relevant to show the selection of the highlighted and to be assessed literature, hence the selection process of the highlighted literature for review follows accordingly. According to the PRISMA statement, a flow diagram needs to be provided to represent the steps of elimination, these being 'identification, screening, eligibility and final inclusion". The process of elimination of the studies is represented graphically in Figure 2.

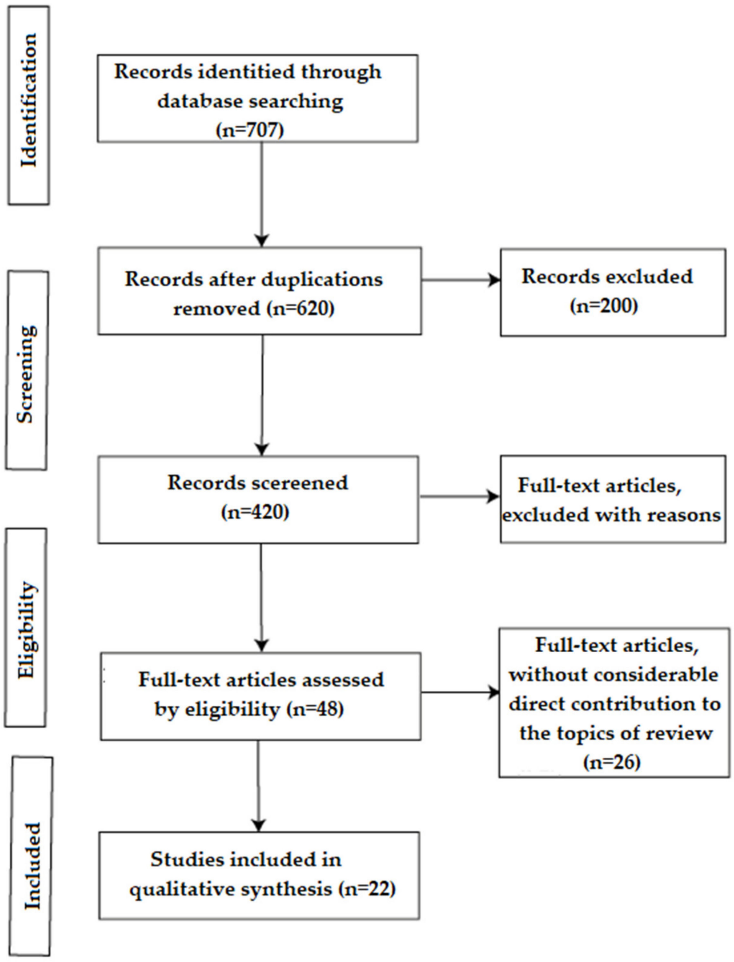

Figure 2. The PRISMA 2009 flow diagram of the search process for the highlighted and reviewed articles, according to Moher et al. Reproduced from Moher et al. [17], Springer 2009. (source: own research, 2020).

In the first step of elimination, the search process was conducted using the Google Scholar search engine, where 16,000 studies were listed. Applying the brackets around the search phrase "system dynamics" and narrowing the time scale to 2015–2020, we obtained 707 hits. The overwhelming majority of these references were evaluated as irrelevant from the point of view of our study, because they applied system dynamics modelling for the analysis of technological or physical distributional processes, broken links, or the kinds of summary which were irrelevant for our work.

Additional literature was included from the examination of the reference lists in the list of the literature extracted. At the screening step, 87 duplicates were identified. During this phase, 420 records were examined solely on basis of the title and keywords. After the elimination of 177 studies, 48 full-text studies were assessed for eligibility. After the full-text review, 26 studies were excluded for differing reasons, hence a final total of 22 system dynamics studies were selected.

Each of the remaining 22 studies was examined, and the data relevant for this paper was gathered and tabulated accordingly. The appropriate information collected is as follows:

(1) Author(s) of the literature.
(2) Year of publication.
(3) Country of study.
(4) Scope/product of research
(5) Input (extern) variables, not influenced by the system.
(6) Loop variables, having a feedback effect in the system.
(7) Brief summary of results

Simplifications and assumptions were needed in order to gather the data under each scope. The reasoning behind this is that each of the authors of the highlighted studies interpreted the principles of system dynamics differently, hence diverse approaches were applied to the accumulated structure of the models. This meant the appearance of differences in the input variables and the various alterations in the methodology of using the loop variables. The authors took the liberty to make assumptions and to introduce simplifications into the system with the aim of providing a more transparent and easily interpretable table. Such assumptions were, for example, to merge the terms 'price of ethanol', 'ethanol price', 'selling price of ethanol' etc. and simplify them as 'ethanol price'. Multiple merges have been carried out, including the afore-mentioned example. The variables were gathered, summarized and tabulated from the highlighted literature. No indication of importance was established by the order of the variables.

The assessment of risk of bias of individual studies was conducted at the study level since the outcomes of the papers differed at an incomparable level. The approaches of different papers are highly diverse, which is why the biases in the studies were evaluated separately from each other, on a case-by-case basis. The variables across the studies were positioned along a wide scale, hence the introduction of scopes of studies. The introduction of the scopes meant a level of assumption through the classification which may lead to an appearance of bias within as well as across the studies.

The principal summary measure of the collection of data was to standardize the different input variables within the scopes of the studies. We have summarised the different studies on base of their scope.

2.1. Input Variables

Table 1 shows the list of the most important input assumptions which needed to be made in order to create a unified, clean system for the collected data.

Table 1. List of input variables according to the scopes of the research.

Scope of Research	Number of Studies	Variables Characteristic for Scope
Feasibility	4	Commodities demand, commodities land use, commodities price, commodities production, commodities stock, commodities yield, DDG + S production, environmental impact, ethanol demand, ethanol land use, ethanol price, ethanol production, ethanol stock, ethanol yield, food demand for grain, fuel demand, fuel export, fuel import, fuel price, fuel stock, GHG emissions, investments, grain demand for livestock, planted area, production cost, subsidy.
Food security (*)	2	Biofuel demand, population trends, food demand, food production, food price, food for biofuel, land under cultivation, land productivity, remaining potential agricultural land.
Green economy transition *	2	Biofuel production, biofuel demand, by-products of biofuel production, fossil fuel market, employment due to biofuel production, profitability of biofuel, biofuel production cost, GDP, investment into biofuel (green economy), population trends.
Incentives *	1	Biofuel demand, biofuel price, biofuels production, fuel demand, incentives to crops and to refining, investment in capacity and in crops, mix percentage, refining capacity, refining profits.
Policy making	1	Ethanol price, sugar price, gasoline price, ethanol demand, expected production costs, effect of cost on price, effect of investment coverage on price, GDP, accumulated production, perceived investment coverage, expected profits.
Production (*)	4	Allocation of commodities to ethanol production, allocation of commodities to food and animal feed, available land for farming, biofuel capacity, biofuel capacity expansion, biofuel consumption, biofuel price, biofuel production, biofuel shortage, biological residue, births, commodities price, commodities production, deaths, desire to produce biofuels, ecological impacts, employment creation, environmental pollution, ethanol demand, ethanol price, ethanol production, ethanol production investment, fossil fuel consumption, fossil fuel demand, fossil fuel price, fossil fuel shortage, fuel demand, gap between ethanol demand and supply, GDP, green economy investments, incentives, investments, biofuel demand, population, profitability, total production costs, transportation need, work force demand.
Sustainability (*)	3	Ethanol production, ethanol distribution, ethanol demand, ethanol price, ethanol production efficiency, ethanol investments, gasoline demand, gasoline price, productivity, resource production, resource distribution, resource price, resource demand, resource production rate, resource allocation to production, land use, land availability, water consumption, environmental pollution, social impacts.
Waste management	1	Bioethanol production, bioethanol inventory, harvest performance, crop yield vs. milling yield, planting vs. harvest, bagasse and vinasse recirculation, composting.
Water footprint	1	Industrial water consumption, domestic water consumption, water availability, rainwater volume, water footprints (agriculture and ethanol production), water consumption (green and blue), grey water generation, land availability, food demand, livestock demand, ethanol demand.

* means that each study included in the given scope is concerned solely with biofuels; (*) means that some studies included in the given scope are concerned with biofuels. Source: Own research, 2020.

2.2. Loop Variables

Table 2 presents the list of loop variables across the scopes. In system dynamics the loops represent feedback effects among the input variables. There are two types of feedback loops: the balancing and reinforcing feedbacks, although these can be used deliberately across the models, while some studies contain thousands of them. The dynamics of all systems are rooted in the interaction of these two loop types [22].

Table 2. List of loop variables according to the scopes of the research.

Scope of Research	Number of Studies	Variables Appearing in Scopes
Feasibility	4	Balancing loops Behavior of ethanol, behavior of sugar, blending policy, demand and prices of ethanol and of gasoline, ethanol production and fossil fuel consumption, ethanol production cost and price ratio, ethanol production related emissions, ethanol production, feedstock for an ethanol plant and production rate, gasoline production, GHG emissions and oil imports, land use and need, oil cost and consumption, production amount, sugarcane consumption and production, sugarcane availability and need. Reinforcing loops Average age and productivity of the sugarcane, fuel imports and stock, GHG emission savings and related taxes, green harvest policies, influence of costs on profit, investment, national consumption of ethanol, national sales, oil consumption and price, production, productivity, sugar demand.
Food security (*)	2	Balancing loops Biofuel crop land and price, biofuel demand and inventory, food inventory and price, land transfer and food cropland. Reinforcing loops Biofuel cropland and production, fuel demand and biofuel demand, population trend and fuel demand.
Green economy transition *	2	Balancing loops Death rates, ethanol production and fossil fuel use, learning curve and production costs. Reinforcing loops Birth rates, by-products and profitability, employment and GDP, ethanol production and costs, green economy investments and production, production and employment, production and land use, production and profitability, production and water demand.
Incentives *	1	Balancing loop Shortage of crops and incentives. Reinforcing loops Biofuel production and surplus of refining capacity, incentives and refining capacity and profits, refining, surplus of crops capacity and biofuel production.
Policy making	1	Balancing loops Capacity adjustment, demand adjustment, feedstock adjustment, production adjustment, supply substitution. Reinforcing loop Learning curve.

Table 2. *Cont.*

Scope of Research	Number of Studies	Variables Appearing in Scopes
Production (*)	4	Balancing loops Biofuel and fossil fuel consumption, biofuel capacity, biofuel price, corn price, deaths, environmental effects, fossil fuel price, government tax incentives, price, sugar beet production area. Reinforcing loops Biofuel demand, births, capacity building, commercial scale financials, corn production, economic effects, industry development, industry production and capacity, land use, level of ethanol, pioneer scale financials, water usage.
Sustainability (*)	3	Balancing loops Ethanol production and distribution, ethanol to sell and inventory, land use, price and demand (of sugar, sugarcane, ethanol and gasoline), production and water consumption, wastewater generation. Reinforcing loops Employment generation, environmental pollution, ethanol production and investments, production and efficiency, sugarcane demand and planting, sugarcane production and ethanol production.
Waste management	1	Balancing loops Plantation and harvest, production and inventory of ethanol, treatment of vinasse. Reinforcing loops Inventory and sales, milling and production of bagasse.
Water footprint	1	Balancing loops Consumption and stock, planting and available land, production of ethanol and feedstock. Reinforcing loops Available land and production, production and consumption.

* means that each study included in the given scope is concerned solely with biofuels; (*) means that some of the studies included in the given scope are concerned with biofuels. Source: Own research, 2020.

A balancing loop consists of a negative and a positive feedback effect (hence the name), striving for balance within the system. It provides stability and sets a limit to the system as well as helping to maintain the natural equilibrium of the system examined [23]. The reinforcing loop is made of positive effects, which reinforce each other's behaviour. The amplification of effects is modelled, and an exponential growth or a collapse is observed at this loop type [23]. A unification of loop variables among all the papers included in a given scope was made.

3. Literature Review and Results

3.1. Study Selection and Characteristics

Additional analyses were included. Table 3 shows the distribution of studies according to the year of publication. Most of the literature used was published in 2015, and 68% of the studies go back no more than 3 years. It is relevant to use up to date references in order to give the most relevant data possible.

Table 3. Distribution of publications by year of appearance and country of focus.

Distribution of Publications by Year of Appearance		Distribution of Publications by Country of Focus	
Year	**Number of Publications**	**Country/Region Concerned**	**Number of Publications**
2009	1	Brazil	4
2010	1	Columbia	5
2011	0	Ethiopia	1
2012	2	EU	1
2013	0	Germany	1
2014	2	Ghana	1
2015	5	Indonesia	1
2016	3	Mexico	2
2017	4	South Africa	3
2018	1	Taiwan	1
2019	2	USA	2
2020	1		

Source: own research, 2020.

Table 3 shows the distribution of studies across the countries of interest. The distribution roughly represents the level of interest of the countries in the sector. It is commonly known that Brazil is one of the top countries regarding bioethanol production, along with the United States of America [24]. Colombia, Mexico and growing number of African countries are on the edge of using bioethanol as one of the main sources of fuel, to reduce dependence on fossil fuel imports. These countries are emerging from their previous low ranks, managing to be ranked among the top 15 bioethanol producing countries [25]. The European Union although Germany is the sixth main bioethanol producer is the third in the list of producers [24,26].

All the literature listed in Table A2 has the same characteristics in terms of using the modelling principles of system dynamics. System dynamics is a powerful tool to assess the effects of changes within a complex system [23]. System dynamics models are the 'structural, behavioural representations of systems', in which the structure of a system includes four elements: feedback loops (balancing and reinforcing), stocks, flows and nonlinearities [22]. The approach can provide a wider perspective on any system (including the bioethanol system) and it is able to take into account the mutual dependencies and feedback loops over time [12].

Both a disadvantage and strength of the model is that it requires an enormous amount of data and variables in order to represent the present and future aspects as accurately as possible [27]. Study sizes vary from tens of variables to tens of thousands. The wider the pool of variables, the more accurately the model can mimic reality, although the more complex and harder to understand it becomes. Most of the literature being reviewed eleven papers out of nineteen used the data extraction method of employing historical data from previous studies, as well as databases. Most of the databases were governmental data, but there was one case which used a case study. The study by Jonker et al. [27] used data exportation from small scale pilot projects located in South Africa and medium to large scale pilot projects' data from other countries. Only 15% of the highlighted literature uses the method of building up a research group of professionals from all relevant disciplines. Interviews with experts in different disciplines were held. An interview was conducted among them in order to gather all the relevant data to use as variables in the models. Ansah [28] uses the combination of gathered data from databases and interviewing a group of experts. The remaining 15% of the papers did not state the source of the data they used.

3.2. Risk of Bias Within Studies

The introduction of variable assumptions in order to unify the studies involved a certain level of risk of bias, but it was not considered relevant enough to call the data and outcomes into question.

3.3. Results of Individual Studies

Each of the paragraphs included under the scopes describes the characteristics and outcomes of each highlighted study. The introduction of the methods used was presented in detail. The data extraction methods and the data items were also discussed in depth. Nine different scopes were established by the authors, namely, the 'scope of feasibility', 'scope of food security', 'scope of green economy transition', 'scope of incentives', 'scope of policy making', 'scope of production', 'scope of sustainability', 'scope of waste management' and the 'scope of water footprint'. A tabulated data epitome was provided of both input and loop variables to summarize the wide spectrum of the different scopes. Each scope and its individual studies were assessed.

The studies included in this scope represent the measures taken in order to achieve the feasibility of applying bioethanol (or biofuels in general) to the public economy, making sure the fewest compromises are made along the way. Policy suggestions and threshold limits are suggested to achieve the individually pre-set goals.

Demczuk and Padula [23] present four main simulation scenarios (and many others), where the highest outcome value (i.e., the harvested area) occurred in simulation 4, with a higher initial yield and a reduced rate value added tax (VAT) of 12%. Even these highest outcomes are not sufficient to satisfy the ethanol demand of the region (the region being in Brazil). Another important variable is the pump price of regular gasoline. The Brazilian government artificially reduces the price of gasoline, endangering the demand for ethanol-containing fuels. If it had not been for the 2011 governmental change in the gas price, the ethanol sector would have increased in this region. Further simulations were run to show the effect of an aggressive tax rate reduction to 6% and 0%, respectively, but no significant increase in harvested area could be demonstrated. A seventh simulation was made to answer the question of whether the pump price of gasoline could guarantee the production of ethanol. Only an unrealistically high price would achieve the required goal. Overall, a production mix of hydrous ethanol, anhydrous ethanol, sugar and bioelectricity would generate a considerably higher revenue. Further questions are raised following this study.

Jiménez et al. [29] report results from Colombia which present a woeful scenario. Sugar production in the long run would not increase, and what is more, a decrease from the current 2.1 million tons per year to 1.7 million could be expected. Currently, the Colombian government provides subsidies in order to encourage production, which has resulted in a growing ethanol sector. The paper offers three strategic alternatives to avoid (the currently ongoing) difficulties in the field.

In order to achieve more independence in terms of energy dependence, Nigatu [30] shows that Ethiopia needs to produce more energy. From among the many alternatives, biofuel production is a feasible solution. In order to achieve these goals, an interdisciplinary, multi-level complex system should be developed. Theoretically, using input data related to the sugar industry, land, water and capital, it would be possible to increase ethanol production to over 300,000 tons per year. Policy scenarios were analyzed for improved production and consumption performances [31]. Ethanol consumption is mainly driven by the existing price difference. The quantity of the available resources (i.e., natural resources, land, water) sets a limit on production. It was shown that finding an appropriate blending strategy could stimulate production.

Rendon-Sagardi et al. [32] published a study with five scenarios which were created to simulate the feasibility of ethanol production in Mexico between 2014 and 2030. Following a system dynamic approach, a sensitivity analysis of the scenarios was held. The result revealed that in the current situation (in terms of conditions and policy) the country is net importing in fuel production (because of the lack of crude oil). An increase in imports is predicted to fulfil the demand. This is both economically and environmentally undesirable [16]. Blends were tested to offer a solution, but no satisfactory result was achieved. It is worth noting that the use of ethanol as an alternative fuel would reduce CO_2 emissions by approximately 1.2 million tonnes between 2014 and 2030. Since none of the scenarios produced a solution to the feasibility question, no recommendations were made, although the authors concluded that in Mexico it is seen as the beginning of a transition process to using more ethanol as biofuels.

3.3.1. Scope of Food Security

The scope of food security gathers studies related to the effects of bioethanol production on the food industry sector, mainly on the phenomenon of land use changes and the threat of rises in food prices. Ansah [28] shows that Africa has a great potential for rapid bioethanol production development: already numerous investments have been made by both local and international investors due to its presumably abundant land, the presence of an inexpensive work force and the 'preferential access to protected markets'. Special attention is needed from policy makers to make sure the biofuel rush does not affect food security drastically. A rise in food prices may occur if intense agricultural land use for feedstock production of biofuel appears [33].

The study by Papachristos and Adamides [34] states that beyond a certain threshold, the rate by which biofuel production increases in the European Union will negatively affect the production of food commodities. The policies and the incentives in regard of biofuels need to be examined.

3.3.2. Scope of Greening of the Economy

The scope of the greening of the economy presents the difficulties of transitioning to more environmentally feasible alternatives from non-renewable resources. Such a transitioning system approach is required in order to shift to biofuels from the ongoing dependence on fossil fuels.

Jonker et al. [35] publicized a study made to show a green economy transition to biofuels (bioethanol and biodiesel). The summary section of our research only focuses on the bioethanol sector; hence there may be some missing data. It was found that one of the pressures related to bioethanol production is the availability of feedstock. Land availability is crucial to the transition and production of biofuels. Four recommendations were made by the author: to increase the amount of triticale commodities; to properly manage or reduce capital expenditure; to reduce operational costs by procuration of biomass through an "invasive alien species land clearing scheme", and to locate the bioethanol plant near the production site of commodities.

Jonker et al. [35] rewrote his previously mentioned 2015 study with other co-authors (hence Jonker et al.). The reconducted study still assesses the biofuel field, i.e., bioethanol and biodiesel. Multiple scenarios were tested, and a recommendation of a scenario of use was made. The scenario recommended that bioethanol should be produced in local scale, applying biomass for process heat. Three factors are listed that needed to be addressed: improvement of feedstock availability (by using uncultivated marginal land), reduction of capital costs (by introducing alternative financial options) and an incorporation of bioethanol production to invade 'alien land'. Despite no sufficient data being available from the region, it is concluded that the system dynamics approach is well applicable for the analysis of the complex system as it can provide a good insight into the main drivers and intervention possibilities.

3.3.3. Scope of Incentives

The presence of incentives to shift to and produce biofuels, especially bioethanol, is necessary in order to achieve the desired goals. Investment in the sector solely for the sake of business is not adequate. Governmental subsidies, tax allowances, and external incentives need to be present to encourage the production of commodities and the operation of refineries.

Franco et al. [36] conclude that the most relevant commodities for Colombia are sugarcane for bioethanol production and palm oil to produce biodiesel. According to the model scenarios, bioethanol production and sugar cane planting seem to be profitable. During each of the scenarios (even the base scenario) the supply of ethanol is ever-increasing. To maintain the increase in supply, an increase in investments (especially in refineries) needs to occur in parallel with supply growth.

3.3.4. Scope of Policy Making

Policies are both encouraging factors and limits to the growth of any sector. In order to achieve balance and to ensure the motivation of the most important aspects of a sector, the right policies need to be set. Going to the edge in any direction can lead to a collapse of the market and even the economy of the state itself.

According to Santos [37] and Meyer and Meyer [38] government policies (case studies from Brazil, Poland and South Africa) need to be composed of both short- and long-term policies. The system is 'highly resistant' to policies. An increase in gasoline prices would achieve the same effect as the current subsidy system for the other alternatives, only the investment made by the government would decrease (financially). An effective alternative could be a long-term policy to differentiate production in terms of corn use [39]. An increase in productivity means prices decrease, leading to lower profits. Ethanol production is highly correlated with the sugar and gasoline sectors, which might seem obvious, but previous studies have shown a weak link between sugar production and ethanol production (this stresses the use of system dynamics). Despite all this, the future seems promising as the industry is expected to grow.

3.3.5. Scope of Production

The scope of production might be the most diverse of all. To include a study here, an appropriate means of assessing the production alternatives and processes was needed. Many of the papers included here could be feasible for other scopes as well.

Jonker et al. [27] presents the current structure of the biofuel sector in South Africa. Although this paper does not fall solely under the scope of production, it is listed here due to the extensive elaboration of production processes. The literature also assesses aspects of the green economy transition as well as feasibility predictions. It concludes that triticale and canola can feasibly become part of the transition to a greener economy in the Western Cape Province, in South Africa.

In the study by Rozman et al. [40] on Germany, a simulation of a sugar beet method was done by a preliminary system dynamics model. This improves the decision making processes and helps build policies. Economic analysis was run using a spreadsheet process simulation model. The results show that with the set parameters, sugar beet production is economically feasible. Further, a multi-criteria AHP (analytical hierarchical process) analysis was used to show that sugar and biogas are the most suitable alternatives for investment.

Vimmerstedt et al. [41] emphasizes the need to use holistic models to create a transparent and understandable system. System dynamics can stimulate variables over time, helping to understand different aspects which have effects on the system such as incentives, investments or impacts of policies. This paper utilizes a new-fangled method to create the model: applying the biomass scenario model (BSM) as a system dynamics approach. The similar outcomes with other solely system dynamics-based papers show the viability of the model and justify its inclusion. The model locates the holdups in the supply chain and presents an effect of incentive magnitude to tackle with the problems. The paper concludes that in the case of rapid industry growth, a shortage of resources for refinery construction and a competition in feedstock utilization between feed and fuel production may arise. It concludes that cellulose based ethanol will be capable to rapidly respond to the changes in the sector, unlike its 'opponents'.

Kibira et al. [42] presents the current state and future prospects of bioethanol production in USA. It is stated that corn as a commodity is the most viable option to produce bioethanol. The further improvement of farm technologies will push the productivity of farmland. The authors raise awareness that the increasing use of corn as a commodity for bioethanol will subsequently increase the price of food. The model includes four sectors: primary and secondary ethanol production, the utilization of energy and monetary flows [43]. It was a challenging task to find the relevant relationships between these factors.

3.3.6. Scope of Sustainability

The scope of sustainability focuses on the main aspects of sustainability tackled by the bioethanol (or biofuel) sector. Magda et al. [44] state that renewable energy sources are vital for long term sustainability. Under the current pressure of achieving sustainability goals and creating a sustainable economic environment, this scope is increasingly required [30].

Guevara et al. [45] state that sugarcane production demand is increasing due to economic pressure and ethanol production demand (this is due to the introduction of ethanol-run-cars) in Brazil. Intensified technologies create an increase in productivity that leads to a dependence on external inputs for economic sustainability. The future causes of global warming will also affect sugarcane production through extreme temperatures and weather. The potential solutions lie in establishing and maintaining resilient corps against extreme weather, identifying the types of production systems, providing land to fulfil the growing production demand, minimizing price volatility, developing new technologies for planting and harvesting, and maximizing the performance of production units.

The study by Ibarra-Vega [46] uses the system dynamics model to evaluate the sustainability indicators in the Colombian biofuel sector. It was found that the system dynamics approach can accurately represent the sustainability indicators such as water use and employment rates, which are necessary to assess the sustainability of the production of biofuels. The policies implemented to increase employment by 80% are improving the outlook as well as leading the system. Silva et al. [47] shares the content of the publication of Guevara et al. [45] since the primary and secondary authors are Silva and Guevara. No further conclusion is derived.

3.3.7. Scope of Waste Management

As is presented in the literature review paragraph below, the current status of the bioethanol sector (as with the majority of industries) has the feature that the higher capacity the industry produces products at, the greater the negative environmental impact it has. Hence the simulation of different waste management scenarios is undoubtedly critical.

Ibarra-Vega [46] established a system dynamics model of scenarios for the waste management of the bioethanol industry. Different scenarios represent how variables and initial conditions affect the waste generation of the industry. It was shown that the higher the production capacity of bioethanol production, the greater the environmental burden which would appear. It is essential to link the by-product combustions to the production chain combustion in order to gather together all impacting factors.

3.3.8. Scope of Water Footprint

The analysis of the scope of the water footprint is essential and goes hand in hand with the justifications provided for the scope of sustainability. A thorough assessment of environmental and economic factors is needed in order to enable the industry to lower the water footprint of ethanol production as much as possible.

Trujillo-Mata et al. [48] and Svazas et al. [49] emphasize the importance of using system dynamics to evaluate the water footprint of bioethanol production since this resource type is the most abundantly utilized in the supply chain of bioethanol production. It concludes that the establishment of a CLD (causal loop diagram) is an effective tool to assess the effects of certain steps taken in the production line regarding the water footprint.

3.4. Synthesis of Results

The synthesis of results will be conducted according to the established scopes in order to unify the findings. Each scope collects the main input variables and loop variables of each model within the individual domains. The scope of feasibility connects the input variables and loop variables of the four studies included. The main variables across the studies were found to be 'ethanol price', 'ethanol demand', 'ethanol land use', 'investments', 'fuel demand', 'fuel export', 'fuel import' and 'subsidy'. These factors seemed to be relevant in most cases, thus different methods of extracting the variables were used across the studies.

The loop variables of the scope mostly differed in terms of the balancing loop level: a variety of loops were identified across the studies. A general accordance was shown by including the balancing loops of 'ethanol production cost and price ratio', 'land use and need', 'sugarcane/commodity/consumption and production' and 'sugarcane/commodity/availability and need'. The most relevant reinforcing loops appeared to be 'fuel imports and stock', 'influence of costs on the profit', 'investment', 'national consumption of ethanol', 'oil consumption and price', 'productivity' and 'sugar demand'.

The startling finding of the analyses of this scope was the lack of interest in environmental effects and the lack of consideration of greenhouse gas emissions. Variables related to this topic have appeared, but no significant impact was demonstrated with the model. The main focus of the variables was the economic factors of the production processes.

The input variables of the food security scope were more persistent, although two studies were included in the domain, hence no amplitude of bias can occur. The scope included papers each dealing with the biofuel and bioethanol sectors severally. The most relevant input variables were 'biofuel demand', 'land productivity', 'potential agricultural land remaining', 'food production', 'food price' and 'food for biofuel'.

As could be predicted, the importance of land use and according changes are represented in the model. The food price is also accurately represented.

The balancing loops of the scope include 'biofuel crop land and price', 'biofuel demand and inventory', 'food inventory and price' and 'land transfer and food croplands'. If the biofuel crop increases (hence the production grows), the price of biofuel decreases. At first sight, a contradictory loop 'Biofuel demand and inventory' was found, although the explanation for including the loop in the balancing sector is that if the demand for the product increases, the stock (inventory) of such a product will decrease. The other balancing loop variables follow the same train of thought. The reinforcing loops show the supporting dynamics between 'biofuel cropland and production', 'fuel demand and biofuel demand' and 'population trend and fuel demand'. It is questionable that population growth directly positively effects fuel demand, but for the sake of consumerism and growing use of transport, this factor is feasible.

The food security scope was expected to focus mainly on the connection between food prices and biofuel (bioethanol) production, but a more equalized model system was determined. The related important phenomenon of land use change was adequately represented.

The input variables of the two publications on the scope of the green economy transition focused on all aspects related to biofuels: 'biofuel production', 'biofuel demand', 'by-products of biofuel production', 'profitability of biofuel', 'biofuel production cost', and 'investment into biofuel', and also on other aspects such as 'fossil fuel demand' and 'population trends'. Although population trends seem to appear in most of the variables of the studies, it was found most relevant in the green economy transition scope. The variable of 'investment in biofuel' is the main aspect of the green economy.

The loop variables are chosen in appropriate accordance with the input variables: both the balancing and reinforcing loops represent the population trends (balancing loop: 'death rates', reinforcing loop: 'birth rates'). The balancing loops also include the 'ethanol production and fossil fuel use' and 'learning curve and production costs' loops. The balancing loop of 'ethanol production and fossil fuel use' seems to be interpretable in only one way: if fossil fuel use decreases, ethanol production increases in order to satisfy the demand. But the option of an ethanol production increase does not imply a decrease in fossil fuel use. This might have a puzzling effect on the model. The reinforcing loops seem to show no confusing effect. The most relevant ones include 'ethanol production and costs', 'green economy investments and production', 'production and profitability', and 'production and water demand', although a multiple reinforcing loop variable focuses on the connection among employment rates, GDP and production.

The variables (aside from the one questionable balancing loop described) seem to be in conjunction with the scope. The input variables describe the idiosyncrasy of the scope well, and the loop variables represent the dynamics sensibly.

The scope of incentives includes one study; hence no comparison was made in this domain. The ideal study would include multiple studies under the same scope although the number of studies in the literature was not adequate.

The input variables focused on the different aspects of the biofuel production line: 'biofuel demand', 'biofuel price', 'biofuel production' and on other aspects such as 'fuel demand', 'incentives to crops and to refining', 'investment in capacity and in crops', 'mix percentage', 'refining capacity' and 'refining profits'. The variable 'mix percentage' means the proportion of biofuel mixed in with gasoline.

The variables focus more on the industry of the biofuel refineries, and less on land use or population trends. The variables used were adequate in describing the scope, although more variables could justifiably have been included.

The scope included one balancing variable, the 'shortage of crops and incentives'. This is a well formulated balancing loop since an increase in the amount of incentives determines the decrease in the shortage of crops. The reinforcing loops–as was also found in the input variables–focus on the refinery sector of the field. This includes 'biofuel production and surplus of refining capacity', 'incentives and refining capacity and profits', 'refining' and 'surplus of crop capacity and biofuel production'. These are all axiomatic, hence no further explanation is required.

The scope of policy making describes the variables of two studies. The same implication as above is in force. This scope focuses on the policies which need to be implemented or modified as regards the bioethanol market.

The input variables include the ethanol related variables such as 'ethanol price' and 'ethanol demand', further price factors as 'sugar price', 'gasoline price', 'effect of cost on price', 'effect of investment coverage on price' and 'expected production costs', and other variables such as 'GDP', 'accumulated production', 'perceived investment coverage' and 'expected profits'.

The balancing loop variables that denote an equalizer effect are the adjustments of 'capacity', 'demand', 'feedstock' and 'production'; and the loop of 'supply substitution'. There is just one reinforcing loop in the model, i.e., the 'learning curve'. The 'learning curve' represents the R + D approach and mimics development by creating a broader knowledge of the industry. This is a reinforcing loop since the more knowledge of an industry has been acquired the better will be the decisions made, in all aspects (such as those relating to production, or policy making).

The scope of production includes four studies. Two of them manage the models of bioethanol production, and the two remaining provide a list of a general model of the biofuel sector. The most relevant inputs can be categorized, in order to provide a simpler layout, and include inputs related to bioethanol, biofuels, fossil fuels, demography, finance, ecological impacts, and economics, as well as those that cannot be categorized. Bioethanol related variables include 'ethanol demand', 'ethanol price', 'ethanol production', 'investments into the ethanol production' and 'allocation of commodities to ethanol production'. The biofuels related category includes 'biofuel demand', 'biofuel price', 'biofuel production', 'biofuel shortage', 'biofuel consumption', 'biofuel capacity expansion' and 'desire to produce biofuels'. The variables of the two categories are fairly similar, hence the two subjects of the modelling (bioethanol and biofuels) can be co-examined so as to extract outcomes even in one field. The other variables are not listed simply to avoid ambiguity. The variables include those that have already been listed and those which obviously need to be included in the model.

As it was foreseeable, the production scope is the scope with the widest range of variables being used; this is no surprise, since this is the most diversified discipline in the sector.

The loop variables are no different: both the balancing and reinforcing loop variables are widely diversified. The balancing loops include, inter alia, 'biofuel and fossil fuel consumption', 'corn/commodity/price' and 'environmental effects'. The reinforcing, hence propulsive, loops present the same phenomenon: they include, inter alia, 'capacity building', 'pioneer scale financials' and 'land use'.

The variables under the scope show a wide diversity of interests among each other. This can create both positive and negative effects. On the one hand, the level of diversity enables the model to mimic reality more truthfully, while on the other hand the lack of focus on one field might oversimplify all the other contributing inputs.

The scope of sustainability compares the variables of three different publications. They each highlight the use of the following variables, alongside numerous others: 'ethanol/ biofuel/production', 'ethanol/biofuel/demand', 'ethanol/biofuel/price', 'resource production', 'resource demand', 'resource price', 'land use', 'water consumption' and 'environmental pollution'. From this list, the latter three variables are worth mentioning separately. These three variables ensure the model focuses on the sustainability aspects of the sector. Although numerous scopes had previously included these variables, they were only mentioned on the periphery. These models include them in the focus, enabling the simulations to take them into greater consideration.

The loop variables of the models are fairly similar: the balancing loops include, among others, the loop variables of 'land use', 'production and water consumption' and 'wastewater generation', just to mention the focus variables in the scope. The reinforcing loops include the most relevant variables of 'environmental pollution' and 'ethanol production and investments'.

The scope of waste management includes one study; hence no comparison of variables was made. The input variables include–among the usual, predicted variables–'harvest performance', 'bagasse and vinasse recirculation' and 'composting'. The variables are appropriate in the scope of waste management, although a lack of input is noted.

The balancing and reinforcing loops are not rich in variables, either. The balancing loops include 'plantation and harvest', 'production and inventory of ethanol' and 'treatment of vinasse'. The reinforcing loops consist of two variables: 'inventory and sales' and 'milling and production of bagasse'. Since these are sufficient for the description of waste management, Ibarra-Vega [46] did not widen the pool of variables.

The scope of water footprint likewise includes the variables of one paper. As stated before, the ideal scenario would be to have multiple publications for each scope in order to collect similar variables and examine those that differ.

The input variables include a quite different list. Along others, they consist of 'industrial water consumption', 'domestic water consumption', 'water availability', 'rainwater volume', 'water footprints', 'water consumption', 'grey water generation', 'land availability', 'food demand', 'livestock demand' and 'ethanol demand'.

These variables are clearly adequate to define the model of the water footprint of the bioethanol sector.

The loop variables are general; the balancing loops include 'consumption and stock', 'planting and available land' and 'production of ethanol and feedback'. The reinforcing loops are 'available land and production' and 'production and consumption'.

The variables seem to sufficiently describe the inputs and dynamics of the sector.

The input variables and loop variables discussed are widely different; no coherent sector nor two similarly structured models were found from two different authors.

The most important characteristic models according to their scope are summarised in Table 4.

Table 4. The most important characteristic features of models.

Scope	Input Variables	Balancing Loop	Reinforcing Loop
Ethanol price/ethanol demand	biofuel demand, land productivity, land use	cost /price ratio, land constraint food production food demand	fuel import and stock; cost/profit relations investment national demand for ethanol productivity learning curve
Food security scope	biofuel demand land productivity food production and price food for biofuel	biofuel crop land and price demand and inventory land transfer and food croplands	biofuel cropland, fuel-and biofuel demand population trends and biofuel demand
Incentives	biofuel demand, biofuel price	shortage of crops and incentives	refinery sector capacity
Policy making	ethanol price, ethanol demand, sugar price, gasoline prices	capacity, demand, feedstock, production,	learning curve, research
Production	bioethanol, biofuels, fossil fuels, demography, finance, ecology	bio-and fossil fuel consumption, corn/commodity price CO_2 trade	bio-and fossil fuel consumption, corn/commodity price CO_2 trade
Sustainability	ethanol production ethanol demand ethanol price, resource production resource demand	land use water consumption wastewater	environmental pollution bioethanol investment

Source: own research, 2020.

3.5. Cross-Studies Risk of Bias

The above-mentioned lack of uniformity in section "3.2. Risk of bias within studies" regarding the adaption of system dynamics modelling principles may affect the quality of the list of variables. To make sense in the studies' context, it is well-founded to dispense with this sector. Selective reporting within the studies was found, but this did not affect the creation of the paper since only the most important variables are assessed by the authors. No need for an extensive comparison was justified, as a system dynamics model could be built up from thousands or tens of thousands of variables.

4. Discussion

Our results have proven, that although the system dynamics models, background data and results are interrelated and cannot be strictly categorized into boxes, for the integrity of the thesis the systemic discussion method was introduced. The summary of evidence will be discussed according to the scopes of the highlighted literature, with cross references included.

The methods by which the alternative fuel substitutes are implemented determine the level of applicability. Four studies in the literature were reviewed under the scope, which discuss the feasibility of biofuels in Ethiopia, Mexico, Colombia and Brazil. The level of bioethanol production in these countries diverges widely. Brazil is one of the top bioethanol producers, according to Balat et al. [24], while Ethiopia is behind, although it is growing rapidly.

The highlighted study published in 2016 by Demczuk and Padula [23] concluded that the feasibility of ethanol production could only be assured with a significant future increase in the pump price of gasoline. (Since the current government measures strongly assist the ethanol sector through incentives, there is no need for a price increase at this stage.).

The production of bioethanol has a long tradition in Brazil, enhanced by the support of the government in many ways, one being the PROALCOOL program [50].

One of Brazil's approaches to increase the rate of development of biofuel production is the inclusion of family farmers in the production chain [50]. In order to make this feasible, an analysis of the role of stakeholders is required.

Despite (or perhaps because of) it being a rapidly developing country, Rendon-Sagardi et al. [32] describes the woeful results of Mexico which will bump into a fuel shortage in the future, in which domestic fuel demand will not be met even with the contribution of biofuels.

The Colombian study by Jiménez et al. [29] shows that the main commodity of the country's bioethanol production is ground sugar. The study concluded that it is more profitable to use the sugar for ethanol production than to produce it for food. This might result in a shift of production that could have devastating effects on the food industry.

Ethiopia has not yet reached the potential critical thresholds of sugarcane and ethanol production and it was found that the increase in operations will have a harsh impact on the environment [51]. Nigatu [30] and Simionescu et al. [43] state in the highlighted literature that the quantity of ethanol consumption is highly dependent on its price difference with oil. Zenebe et al. [52] disputes that in the context of the existing competitive situation bioethanol production could overtake the country's dependence on oil. Nigatu [30] suggests that a solution could be to find the best blending option. Patrascioiu et al. [53] introduces the Simplex algorithm which could be used as a validated software tool for the analysis of the optimum blending recipes.

To discuss some of the feasibility assessment opportunities, various examples are introduced to show the complexity of the system:

- In a study by Khoo [54], it was found that from among the bioethanol commodities of sugarcane bagasse, stover, switchgrass, rice husk and straw, the first commodity was proved to be the most sustainable because it had the smallest land footprint. erratic fluctuations in the oil
- West et al. [55] state that investment in cellulose-based ethanol production requires a lasting protection from erratic fluctuations in the oil and feedstock market. Investment in yield increases is the key field to sustain feasibility.
- Greenhouse gas savings seem not to have had any effect on changes in the development of the technologies [55].

Overall, alternative biofuel production (such as bioethanol) is a powerful tool for developing countries with available land resources to both develop agrobusiness and decrease their dependence on imports [56].

In the scope of food security, the main issue found among the discussions in the literature was the risk of food price rises because of increasing bioethanol production. Other worrisome factors were food supply and security, and the phenomenon of land use change [57].

Factors arising in the scope, which is currently extensively researched and will be more researched in the future, are sustainability and climate change [56].

For the worrying phenomenon of land use change, the solution of utilization of marginal or unproductive lands has been recommended by multiple studies [58]. Extensive farming methods and an increased use of land might result in the destruction of agricultural land, leading to wide-scale devastating consequences. The process of land use change is indicated under the scope of food security since changes in the availability of agricultural land directly influence the quality and quantity of food, as well as its price and safety for consumers.

As demand for biofuels is rising, producers are shifting towards the more productive commodities, resulting in increasing land use changes [59].

The highlighted study on the European Union by Papachristos and Adamides [34] found a scenario where increasing biofuel production has a negative effect on land availability for food crops.

According to this scenario the promotion of incentives policies was discussed. This further emphasizes the interrelatedness of the scopes with each other.

In order to reduce the price of biofuels, as well as mitigating the effects changes in land use, the diversification of commodities would be helpful, since diversification reduces risk [60].

In the study of the system dynamics analysis of Ghana's bioethanol market by Ansah [28], it was found that numerous investments were made in the field to improve its productivity. Political and economic decision makers have to pay special attention to the growth of the market to avoid any directly or indirectly caused alteration to the food market.

Warner et al. [61] found that for biofuels to serve approximately 25% of the global transportation demand by 2050 would require more than twice the land used to meet food demands per capita, even with the assumption of a 40% increase in food demand. These data should indicate to researchers the need to focus on research on the productivity of biofuel commodities.

Among many others, Musango [62] and Newes [63] advocate the utilization of a system dynamics approach for the application of the transition to a green economy because of the model's transparency, its establishment of an optimization approach, the way it deals with complexity and its sectoral focus.

Shafiei et al. [12] states that the application of system dynamics to simulate the long-term and short-term effects of the transition to alternative fuels has the potential to provide vital policy measures. In line with the general purpose of greening of the economy, attention points need to be listed. These focus points, according to Musango [62], are achieving low carbon growth, developing resource efficiency and targeting pro-job development in developing countries.

By defining critical success factors, the model is guaranteed to fulfil the requirements set by Newes [63]. These critical success factors could include according to Newes [63] - the development of stakeholders' thinking, the determining of the key leverage points and a provision of transparency in the model.

The two highlighted studies by Jonker et al. [27] and Jonker et al. [35] focused more on the land use aspect of the green economy transition. Jonker et al. [35] tested multiple scenarios and recommended one which described how an alternative solution for a green economy transition would be the utilization of a locally produced biomass-to-bioethanol process line. The studies emphasize the areas that need to be addressed. The first area is the improvement of feedstock availability, which could be achieved by using uncultivated marginal land as new land. This was followed by the reduction of capital costs, which means the introduction of alternative financial support. And finally, the studies introduced the factor of an incorporation of bioethanol production to invade 'alien land' [35].

Musango [62] concluded that the Western Cape Province of South Africa has great potential in transitioning to a green economy since several local sectors have proved that they are capable of utilizing alternatives. They focus on the fields of water management, agriculture, transportation systems, renewable energy sources, decreasing of carbon emission and other public goods and services.

The scope of incentives is in close contact with the scope of policy making, since policies enable the creation of financial support and the implementation of incentives.

Vimmerstedt and Newes [64] found that an increase in production of a set biofuel is more likely to be present when other incentives and economic conditions are moderately favourable for other biofuels. There are incentives present for biofuels in the USA, namely the Biomass crop assistance program, tax credits and loan guarantees [64]. These measures are worth considering in other countries.

The highlighted literature dealing with Colombia presents an as yet immature market. There is insufficient investment in the refining industry and in capacity building of crops, resulting in the appearance of difficulties in the transportation of the products. The model applied presented a promising future scenario if the right policies and incentives are implemented [36].

Not only under the scope of policy making, but regarding all aspects, the importance of policy making is ever more important in the sector, since more challenges have emerged for decision-makers in terms of biofuel production and transition, including ensuring the development of clean and safe energy sources, while equalizing the volatility effects of the market [59]. While the sector is continually growing in both size and complexity, according to Qudrat-Ullah [65] and Qudrat-Ullah [66] new or better tools of analysis are needed to enable decision-makers to acquire an appropriate system thinking approach.

Although it is not the task of policy makers, they have a moral obligation to take societal aspects into consideration, i.e., public opinion. The demographic data obviously need to be taken into account. A mathematical model (mixed integer linear programming) has been developed to model various aspects (including societal) within the bioethanol supply chain [67].

By the implementation of the right policy tools, the adoption of biofuels will give a lead in energy security, according to Papachristos and Adamides [34] and assist in the mitigation or even the reduction of CO_2 emissions [68]. Some of the models that utilize large-scale modelling have been implemented in the decision-making process debates at institutions such as the European Parliament, as noted by Fonseca et al. [69], which confirms the importance of model assessments.

Introduced by Bassi [70], a model was built to mimic the impacts of policies on the sector examined, including the factors of sustainability and other societal changes. The Threshold 21 model has an approach which includes three main factors (and their numerous sub-factors): society, economy and the environment. The model uses system dynamics methodology, using existing sector analyses and, contrary to other models, it can be calibrated to mimic each individual country's sectoral particularities. This model is widely used around the globe, especially in countries with higher measures of bioethanol production.

Despite being top of the list for bioethanol production, according to Balat [26] Brazilian bioethanol production faces a rough road ahead [37]. As the results of Santos [37] and Kasperowicz et al. [71] regarding system dynamic modelling shows, the complexity of the system does not allow policy makers to rely on only single-factor decisions. As by Sterman [72] stated: 'You can't do just one thing'. The tools presented are worth considering to assess the decision-making processes to implement new policies.

The scope of production includes the production of four different products along the biofuel production line: two commodities (beet sugar and corn) and two approaches to biofuel production.

The reviewed study by Rozman et al. [40] models the production of bioethanol in the European Union (focusing mainly on Germany, Austria and Croatia) from sugar beet. The reform of the sugar industry by the European Commission [73] shifted the EU's status as a massive sugar exporter to a dependent importer. This drastically changed the EU's sugar market [74]. The 2017 abolition of the sugar quota has balanced the market and opened up new opportunities for businesses [73]. Germany being the top bioethanol producer in the European Union, the examination and modelling of the trends of production is crucial for the sector. New coordinating behaviors are required between the commodity producers and their clients in order to increase efficiency and profitability [75]. The investments needed in agrobusiness (including biofuel production) to develop the sector are long-term investments, hence adequate policies and supporting materials are needed to support the industry [76]. The role of a country's authorities is vital and is required to consider multiple influential aspects such as the economic and environmental factors. Given the complexity of the issue, a system dynamics model approach was advocated. This made possible a simulation of the effects of the investments in the sugar industry on both an environmental and an economical level [76].

This is a useful tool to be considered by many parties interested in the sector, such as farmers, policy makers and business owners.

The strength of the study by [76] lies in the accentuation of the level of complexity of the industry. It emphasizes the importance of the decision-making parties and their influence on the system.

Kibira et al. [42] state that the most eligible commodity for bioethanol production in the USA is corn. On the other hand, multiple papers discuss about the increasing market of cellulosic bioethanol production [41]. However, for cellulose-based biofuels it is a necessity the relatively low costs, to be competitive with gasoline, a combination of factors need to be present. The presence of an abundant amount of biomass as a commodity, capital expenditure and an increase in farmgate feedstock.

Kibira et al. [42] also raises the risk of food price increases as long as the commodities come from feedstock for food. Numerous studies have been made to investigate how to avoid these resources. The country has the possibility to produce annually approximately 1.3 billion tons of biomass which can be used for biofuel production. This amount enables the United States of America to replace almost two thirds of its gasoline consumption [77]. Sheenan [78] suggests that the 1–1.3 billion tons of biomass production (which is used for bioethanol production) will be achievable over the next 20 years, but this is a function of the price of oil and the policies regarding the sector.

To provide an outlook for a developing country, the study of Jonker et al. [27] was chosen for inclusion in the list of the highlighted literature. Developing countries are proving to have the potential to produce biofuel, thus reducing their dependence on crude oil exports [79]. According to Musango [62], a collective analysis of the three main factors is needed. These factors are the society, including the population, labor, health, education, poverty, infrastructure; the economy, including investment, production, technology, government and households; and the environment, including energy, land, water, minerals, sustainability and emissions. By promoting such a transdisciplinary approach, links between science, policy business and societal aspects can be made. Musango [62] further emphasizes the importance of system dynamics to capture system structures and uncertainties.

Before the discussion of the scope of sustainability, it needs to be stated that there are limits to the sustainable expansion of bioenergy both in terms of scale and the rate of expansion [80]. Although the innovation of technology drives the development of processes and products, according to Berawi [81], its sustainable introduction and maintenance is inevitable for our future.

Most of the literature on the sustainability of biofuels does not include the social aspect, according to Fontes and Freires [82], although this factor is worthy of inclusion, especially for the implementation of policies related to sustainability [39]. The importance and acknowledgement of sustainable supply change management is ever-increasing, and the integration of social objectives with environmental objectives is intensifying [83].

Brazil has multiple areas in which to achieve improvements, since it is one of the most developed bioethanol producers in the world. One of these aspects is enabling sustainability within development processes. Various modelling approaches have been conducted for the study of this sector, one being the system dynamics approach. The two studies highlighted target this method. The strength of the highlighted study by Guevara et al. [45] was the analysis of the environment and the scenarios required for the recognition of causes and effects. The main characteristic of the highlighted study by Silva et al. [47] compared to the other similar studies, is the provision of border values within which the model needs to operate, by using design science (survey methodology).

The scope of waste management highlights the managing processes of the generated by- products and residues.

The highlighted literature presents the waste management line of the two residues derived from the cane production process: bagasse and vinasse. According to Inman [84], aiming to achieve a more sustainable and environmental-friendly process line, the minimization or even the elimination of the negative effects is required.

The last scope of the literature highlighted is the scope of the water footprint. The scope discusses the magnitude of the water footprint for various stations of the bioethanol process line by measuring direct and indirect water use [84]. With rapid population growth and the appearance of the negative effects of climate change, water supply changes are an ever-present source of stress for regions with water scarcity [85].

The study highlighted examines water consumption by integrating Bioethanol supply chain analysis with the Water footprint assessment [48]. The study used the combination of supply chain evaluation and system dynamics to be able to establish the water consumption trends of Mexico. Emergent countries (like Mexico) are expected to increase natural resource consumption in the future [48].

To measure the water footprint of a process line, multiple models have been made, but Inman et al. [84] created a model (BioSpatial H_2O) that is able to analyze water consumption by building on previous results and providing a platform for a scenario based assessment. Models like this enable researchers to provide well-founded, more secure measurement to application calculations.

Aivazidou et al. [86] found that it is less economically and environmentally sustainable to reuse and recycle industrial water than to utilize technological innovations in agriculture such as the precision agriculture. The changes in water consumption behaviour cause stress, since, according to a 2005 estimate, 35% of the world's population is experiencing long-term water shortages [87].

To be able to provide a comprehensive answer, the complexity of the sector needs to be understood. Which bioethanol commodity is the most ideal, and how much it is worth producing or using it differs from country to country. It is desirable to develop a model (or apply existing ones, possibly by further developing them) in order for the country or region to find the appropriate base material, its cultivation parameters and the feasibility of consumption. Forrester [88] confirms the disappointing findings of this paper: the number of authors using system dynamics is growing more rapidly than the number of professionals who are able to use it. Since system dynamics is a useful tool in order to understand complex systems, not using it would not solve the current problems. A more thorough education system and a consistent reporting method is required. Such education could be achieved by providing training sessions on how to use the available tools. Numerous approaches have emerged in the field, and two projects about the bio-economy 'BIOECONOMY' and 'BIO-CLIMATE' have been established. Initiatives like this enable the scientific community to deepen their knowledge and help them to acquire the most up-to-date research methods. Musango [62] mentions that these partially conducted studies might even be more restrictive for a deeper understanding of the technologies analyzed than properly conducted ones due to their lack of integrity. Learning to apply the model in one field, leads to the discovery of new aspects in another [88].

Ghaderi et al. [89] have analysed the relation of bioethanol and biodiesel by system dynamic modelling. They advocate that the total market share of biofuels could be increased by the enhancement of oil plant production and a reduction in bioethanol production.

Kuo et al. [90] have analysed the role of state subsidies in the conversion to the application of a bioethanol-gasoline blend. Their results highlight the importance of the world crude oil price in the competitiveness of bioethanol. The role of bioethanol in the international CO_2 trade is relatively limited.

In our opinion, based on the literature review, a more comprehensive system for the bioethanol model could be formulated. The basic building blocks of this model can be summarised in Figure 3.

In our opinion, the models should better integrate the short- and long-term consequences of changing air quality. The model-calibrations and optimisation should take into consideration the results of dynamic system optimisation e.g., Kalman-filtering Sinopoli et al. [91] or Powel optimization [92].

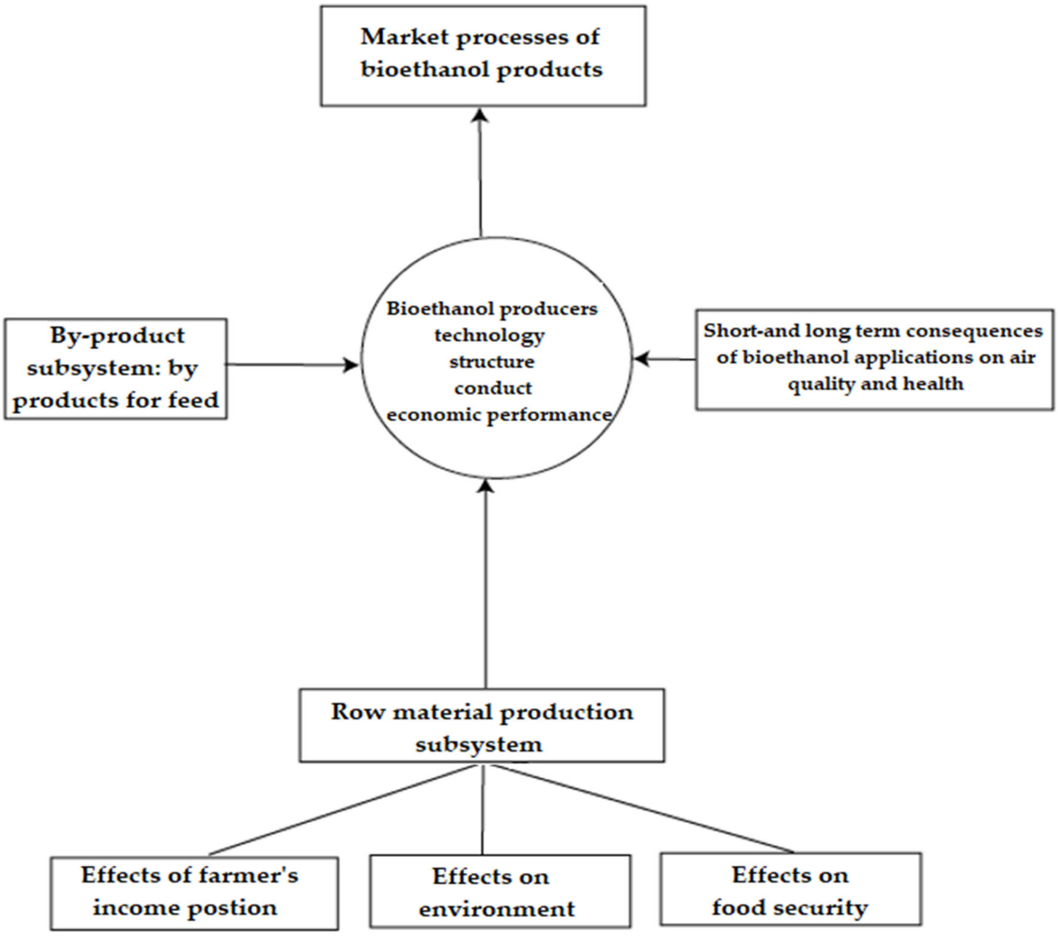

Figure 3. The basic building blocks of this model (source: own research, 2020).

5. Conclusions

The PRISMA statement appears to be a useful method to drive consistency into the systematic reporting discipline. A constructed, pre-established structure enables scientists and researchers from all fields to be able to publish without compromising through omission, or overpacking their papers. On the other hand, no structural instruction should come at the expense of elasticity; authors need to be able to appropriately express their thinking. A balance between a structural spine and a flexible scientific outlook should be established.

These measures thus have a great latent potential to offer vital policy insights [12]. Fritz et al. [56] concludes that the most powerful tool to use is case studies, especially if they are paired with a rationale and a model. These findings all have implications for future research. Research into the implementation of the combination of system dynamics and a reviewing mechanism (such as the PRISMA statement) in other fields is recommended.

Multiple preventive factors were present in the creation of this study, although there is no evidence that any of them have modified the assessment negatively. These limitations include but are not restricted to: the conscious restriction of only using literature in English, the use of a large number of references even though they might not cover the topic adequately, the fact that retrieval of the research identified was incomplete, the fact that other possible aspects of the bioethanol sector were not entirely addressed, a lack of consideration of societal aspects and the possibility of bias within and across studies.

Despite these limitations, the study seems to address a satisfactory area of the sector, allowing it to be used a springboard for further studies.

Author Contributions: J.P., A.K. and Z.L. conceived and designed the experiment; E.K., Z.L. and A.K. compiled the data which is analyzed by E.K. contributed analysis tool, and E.K., Z.L., J.P. and J.O. wrote the paper. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. PRISMA Checklist 2009.

Section/Topic		Checklist Item
Title		
Title	1	Identify the report as a systematic review, meta-analysis, or both.
Abstarct		
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.
Introduction		
Rationale	3	Describe the rationale for the review in the context of what is already known.
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).
Methods		
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow- up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.
Search	8	Present full electronic search strategy for at least one data base, including any limits used, such that it could be repeated.
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g.,I^2) for each meta-analysis.
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.

Table A1. *Cont.*

Section/Topic		Checklist Item
Results		
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression (see Item 16).
Discussion		
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.
Funding		
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.

Source: own research, 2020.

Table A2. Short summary of sources, applied in the analysis.

Input Variables	Scope of Research	Country	Author(s)
Average age (of the sugarcane field), CONFINS, Costs, Demand for ethanol, Depreciation, Effective operating cost (EOC), Effective operating profit (EOP), Ethanol conversion factor, Farm productivity (yields), Financial result (profit), ICMS, Investments, Margin for distribution and resale, New area, New areas (investment), Opportunity cost (of land use), Percentage of ethanol in the blend, PIS, Planted area, Price for regular gasoline to the consumer, Price of ethanol, Price paid to sugarcane farmers (PPFTS), Price paid to the ethanol processing plant (FOB), Production costs, Production of ethanol, Production of TRS, Production, Pump price for regular gasoline, Rate of ICMS (sales tax), Replanting the sugarcane fields at the right time in order to maintain high average productivity levels, Revenue, Stock sugarcane, Sugarcane sold, Total cost (TC), Total operating cost (TOC), Total operating profit (TOP), Total profit (TP), TRS price of ethanol, TRS price of sugarcane.	Feasibility	Brazil	Demczuk and Padula [23]
Area planted with sugar cane, Demand for sugar, Demand for ethanol, Ethanol inventory, Ethanol price, Ethanol production, Ethanol sales, Ground cane, National ethanol consumption, Sugar inventory, Sugar price, Sugar production, Sugar sales, Sugar sector profitability.	Feasibility	Colombia	Jiménez et al. [29]
Area for grain crop, Area for sugarcane crop, Available crude oil, Crude oil price, DDG+S production, Direct costs, Environmental impact, Ethanol demand, Ethanol price, Ethanol production, Ethanol stock, Ethanol yield, Exported crude oil, Exported grain, Exported molasses, Food demand for grain, Fuel demand, Fuel price, Fuel stock, Gasoline production, Gasoline yield, Grain price, Grain stock, Grain yield, Grain, Imported fuel, Imported grain, Imported molasses, Indirect costs, Livestock demand for grain, Livestock demand for molasses, Milling capacity, Molasses price, Molasses stock, Molasses yield, Molasses, MTBE and TAME demand, MTBE and TAME price, Need for cane crop, Need for Grain, Planted grain but not harvested, Sugar demand, Sugarcane production, Sugarcane stock, Vehicles.	Feasibility	Mexico	Rendon-Sagardi et al. [32]
Agricultural capital, Biofuel demand, Capital life, Crude birth rate, Deaths, Food consumption, Food exports, Food for biofuel, Food imports, Food production, Land productivity, Land under cultivation, Oil price, Population, Potential agricultural land remaining, Total food demand.	Food security	Ghana	Ansah [11]
Biofuel inventory, Biofuel crop land, Biofuel crop yield per ha, Biofuel demand, Biofuel price, Biofuel production, Biofuel technology & management capability, Cars per capital EU fuel mix, Food crop land, Food crop yield per ha, Food demand, Food inventory, Food price, Food production, Fuel demand, Incentive for biofuels, kg consumed per capita annually, km per capita annually, Land transfer to biofuels, Population trends.	Food security	EU*	Papachristos and Adamides [34]
Agricultural land use, Biofuel production by-product, Biofuel production capacity, Biofuel production cost, Biofuel production, Cumulative biofuel production, Emissions, Employment due to biofuel, Energy requirement, Feedstock requirement, Fossil fuel use, Investment into biofuel (Green Economy), Learning curve, Profitability of biofuel, Water demand, WC GDP.	Green economy transition	South Africa	Jonker et al. [27]

Table A2. *Cont.*

Input Variables	Scope of Research	Country	Author(s)
Agricultural land use, Biofuel demand, Biofuel production by-product, Biofuel production capacity, Biofuel production cost, Biofuel production, Births, Cumulative biofuel production, Deaths, Emissions, Employment due to biofuel, Energy requirement, Feedstock requirement, Fossil fuel demand, Fossil fuel use, Fuel demand, Investment into biofuel (Green Economy), Learning curve, Mandatory blending policy, Population, Profitability of biofuel, Water demand, WC GDP.	Green economy transition	South Africa	Jonker et al. [35]
Biofuel demand, Biofuel price, Biofuels production, Crops capacity, Crops price, Crops profits, Fuel demand, Incentives to crops, Incentives to refining, Investment in capacity, Investment in crops, Mix percentage, Refining capacity, Refining profits, Shortage of crops, Shortage of refining capacity, Surplus of crop capacity, Surplus of refining capacity.	Incentives	Colombia	Franco et al. [36]
Accumulated production, Effect of cost on price, Effect of investment, Coverage on price, Ethanol demand, Expected production costs, Expected profits, External demand, Gasoline price, GDP, Long run expected price, Perceived investment coverage, Price of ethanol, Short run expected price, Sugar price.	Policy making	Brazil	Santos [37]
Biofuel capacity expansion, Biofuel capacity, Biofuel Consumption, Biofuel demand, Biofuel price, Biofuel production, Biofuel shortage, Birth rate, Births, Climate change, Deaths, Death rate, Desire to produce biofuel, Employment creation, Feedstock available (food), Feedstock demand (biofuel), Feedstock demand (food), Feedstock available (biofuel), Fossil fuel consumption, Fossil fuel demand, Fossil fuel price, Fossil fuel production/import, Fossil fuel shortage, Fuel demand, GDP Green economy investment, Land use, Mandatory blending policy, Population, Transport need, Water requirement, Water supply.	Production	South Africa	Jonker et al. [27]
Available land for agriculture, Biological residue, Ecological impacts, Employment opportunity, Ethanol production, Gas power plant, Humus, Investment in sugar production, Land for beet production, Sugar market surplus, Sugar price, Sugar production, Work force demand.	Production (beet sugar)	Germany	Rozman et al. [40]
Agricultural crop prices, Annual and perennial crop supply/production, Biofuel prices, Biorefinery utilization, Construction of pilot- and demonstration-scale integrated biorefineries, Construction of pioneer and full-scale commercial biorefineries, Consumer purchases of light-duty vehicles, Crop and feedstock grower decisions, Domestic demand for agricultural crops, Electricity prices, Forest and urban residue supply curves, Fuel choice by consumers Industry maturation (industrial learning), International agricultural trade, International trade in biofuels, Investment in biorefineries, Investment in refuelling infrastructure, Petroleum prices, Prices of co-products from biorefineries, RIN prices	Production (with BSM)	USA*	Vimmerstedt et al. [41]

Table A2. *Cont.*

Input Variables	Scope of Research	Country	Author(s)
Agricultural efficiency, Allocation of corn to ethanol production, Allocation of corn to food and animal feed, Available agricultural farmland, Corn ethanol production, Corn price, Corn production, Corn yield per acre, DDGS and CGF/CGM revenue, Demand for allocation of corn to ethanol, Demand for corn for human food and animal feed, Environmental pollution, Ethanol demand, Ethanol price, Ethanol produced per bushel of corn, Ethanol production efficiency, Ethanol production investment, Farmland for corn farming, Gap between demand and corn allocated for food and ethanol, Gap between ethanol demand and supply, Gap between ethanol demand and supply, Gasoline demand, Gasoline price, Human corn food and animal feed price, Incentives, Oil price, Production water cost, Production energy costs, Profitability, Revenue from animal feeds, Total production costs, Transportation costs, Water and energy costs at farm, Water energy and energy usage at farm.	Production (corn)	USA	Kibira et al. [42]
Allocation of sugarcane to production, Energy market, Energy source, Environmental pollution, Ethanol demand, Ethanol distribution, Ethanol price, Ethanol production efficiency, Ethanol production, Food (Human, Animal), Gasoline demand, Gasoline price, Investment, Investments in ethanol, Land available for food, Land available for planting, Land available for sugarcane, Land disposal, Land preparation, Sugar demand, Sugar price, Sugarcane production, Sugarcane productive rate, Water consumption, Water.	Sustainability	Brazil	Guevara et al. [45]
Bioethanol inventory, Bioethanol production, Bioethanol to sell, Distribution, Enlistment of sugarcane, Environmental impact indicator, Fraction aimed at bioethanol, Harvest yield, Harvested, Hectares of sugarcane, Hectares, Impact of social indicator, Installed capacity, Net increase, Planted area, Produced bioethanol, Productivity, Sugarcane demand factor, Sugarcane juice, Water consumption.	Sustainability	Colombia	Ibarra-Vega [46]
Allocation sugarcane to production, Environmental Pollution, Ethanol demand, Ethanol Price, Ethanol production efficiency, Ethanol production, Gasoline Demand, Gasoline price, Investment in ethanol, Land available for food, Land available for planting, Land available for sugarcane, Land use, Sugar demand, Sugar price, Sugar production, Sugarcane demand, Sugarcane price, Sugarcane production, Sugarcane productive rate, Water consumption.	Sustainability	Brazil	Silva et al. [47]
Bagasse Generation, Bagasse Management, Bagasse Reuse, Bioethanol inventory, Bioethanol production, Cane bagasse, Cane harvest, Composting Bagasse and Vinasse, Crop Yield, Fermentable Juice, Harvest Performance, Hectares of cane, Milling to get juice, Milling Yield, Planting cane, Sowing Time, Vinasse Generation, Vinasse Recirculation, Vinasse Treatment, Wholesale Inventory, Wholesaler Sales.	Waste management	Colombia	Ibarra-Vega [46]

Table A2. *Cont.*

Input Variables	Scope of Research	Country	Author(s)
Blue water consumption production, Blue water consumption sorghum, Blue water consumption sugar, Domestic consumption, Ethanol demand, Ethanol production, Ethanol stock, Fertilizers use sorghum, Fertilizers use sugar, Food demand for sorghum, Grain export, Green water consumption sorghum, Green water consumption sugar, Grey water general production, Grey water generating (sorghum), Grey water generating (sugar), Land availability (sugarcane), Land availability (sorghum), Livestock demand for molasses, Livestock demand for sorghum, Molasses export, Molasses import, Molasses stock, Molasses yield, Milling capacity, New industrial water consumption, Rainwater volume, Sorghum import, Sorghum sowing, Sorghum stock, Sorghum yield, Sugar demand, Sugar production, Sugarcane sowing, Sugarcane stock, Sugarcane yield, Water Availability, Water footprint agriculture, Water footprint production.	Water footprint	Mexico	Trujillo-Mata et al. [48]
Vehicle ratio using bioethanol, demand variation of gasoline, gross requirement of gasoline, ethanol price, raw material cost of gasoline production, auxiliary material costs of production, fixed production costs (maintenance, labour, investment, depreciation), fixed costs sharing income from by-products, carbon emission price, carbon emission difference	Development of governmental subsidy politics	Taiwan	[Kuo et al. [90]]
Ethanol and biodiesel price elasticities, production costs of biodiesel and bioethanol, satisfaction of food demand, income elasticity of food price, land erosion rate, rural population workplace, share of non-food agricultural products, effects if learning curve	Possibilities of co-existences between bioenergy and food production	Colombia	Martínez-Jaramillo et al. [93]
Unit transportation costs of corn, distance between corn harvesting sites and the collection facilities, unit corn production costs, yield, rate of other usage of corn, distance between corn collection facility and biorefinery unit, transportation costs between biorefinery and consumer market, unit storage costs of corn, unit storage costs of bioethanol, production costs of biorefineries, production capacity of bioethanol production, export/import balance of bioethanol	Market share of bioethanol and biodiesel	USA	Ghaderi et al. [89]

Source: own research, 2020.

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