The macro-environment for liquid biofuels in the German science, mass media and government

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Abstract

The purpose of this study is to investigate under which dimensions the macro-environment for liquid biofuels has been structured during time, respectively by science, mass media, and government in Germany, and how these three social expressions related to each other. Research was carried out on German official government documents, mass media news, and scientific papers on the topic 'liquid biofuels'. Text Mining was used to extract knowledge from their content. The results indicate that in configurating the macro-environment for liquid biofuels there is some degree of proximity between media and government, less between media and science, and the least between government and science.

Key-words: Bioenergy, Ethanol, Biodiesel, Strategic Planning, Environmental Scanning.

1. Introduction

Economic interest on renewable fuels has grown considerably, particularly the production and consumption of liquid biofuels, namely biodiesel and ethanol. Biodiesel and ethanol production soared around the globe, mainly in United States, Brazil, Germany, France, Italy and Spain (IEA, 2009). According to Bockey (2009) biodiesel is one of the most promising renewable fuels in Germany, followed by ethanol. Biodiesel has emerged as the leading liquid biofuel option partially because of the ready availability of raw materials for its production, mainly rapeseed (Bockey, 2009). From 1998 to 2008 German biodiesel production has moved from a modest level near 100,000 metric tonnes to 2,819,000 metric tones (EBB, 2009). The EBB data show that Germany not only is the leader European country in biodiesel production, but also that Germany presents the highest production capacity among the EU-27 members.

This increase in the production level and production capacity means that the liquid biofuel businesses are attracting more and more investments along the production chain, from farmers to processors and distribution stages. Therefore, it seems that decision-makers of the

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German liquid biofuels sector and related to it would be interested in scanning the industry macro-environment properly as a way to support their strategic planning and the decision making process. The macro-enviromental scanning is a first and important stage in the strategic planning process through which the decision makers can look out for the patterns and changes in the industry environment as a way to gather informations which help them in the decision making process (Johnson et al., 2008).

The macro-environment for a specific industry or sector can affect business in different ways. It can be configured by the interaction between a wide range of stakeholders, namely policy-makers, scientists and journalists, along the public and the industry/sector actors. As a new field of interest and investments, the liquid biofuels sector asks for a set of particular public policies to regulate it, to create incentives and/or to draw some limits or restrictions to its activities. In such a case, the German government can be seen as a player whith an important role in the liquid biofuels macro-environment configuration in Germany and in Europe as well (Balat, 2007; Talamini et al., 2009). Scientists, on the one hand, by their knowledge itself and their contributions to the technological development, can influence the macro-enviroment configuration of a certain business by their interaction with policy-makers and journalists, suggesting a new set of concerns and technical aspects to be referred to in public policies or in mass media messages, according to their scientific findings (Sabatier, 1991; IPCC, 2004). On the other hand, mass media, in their way of spreading information, have a powerful influence on the public and on the policy-makers, and are able, as well, of changing the macro-environment configuration of an economic activity (Gamson and Modigliani, 1989; Strömberg, 2001).

One may expect that the macro-environment for liquid biofuel production in Germany can be associated with environmental and cultural dimensions, as European consumers concerned with environmental issues are moving to environmentally-correct products, as stated by Büttner and Grübler (1995) and Willer and Yussefi (2005). Alternatively, it may as well be associated with the political and economical dimensions as represented by the following events: first, the passage of the *Renewable Energy Act* on April 1st 2000, the target of which is to increase the use of renewable energy sources to 12.5%-point by 2010 and 20%-point by 2020 (Germany, 2000); second, the Directive 2003/30/EC dated May 8th 2003, which established the target of using 2 % of biofuels added to fossil fuels until 2005 and 5.75 % (later 4 %) by 2010 (EC, 2006); and third, Germany has the largest tax incentive in the European Union for the production of liquid biofuels (Frondel and Peters, 2006).

Taking into account that, firstly, the liquid biofuels industry in Germany has been attracting many investors and new opportunities for investments are latent; secondly, understanding the macro-enviroment configuration is important for decision-makers; and, thirdly, scientists, journalists and police-makers play an important role in configuring a business macro-environment, this paper aims to answer the following questions: under which dimensions the macro-environment for liquid biofuels has been structured during time, respectively by science, media, and government in Germany? Are there similarities in the macro-environment configuration expressed by German scientists, journalists and policy-makers?

2. Interactions between scientists, journalists and policy-makers

The relationship between mass media and government is a matter widely studied in communication sciences. Accordingly, there is a bi-directional relationship between these two spheres, and the level of influence on each other depends on the relative power in a specific situation. According to Mermin (1997), there is a relationship of influence and dependency between mass media and government. If mass media can drive the government attention to

specific subjects, it can also have influence on the public policies carried out by government. On the other hand, government can also use its power to define the mass media agenda. Moreover, the government can be seen as a mass media sponsor (Gamson and Modigliani, 1989), while it influences the mass media agenda (Strömberg, 2001) and frames its policies through the mass media, as stated by Van Gorp (2007).

The relationship between mass media and government can be assumed as stronger than that between mass media and science, because journalists more often favor in covering politic events compared to scientific ones (Friedman et al., 1986).

For a long time science and government have developed their activities distanced from each other and with relative little interdependency. The relationship between scientists and the public policy-makers was occasional, making the scientific knowledge an element of minor importance in the public policies definition. According to Sabatier (1991), a more frequent use of science in the elaboration of public policies had begun in the 1960's. Since then, scientists and government agree that there is a kind of interdependency between them. In spite of this apparent change the relationships between scientists and the public policy-makers are commonly tense and relatively fragile.

The difficulties in the dialogue between government and science may be dependent on the country priorities and government necessities. In the United States, for instance, the importance of scientific questions in the political agenda have changed significantly since the 1950's, when the top issue was the atomic bomb and the scientists had the control over the issue. Since then science is viewed as something complementary and that should be developed to support the main political issues (Abelson, 1988).

Accordingly to Averch (1987), the tension and the conflict existent between science and the formulation of public policies are normal, caused by three main reasons: (i) different strategic perspectives; (ii) decisions based on distinct utility principles; and, (iii) the political "morality" of social applied research and politics research. For the author, the conflict can be minimized (but not completely eliminated) by two ways: (i) researches that result in scientific truth and useful information for the decision maker; e (ii) more attention at the quality control and at the possibilities of use of the results produced by scientific knowledge.

Other causes are pointed out as decisive for the weak influence of science on government. Keren (1983) writes that competitive visions about the nature of knowledge restrict the communication between scientists and those involved in public policies formulation. Abelson (1988) also points towards problems in the communication saying that many scientists show difficulties in separating technical knowledge from ideological convictions when called upon to assist governments. Besides that, the introspective culture of the scientific community can impose loss of credibility to those scientists, who got themselves involved in questions related to politics or public management (Steel et al., 2008).

In Miller's (1999) opinion, the political decisions are more affected by the political game than by the technical and rational arguments. In addition, not always the political interests are aligned with the scientific knowledge. For Booth (1990) the use of scientific knowledge in the elaboration of public policies relies, for example, on: (i) the nature of the elaboration process of policies; (ii) the functions of the research on elaboration of the policies; and (iii) the way on which the relationships between research and politics are presented. According to Bradshaw and Borchers (2000) the gap between science and policy is the scientific uncertainty, which could be solved if scientific uncertainty is incorporated into a rigorous decision-theoretic framework as knowledge. In other words, science might be producing the necessary knowledge, which is sub-utilized for structural reasons of the political process and which leads to a distorted evaluation of the importance of science.

The increasing importance addressed to the climate change and environmental matters has given a new opportunity for scientists and policy-makers to work closely. The

assessment of Inter-governmental Panel on Climate Change is a clear example (IPCC, 2004). Around the globe many efforts can be seen in the sense to integrate scientists and other stakeholders (Falkenmark et al., 2004; Totlandsdal et al., 2007; Holmes and Clark, 2008). The Copenhagen round table on climate change is another, recent example of this trend (Tollefson, 2009).

Regarding the liquid biofuels, there is apparently a closer dialogue between scientists and government. Searching for publications on the subjet in the Science Magazine, one of the leader scientific journals worldwide, one can hit ca. 126 references with the key-words "policy" and "biofuel" from 1975 to 2009, most of them published in the last five years. Evenmore, such journal offers the Policy Forum, a specific section designed to establish a communication between the scientific community and the political arena.

In the scientists-journalists relationship, a question to be addressed in understanding the science-mass media interaction is: why this relationship should be present? According to Dunwoody and Ryan (1985) and Friedman et al. (1986), the presence of this relationship can not be explained just by the necessity in transmitting the scientific knowledge to the public, but also for science obtaining popular support in getting public financing. In the same direction, Gehards and Schäfer (2009) suggest that this relationship is a way of legitimation of science to the public. Insofar, mass media acts as a mediador, not only between science and public, but also between science and government. On the mass media side, science is also an important source of information to compose the mass media daily news agenda (Friedman et al., 1986).

We have been looking at the way science, mass media, and government interact in configurating the macro-environment for liquid biofuels in those countries where this new industry is emerging. In Brazil, one of the leading countries in this field, we measured the similarities between the way Brazilian government and mass media configurate the biofuel industry macro-environment, and between science and public policies (Talamini and Dewes (2008, 2009). The results suggest that there are no significant similarities between them, although government and mass media are closer in similarity than science and government. Based on those results, it seems that, in Brazil, scientists, journalists and policy-makers describe the matters of liquid biofuels business from a different perspective.

Taking into account the aspects of scientists-journalists-policy maker's relationship, as described in the literature, the following propositons are stated:

Proposition 1: there is similarity in the macro-environmental dimensions under which the liquid biofuels are framed by mass media and government in Germany;

Proposition 2: there is dissimilarity in the macro-environmental dimensions under which the liquid biofuels are framed by science and government in Germany;

Proposition 3: there is dissimilarity in the macro-environmental dimensions under which the liquid biofuels are framed by science and mass media in Germany.

In the business environment, the strategic planning and decision taking are continuous developed by supporting of information gathered in different sources. From a long time the most common sources of information external to organization used by managers are those related to the mass media and governmental agencies. The scientific studies are not pointed out as a usual source of information by managers (Keegan, 1974, Ginter and Duncan, 1990; Ngamkroeckjoti and Johri, 2000; Jogaratnam and Law, 2006). However, in the case of science being a driver for public policies, for instance, scientific information could be added as a source of information to be retrieved by decision-makers.

3. Methods and procedures

In order to scan the macro-environment for liquid biofuels in Germany, a documental analysis of scientific papers, mass media news, and government official documents was accomplished. The concept of Knowledge Discovery in Text and Text Mining techniques were used. The Text Mining procedures adopted in this study followed a structure based on Hippner and Rentzmann's (2006) study.

The selection of scientific papers, mass media news and government documents was conducted by using a list of key-words representative of the "liquid biofuels" subject, considering the frequency of their occurrence in the literature dealing with matters related to bioenergy, biobased economy and biofuels (see Figure 1). The list of key-words was composed by words in English and also German Languages because some sources the documents were available in both idioms. The stated key-words were used to search and trace mass media news, scientific papers and governmental documents in Germany, as presented in the Figure 2. The searching for governmental documents starts from the main German government site in the World Wide Web, from which other sites of Ministries, Federal Secretariats, Departments and non-governmental institutions were visited. Using the search

BIOFUEL, BIOFUELS, BIO-FUEL, BIO-FUELS, BIODIESEL, BIO-DIESEL, ETHANOL, BIO-ETHANOL, BIOETHANOL, BIO-OIL, ALCOHOL, BIOKRAFTSTOFF, BIO-KRAFTSTOFF, BIOTREIBSTOFF, BIO-TREIBSTOFF, BIOBRENNSTOFF, BIO-BRENNSTOFF, BIOFEUERING, BIO-FEUERING, ÄTHANOL, BIO-ÄTHANOL, BIOÄTHANOL, BIO-ÖL and BIOÖL

engines available in the related homepages, the documents were located and downloaded.

Figure 1 – Key-words related to liquid biofuels.
Source: prepared by the authors

It is important to note that any information available in "Press Room" sections was excluded from consideration. The reason is that it is important to minimize the impact of ordinary political and electoral discourses, and focus the search on documents that were representative of the official policies and programs of the German government. Scientific papers were searched in the Web of Science database, selecting those papers pertaining to authors affiliated to German institutions. For representing the German mass media well known newspapers and tabloids were chosen. Search engine was used to retrieve the news from newpapers archive.

Stakeholder	Source of Information	World Wide Web link
Science	Web of Science	http://portal.isiknowledge.com
Mass Media	Die Zeit	http://www.zeit.de
	Welt Online	http://www.welt.de/archiv
	Berliner Zeitung	http://www.berlinonline.de/berliner-zeitung
	Sueddeutsche Zeitung	http://www.sueddeutsche.de
	Frankfurter Rundschau	http://www.fr-online.de
	Der Tagesspiegel	http://www.tagesspiegel.de
	Hamburger Morgenpost	http://www.mopo.de
	Freitag	http://www.freitag.de
Government	German Government official portal on the World Wide Web	http://www.bundesregierung.de

Figure 2 – German's sources of information
Source: elaborathed by authors

What did the data gathering entail? The search and collection of documents, and the construction of the preliminary database began on the first week of February 2007 and were completed by the last week of June 2007. A ten-year, (1997-2006)-period was analyzed in this

research. Taking into account the volume of scientific publications verified along the last decades, it is noticed how the field of liquid biofuels has expanded. The documents were stored in three different textbases: science, mass media and government. By the end of this process the databases were composed by 149 scientific papers, 765 mass media news, and 170 governmental documents, totaling 1,084 documents.

In the following step, the electronic contents of the documents were transferred onto a specific document base built with the aid of the QDA Miner® software, preparing the documents for subsequent application of the Text Mining procedure. As QDA Miner® uses Rich Text Formats (*.RTF) to build the database while most documents were collected as PDF-formats with their content blocked, 11 scientific papers, 5 mass media news, and 2 government documents were lost. Therefore, the final composition of the database was made up of 138 scientific papers, 760 mass media news, and 168 governmental documents, totaling 1,066 documents.

In order to discovery the knowledge contained in the files, it was necessary to build an analytical structure capable of extracting the relevant information because there is not a unique and specific method applicable to this analysis. A list of words is often used for this purpose, as can be seen in Crawley (2007). The first step to build the specific structure is associated to the definition of the macro-environmental dimensions. According to the literature on macro-environmental analysis, the most frequently used dimensions are those related to the PESTEL acronym, i.e., Political, Economic, Sociocultural, Technological, Environmental and Legal (Johnson et al., 2008). The number of dimensions and their denominations vary from one study to another, depending on the specific interest, the studied macro-environment and/or the activity, allowing for some flexibility. Considering the characteristics of the research matter, we added the agronomical and geopolitical dimensions, and split up the Socio-cultural dimension, thus totaling nine macro-environmental dimensions to be explored, namely, Agronomical, Cultural, Economic, Environmental, Geopolitical, Legal, Political, Social and Technological.

With the macro-environmental dimensions established, the purpose of the following steps was to identify the set of key-words representative of each dimension, which will be referred to here as "dimension-words" or "*d-words*". The set of "*d-words"* is made up of relevant terms that best discriminate a certain macro-environmental dimension. Therefore, nine macro-environmental dimensions imply nine different sets of "*d-words*". At this point, the core issue was: how to identify the terms and to establish the number of "*d-words*" for each dimension? For example, which and how many "*d-words*" would discriminate the economical dimension?

Initially, in order to determine the set of "*d-words*" for each of the nine dimensions, we tried to identify the words that occurred more frequently in academic journals in each of the knowledge fields, associated with a specific macro-environmental dimension. A number of academic journals with high impact factor were initially selected. For instance, the following journals were selected for the economical dimension: *Quarterly Journal of Economics* (impact factor 3.938), *Review of Economic Studies* (2.000), *Oxford Economic Papers* (1.132), *Journal of Economic Theory* (1.046), and *Cambridge Journal of Economics* (0.571). From each journal one issue was randomly selected from the volume of the following years: 1998, 2000, 2002, 2004 and 2006. This covers a period equivalent to the stated research period (1997-2006). The same criteria and procedures were used for the other macro-environmental dimensions.

Titles, abstracts and key-words were collected from all published scientific papers in the selected issues. The contents of these text elements were transferred to a textbase prepared with the aid of the QDA Miner® software. Next, by using the WordStat module of SIMStat®,

a counting of words was obtained, as well as their frequency and the TF*IDF[2] rate. The resulting list with thousands of words was displayed in descending order of the TF*IDF Rate. It indicates the decreasing relevance of the words in the scientific documents published in academic journals of the knowledge fields related to the respective macro-environmental dimensions (Aizawa, 2003).

Next, the number of "*d-words*" under each dimension was determined applying the percentile measures on the list of all words, selecting the number of "*d-words*" that best discriminated each dimension (see Figure 3).

List of "d-words" – English Language	List of "d-words" – German Language
• @ECONOMIC_ECON [ECONOMIC AND MODELS | ECONOMIC AND SOCIAL /C] (1) • @MARKET_ECON [MARKET AND LABOUR | MARKET AND MARKETS /C] (1) • @POLICY_ECON [POLICY AND MONETARY | POLICY AND FISCAL /C] (1) • @SOCIAL_ECON [SOCIAL AND ECONOMIC | SOCIAL AND BEHAVIOR /C] (1) • ECONOMY (1) • EQUILIBRIUM (1) • GAME (1) • GAMES (1) • INCOME (1) • INFORMATION (1) • LABOR (1) • LABOUR (1) • MARKETS (1) • PRICE (1) • PRICES (1) • RISK (1) • TAX (1) • WAGE (1) • WAGES (1)	• @MARKT_ECON [MARKT AND ARBEIT | MARKT AND MÄRKTE /C] (1) • @POLITISCH_ECON [POLITISCH AND WÄHRUNGS | POLITISCH AND STEUERLICH /C] (1) • @SOZIALE_ECON [SOZIALE AND WIRTSCHAFTLICH | SOZIALE AND VERHALTEN /C] (1) • @WIRTSCHAFTLICH_ECON [WIRTSCHAFTLICH AND MODELLE | WIRTSCHAFTLICH AND SOZIALE /C] (1) • ARBEIT (1) • EINKOMMEN (1) • GLEICHGEWICHT (1) • INFORMATIONEN (1) • LOHN (1) • LÖHNE (1) • MÄRKTE (1) • PREIS (1) • PREISE (1) • RISIKO (1) • SPIEL (1) • SPIELE (1) • STEUER (1) • WIRTSCHAFT (1)

Figure 3 – Set of "*d-words*" for the economical dimension
Source: obtained by authors by means of research procedures

An average of 14.2 "*d-words*" was used for each dimension. For "*d-words*" that were common to two or more dimensions, rules were added to the knowledge analysis and extraction structure. The rules took into consideration the co-occurrence of terms within the same document. Jaccard's Coefficient was used for determining these rules (Chung and Lee, 2001).

Text Mining was carried out by using the textbases in electronic format and the knowledge analysis and extraction structure were built from the macro-environmental dimensions and their respective "*d-words*". By using the WordStat module of SIMStat®, it was possible to determine the frequency with which each "*d-word*" occurred in scientific papers, mass media news, and governmental documents. Thereafter the frequency is determine by which each of the macro-environmental dimensions was called upon in the selected documents indicating how the macro-environment of liquid biofuels was configurated by German scientists, journalists and policy-makers.

The frequencies of the occurrence of the macro-environmental dimensions were used for the final analysis of the results. Based on the frequencies, tables and figures were built. To analyze the co-occurrence and the linking process between dimensions a cluster and network analysis was carried out. Adherence and homogeneity tests were conducted to verify the similarities or differences regarding the frequency of use of the nine dimensions for the macro-environment configuration for liquid biofuels between science, mass media and governments.

4. Results

In this section the results will be presented, comparing the nine macro-environmental dimensions under which the liquid biofuels have been configured by science, mass media and

[2] TF*IDF = Term Frequency multiplied by Inverted Document Frequency.

government in Germany. The first set of results is presented on tables which show the absolute and relative frequencies of each macro-environmental dimension according its occurrence in the science, mass media and government publications along the analyzed periods. After it, a comparison between science, mass media and government is presented taking into account the total frequency accumulated over time.

At start, as shown in the Table 1, German science configured the macro-environment for liquid biofuels mostly under the Environmental dimension, followed by the Technological and Legal ones. In the following years three dimensions appear as the most frequent: Environmental, Technological and Agronomical. In 1998 the Agronomical dimension rose up to the first position in frequency and the same occurred in 2004. From 1999 to 2003 and later, in 2005 and 2006, the Environmental dimension was the most frequent in the German science. The importance of such dimensions in the German science can be observed by the average of its relative frequency over time. The Environmental dimension obtained an average of 37 % per year, followed by the Agronomical with 24 % and 19 % for Technological dimension, totaling 80 % of relative frequency of all dimensions. This means that, although the other macro-environmental dimensions were present in the German science agenda, they were just slightly frequent in the science content, so with Cultural, Legal and Social ones.

German mass media towards the liquid biofuels sector has been prioritising other dimension in its discourse. In general, in the German mass media there is no well defined pattern in using dimensions to configure the macro-environmental for liquid biofuels as observed in German science (see Table 2). At the beginning, most attention was addressed to the Economical and Geopolitical dimensions, followed by the Technologinal ones. In 1998 just three dimensions marked the mass media news: Environmental, Economical and Agronomical. In 1999 and 2000 the Agronomical aspects related to the liquid biofuel dominated the mass media news, decreasing its relative importance the following periods. A similar performance was observed regarding the Environmental and Economial dimensions, although the relative frequency of economics aspects increased again in the last periods. The most important matter in the mass media content, regarding the liquid biofuels, was attributed to the Geopolitical dimension. The importance of geopolitical discussion, measured by its relative frequency, has an increasing tendency since 1999. In the last 6 periods it was the most frequent in 5, with the highest values observed in 2001, 2002 and 2003, maybe because the events of September 11, 2001 in the United States and the related facts, like the Iraq War.

Table 1 – Macro-environmental dimension frequency in the German science[a,b]

Macro-environmental Dimensions	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Agronomical	*13*	*249*	*410*	*442*	*186*	*513*	*539*	*416*	*722*	*1217*
	(7,0)	(37,1)	(20,9)	(33,9)	(10,0)	(31,8)	(23,0)	(31,2)	(26,5)	(21,8)
Cultural	*4*	*6*	*42*	*13*	*21*	*25*	*26*	*20*	*38*	*84*
	(2,2)	(0,9)	(2,1)	(1,0)	(1,1)	(1,5)	(1,1)	(1,5)	(1,4)	(1,5)
Economical	*27*	*58*	*175*	*36*	*41*	*41*	*273*	*53*	*288*	*416*
	(14,5)	(8,6)	(8,9)	(2,8)	(2,2)	(2,5)	(11,7)	(4,0)	(10,6)	(7,5)
Environmental	*66*	*205*	*655*	*542*	*1078*	*601*	*938*	*370*	*781*	*1833*
	(35,5)	(30,5)	(33,4)	(41,6)	(58,1)	(37,2)	(40,1)	(27,8)	(28,7)	(32,8)
Geopolitical	*20*	*31*	*82*	*82*	*86*	*38*	*105*	*60*	*310*	*384*
	(10,8)	(4,6)	(4,2)	(6,3)	(4,6)	(2,4)	(4,5)	(4,5)	(11,4)	(6,9)
Legal	*7*	*11*	*13*	*6*	*26*	*15*	*28*	*12*	*45*	*64*
	(3,8)	(1,6)	(0,7)	(0,5)	(1,4)	(0,9)	(1,2)	(0,9)	(1,7)	(1,1)
Political	*15*	*11*	*62*	*6*	*38*	*4*	*65*	*35*	*127*	*161*
	(8,1)	(1,6)	(3,2)	(0,5)	(2,0)	(0,2)	(2,8)	(2,6)	(4,7)	(2,9)
Social	*0*	*17*	*44*	*11*	*37*	*12*	*10*	*1*	*12*	*41*
	(0,0)	(2,5)	(2,2)	(0,8)	(2,0)	(0,7)	(0,4)	(0,1)	(0,4)	(0,7)
Technological	*34*	*84*	*479*	*165*	*342*	*365*	*355*	*365*	*398*	*1383*
	(18,3)	(12,5)	(24,4)	(12,7)	(18,4)	(22,6)	(15,2)	(27,4)	(14,6)	(24,8)
Total	***186***	***672***	***1962***	***1303***	***1855***	***1614***	***2339***	***1332***	***2721***	***5583***
	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)

[a]*Absolute Frequency* and [b](Relative Frequency)
Source: research data

Table 2 – Macro-environmental dimension frequency in the German mass media[a,b]

Macro-environmental Dimensions	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Agronomical	*1*	*1*	*38*	*49*	*75*	*31*	*32*	*86*	*114*	*390*
	(3,4)	(14,3)	(41,3)	(26,2)	(22,2)	(13,8)	(13,9)	(26,5)	(10,6)	(14,3)
Cultural	*2*	*0*	*2*	*9*	*16*	*2*	*8*	*7*	*22*	*65*
	(6,9)	(0,0)	(2,2)	(4,8)	(4,7)	(0,9)	(3,5)	(2,2)	(2,0)	(2,4)
Economical	*8*	*2*	*14*	*30*	*29*	*20*	*24*	*41*	*227*	*516*
	(27,6)	(28,6)	(15,2)	(16,0)	(8,6)	(8,9)	(10,4)	(12,7)	(21,1)	(18,9)
Environmental	*2*	*4*	*8*	*30*	*29*	*45*	*15*	*52*	*150*	*306*
	(6,9)	(57,1)	(8,7)	(16,0)	(8,6)	(20,1)	(6,5)	(16,0)	(13,9)	(11,2)
Geopolitical	*8*	*0*	*19*	*28*	*95*	*57*	*75*	*70*	*264*	*690*
	(27,6)	(0,0)	(20,7)	(15,0)	(28,1)	(25,4)	(32,5)	(21,6)	(24,5)	(25,3)
Legal	*0*	*0*	*1*	*4*	*0*	*4*	*4*	*6*	*23*	*86*
	(0,0)	(0,0)	(1,1)	(2,1)	(0,0)	(1,8)	(1,7)	(1,9)	(2,1)	(3,1)
Political	*2*	*0*	*3*	*6*	*27*	*18*	*14*	*11*	*81*	*223*
	(6,9)	(0,0)	(3,3)	(3,2)	(8,0)	(8,0)	(6,1)	(3,4)	(7,5)	(8,2)
Social	*1*	*0*	*2*	*16*	*16*	*9*	*16*	*13*	*49*	*127*
	(3,4)	(0,0)	(2,2)	(8,6)	(4,7)	(4,0)	(6,9)	(4,0)	(4,5)	(4,6)
Technological	*5*	*0*	*5*	*15*	*51*	*38*	*43*	*38*	*148*	*329*
	(17,2)	(0,0)	(5,4)	(8,0)	(15,1)	(17,0)	(18,6)	(11,7)	(13,7)	(12,0)
Total	***29***	***7***	***92***	***187***	***338***	***224***	***231***	***324***	***1078***	***2732***
	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)

[a]*Absolute Frequency* and [b](Relative Frequency)
Source: research data

The importance of such dimensions in the German mass media can be observed by the average of its relative frequency over time. The Geopolitical dimension obtained an average of 21 % per year, followed by the Agronomical with 19 %, Environmental with 18 %, and Economical with 17 %, totaling 75 % of relative frequency of all dimensions. Other macro-environmental dimensions were also present in the German mass media agenda, but with a weak importance in the newspapers content, maily Legal, Cultural, Social and Political. Technological aspects occupied an intermediary level of importance in the mass media liquid biofuels context.

Results from German government are shown in the Table 3.

Table 3 – Macro-environmental dimension frequency in the German government[a,b]

Macro-environmental Dimensions	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Agronomical	*0*	*0*	*0*	*0*	*49*	*213*	*748*	*919*	*694*	*6666*
	(0,0)	(0,0)	(0,0)	(0,0)	(8,9)	(7,6)	(18,3)	(6,5)	(8,0)	(11,7)
Cultural	*0*	*0*	*0*	*0*	*2*	*17*	*80*	*519*	*341*	*2288*
	(0,0)	(0,0)	(0,0)	(0,0)	(0,4)	(0,6)	(2,0)	(3,7)	(3,9)	(4,0)
Economical	*0*	*0*	*0*	*0*	*3*	*24*	*413*	*1254*	*750*	*6491*
	(0,0)	(0,0)	(0,0)	(0,0)	(0,5)	(0,9)	(10,1)	(8,9)	(8,6)	(11,3)
Environmental	*0*	*0*	*0*	*0*	*177*	*1976*	*898*	*2335*	*1859*	*8899*
	(0,0)	(0,0)	(0,0)	(0,0)	(32,2)	(70,2)	(22,0)	(16,5)	(21,4)	(15,6)
Geopolitical	*0*	*0*	*0*	*0*	*31*	*21*	*372*	*3639*	*1809*	*11069*
	(0,0)	(0,0)	(0,0)	(0,0)	(5,6)	(0,7)	(9,1)	(25,8)	(20,8)	(19,3)
Legal	*0*	*0*	*0*	*0*	*75*	*63*	*196*	*1197*	*392*	*3487*
	(0,0)	(0,0)	(0,0)	(0,0)	(13,7)	(2,2)	(4,8)	(8,5)	(4,5)	(6,1)
Political	*0*	*0*	*0*	*0*	*24*	*41*	*308*	*1755*	*741*	*4989*
	(0,0)	(0,0)	(0,0)	(0,0)	(4,4)	(1,5)	(7,5)	(12,4)	(8,5)	(8,7)
Social	*0*	*0*	*0*	*0*	*9*	*36*	*74*	*524*	*225*	*1755*
	(0,0)	(0,0)	(0,0)	(0,0)	(1,6)	(1,3)	(1,8)	(3,7)	(2,6)	(3,1)
Technological	*0*	*0*	*0*	*0*	*179*	*424*	*992*	*1983*	*1866*	*11570*
	(0,0)	(0,0)	(0,0)	(0,0)	(32,6)	(15,1)	(24,3)	(14,0)	(21,5)	(20,2)
Total	***0***	***0***	***0***	***0***	***549***	***2815***	***4081***	***14125***	***8677***	***57214***
	(0,0)	(0,0)	(0,0)	(0,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)	(100,0)

[a]*Absolute Frequency* and [b](Relative Frequency)
Source: research data

As there were not found any documents in the German government domains from 1997 to 2000, the frequencies in the table were reduced to zero. From 2001 to 2003 the

document contents in the German government were addressed to three main macro-environmental dimensions: Environmental, Technological and Agronomical, highlighting the higher relative frequency of Environmental dimension in 2002. From 2004 to 2006 was observed a remarkable change in the set of the main dimensions under which German governmental has structured the macro-environment for liquid biofuel with an increasing importance attributed to the Geopolitical aspects, besides Technological and Environmental dimensions. The Geopolitical dimension was the most frequent found in 2004.

The significance of such dimensions in the German government can be estimated by the average of its relative frequency over time. The Environmental dimension was the first with an average of 30 % per year, followed by Technological which average was 21 % and Geopolitical with 14 %, totaling 65 % of relative frequency of all dimensions. Of course that others macro-environmental dimensions were also present in the German government agenda, but with a less comparative importance. As a medium average group we found Agronomical, Economical, Legal and Political dimensions and with low average Cultural and Social dimensions.

As stated above, a comparison between science, mass media and government use of macro-environmental dimensions can be done. Such analysis was carried out from the total frequency of each dimension along the time and the findings are presented at the Figure 4. The results confirm the presence of some similarities and differences among the three social expressions. As previously stated, the dimensions Environmental (36,1 %), Agronomical (24,1 %) and Technological (20,3 %) were mainly addressed by the German scientists in scientific papers, while Geopolitical (24,7 %) and Economical (17,4 %) were most frequently used by German journalists. Political (9,0 %), Legal (6,2 %) and Cultural (3,7 %) were most frequently used by German government.

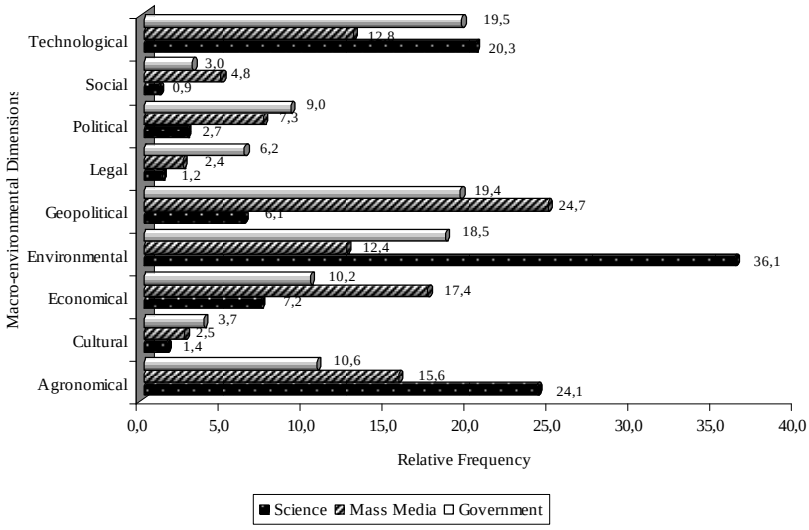

Figure 4 - Relative frequency of the macro-environmental dimensions under which the liquid biofuels were categorized by the German science, mass media and government in a ten-year period
Source: Research data

As similarities between science, mass media and government we can point out the low frequency in the macro-environment configuration under Political, Legal, Social and Cultural dimensions. Science and government present a similarity because Environmental and Technological are among the three main dimensions used in the macro-environment configuration. The presence of Technological among the three main dimensions is a similarity between science and mass media. On the other hand, there is a similarity between mass media and government in the use of the Geopolitical dimension as one most frequently used.

5. Analysis

Looking for simililarities and dissimilarities between the three German social expressions of the liquid biofuels sector, adherence and homogeneity tests were carried out. The results for adherence test between science, mass media and government can be seen at Table 4. According to Siegel and Castellan Jr. (2006) an adherence test is used to check whether there is a significant difference or not between the expected frequency of a category and the observed frequency. In this case, we check for adherence between the expected and observed values for each dimension taking into account the accumulated frequency. Then, we chek for adherence between 'government to mass media' relation, for instance, using the mass media frequency as expected values and government frequency as observed values. The same procedure was accomplished in each relation presented on the Table 4.

The results for adherence test suggest that there is no significant adherence between science, mass media and government in Germany regarding the use of dimensions to configure the macro-environment for liquid biofuels. The lowest chi-square value, although without statistic significance, was that one observed between mass media and government (χ^2 = 891,57), suggesting that the relative frequencies of which each dimensions occur in the mass media were closer than those ones verified elsewhere.

As adherence tests don't reveal any significant similarity between science, mass media and government, homogeneity tests were carried out. In the homogeneity test we were looking whether two fields of social expression were using or not macro-environmental dimensions in a similar frequency taking the accumulated frequency over time. The results for homogeneity test are presented on the Table 5.

Table 4 – Adherence Test between German liquid biofuels stakeholders – Total dimensions frequency

Stakeholder's Relations	χ^2
Government to Mass Media	16910,33
Mass Media to Government	891,57
Government to Science	79465,9
Science to Government	10805,1
Mass Media to Science	15886,20
Science to Mass Media	6174,83

df = 8; α = 0,01; Critical χ^2 value = 20,090; *p < 0,01

Table 5 – Homogeneity Test between German liquid biofuels stakeholders – Total dimensions frequency

Relations	χ^2
Mass Media and Government	833,9
Science and Government	8410,5
Science and Mass Media	3547,3

df = 8; α = 0,01; Critical χ^2 value = 20,090; *p < 0,01

The results for homogeneity test suggest also that there is no significant similarity between science, mass media and government in Germany regarding the use of dimensions to configure the macro-environment for liquid biofuels. The closer homogeneity was verified between German mass media and government with the lowest chi-square value (χ^2 = 833,9). The second lower chi-square value (χ^2 = 3547,3) occurred between science and mass media. Finally, when comparing science and government results in the highest chi-square value (χ^2 = 8410,5), suggesting a weak similarity between those two stakeholders in the use of dimensions to configure the macro-environment for liquid biofuels in Germany. Although any chi-square value have been significant at p<0,01.

After looking for similarities between science, mass media and governemtn through the adherence and the homogeneity tests, a cluster and network analysis was accomplished. The clusters of macro-environmental dimensions were grouped by similarity index, according to Jaccard's coefficient by occurrence of each dimension. The network of dimensions was designed from its co-ocurrence frequency at the same document. The thickest lines mean a

strong relation between two dimensions. As thicker as a line is, stronger is the relation, that is, the more frequently two dimensions were found in the same document. The results are shown in the Figure 5.

The top four dimensions cluster in the German government could be devided into two other clusters, one grouping the Technological and Environmental dimensions and other with Geopolitical and Economical dimension (Figure 5c). The next stronger relations occur with Agronomical dimension. Those findings suggest that, when discussing about the liquid biofuels, the technological and environmental aspects are more closely related in the policy-makers discourse, followed by the geopolitical and economical ones.

German science, on the other hand, has a well defined dominating cluster, which is composed by Agronomical and Technological first, linking with Environmental thereafter (Figure 5a). This cluster presents strong relations between the three dimensions and is so far from other macro-enviromental dimensions, meaning that, when researching and working on liquid biofuels, German scientists have been investigating the relations between agronomical, technological and environmental aspects of liquid biofuels production and consumption.

Finally, German mass media presents a cluster of top four dimension co-ocurrence similar to that seen in the German government, almost in the list of macro-enviromental dimensions that compose the top cluster: Geopolitical, Economical, Technological and Environmental (Figure 5b). The strongest link occurs between Economical and Geopolitical dimensions, then linking with Technological and after with Environmental dimension. The results suggest that, when informing the public (policy-makers, scientists, consumers, producers, managers, investors, and so on) about the liquid biofuels, the German journalists prioritize and relate geopolitical and economical aspects with each other more frequently, linking with technological and environmental matters as secondaryly in their discourse.

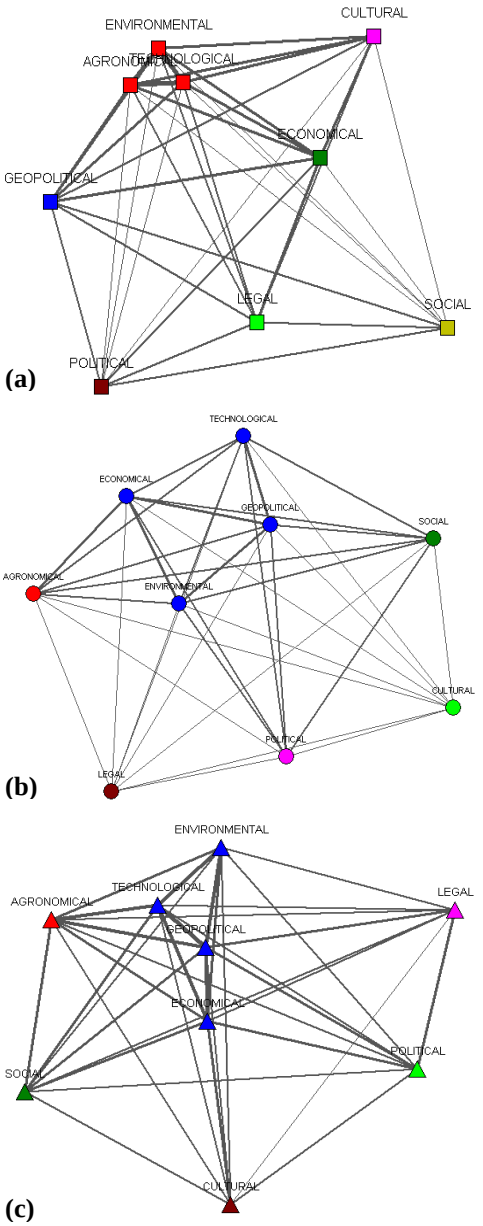

Figure 5 – Macro-environmental dimensions cluster and networks on science, mass media and government
Source: research data

6. Concluding remarks

This paper has as main pourposes to investigate under which dimensions the macro-environment for liquid biofuels has been structured during time, respectively by German scientists, journalists and policy-makers and test for similarities between those stakeholders. In order to achieve such a goal, a documentary research was conducted using a database of scientific papers, mass media news and official government documents. In strategic planning

to developing and running businesses and other matters regarding liquid biofuels activities it is important to find out whether the perceived critical issues suit the prime dimensions factually emphasized by those stakeholders. Decision-makers can be also interested on which stakeholder discourse should they drive their attention to regarding the mutual influence in configuring the macro-enviroment for liquid biofuels.

The primary conclusion of this study is that there is a set of macro-environmental dimension most frequently used in German science, mass media and government. Such dimensions are: Agronomical, Envionmental, Economical, Geopolitical, and Technological. Although present in the stakeholders discourse, other dimensions (Cultural, Legal, Political, and Social) were less frequently noticed on the document's content. Despite their same set of most frequently used dimensions, it does not means that there is a high level of similarity between science, mass media and government because the frequency that each dimension had occurred varied from each stakerholder and over time. Therefore, the main conclusion is that, when scanning the macro-environment for liquid biofuels, the decision-makers will probably find out different configurations according the source of information used. On following question is to identify which of them have more influence on the liquid biofuels players' decisions. In future studies we hope to explore such influences.

Derived from a literature overview, a set of propositions regarding the similarity in the macro-enviroment configuration was declared. Retrieving such propositions after the results and data analysis, we may conclude that proposition 1 was not confirmed, while propositions 2 and 3 were confirmed. That is, based on the results of adherence and homogeneity tests we should reject the hypothesis that German mass media and government configures the macro-environment for liquid biofuels under the same dimensions, at least at a chi-square statistical significance level. On the other hand, we can accept the hypothesis that there is difference in the macro-environmental dimension under which the liquid biofuels are framed by German science and government and also by science and mass media.

Considering the fact that German science, mass media and government stress different macro-environmental dimensions, it implies that investment decisions and the expansion in the production and use of liquid biofuels may be more or less affected by (changes in) the prevalent configuration of the national macro-environment. For example, changes in the environmental dimension may have a larger impact on the German scientific knowledge regarding biofuels than in other stakeholders. As well as changes in the economical dimension may have a larger impact on the German mass media then in other stakeholders. This stakeholder-by-stakeholder analysis of macro-environment configuration may help to safeguard private biofuel activities in Germany, by deploying a stakeholder-specific strategy on macro-enviromental scanning.

In spite of statistical results have shown that there are no similarities between German science, mass media and government, the additional analysis of frequencies on which dimensions have joined occurred at the same documents suggest a closer relationship between mass media and government, followed by the relationship between mass media and science and, finally, by science and government. What should it means? In our opinion, such findings take us to wonder about the influence of journalists on the policy-makers. In other words, it could mean that German public policies regarding the liquid biofuels are more mass media-based than science-based. Therefore, it may reflect disarrangement between the scientific knowledge produced by German scientists and the knowledge required by policy-makers to propose public policies. On the other hand, the policy-makers may be disinterested or disregarding the scientific knowledge.

We conclude that there are almost two implications on those findings. First, for academic audience, is that there is an opportunity for scientists and policy-makers working closer to each other. Second, for decision-makers, is that whether one wants to know the

public policies direction in Germany he/she should look out on the mass media discourse instead of scanning the macro-environment in German science. Such conclusion may be helpful for business managers and decision-makers in the liquid biofuels sector once the macro-environment may be properly scanned by using the most relevant sources of information. A clear prospective of liquid biofuel macro-environment will certainly lead the decision-makers to better strategic planning and management of this industry, helping them to better structures and add value their business.

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