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Alternative Fuels Research: A Scientometric Profile

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Abstract : The following paper examines the research of alternative fuels in the world as revealed by the publications indexed in Web of Science (WoS) during a period of 5 years from 2013 to 2017. It was had that the academic institutions contributed with approximately half of the total production. Arizona State University from United States surpassed all other institutions in the world. The alternative fuel research done by scientists is well connected with the behavior of international research trends in this field. Recent trends show that there should be more national collaborative research, referring to the United States, and international research that involves larger teams. More emphasis is being given to research on alternative fuels based on bioethanol.
Keywords : Alternative, Bioethanol, Energy, Amount, Production.

Introduction

Alternative fuels today are a quite viable solution for dependence on non-renewable fuels or fossil fuels, which translates into less import costs[1], and at the same time, these can replace long-term petroleum-based fuels. Alternative fuels today are prioritized for many reasons such as the energy sustainability they can provide to mitigate the concerns of limited fossil fuel energy; improve the efficiency and output emissions of internal combustion engines with the help of physical or chemical properties and alleviate the unbalanced use of fossil fuels[2]. In the case of fuels such as ammonia and its derivatives, more efficient and safer technologies must be developed since they can play an important role as alternative fuels[3].Alternative fuels are those from a base other than conventional fuels made from gasoline and diesel, which are importantregarding final forms and sources of manufacture.

Today there are alternative fuels defined by entities, such as those of the Energy Policy Law (EPAct) that cover a large amount of unconventional fuels, which are alcohols, such as ethanol (including mixtures with gasoline of more than 85%); natural gas and liquefied fuels that are domestic by-products of natural gas; petroleum liquid gas; liquid fuels derived from coal; hydrogen; biodiesel; fuels, which are not alcohol, fuels from biological materials; and fuels that provide substantial energy security and environmental benefits.Alternative fuels in the future will be the best option for vehicles,given that this option will have as independent variables: The lower emission of polluting particles, economic accessibility and knowledge of the people of non-polluting fuels; and as dependent variables: The environmental impact produced by alternative fuels such as hydrogen, methanol, ethanol, etc.and fossils like gasoline, diesel, among others.Alternative fuels

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can be obtained today even of food products having different concentrations as the case may be, as John F. Monsalve[4] verified in his research of deriving ethanol from the banana peel and the starch of yucca, studying the acid hydrolysis of the starch present in the cassava and the cellulose present in the banana peel where these two substances were fermented to obtain ethanol finally, having an adjustment of the fermentation media for the microorganisms *Saccharomyces cerevisiae NRRL Y-2034* and *Zymomonas mobilis CP4*, finding for the first one an ethanol concentration of 7.92 ± 0.31% and without finding considerable production in the other fermentation medium, respectively.However, these fuels do not only show good hopes, since they all are not ecological and some can harm the environment, either in their production or their use, and even in both circumstances; they are also cleaner when burned, although this does not guarantee absolute reliability since it is necessary to see how much they pollute when comparing the number of greenhouse gases emitted in the complete cycle of production and consumption with what is required to process and transport fossil fuels, and if that were not enough, they would affect biodiversity since there would be deforestation that leads to the loss of local fauna population.

Literature review

Several studies have been published regarding alternative fuels, their procurement, uses, and other activities done with them, such as Cabal and De la Rua[5], which were based on the Life Cycle Analysis methodology to analyze the processes of production, distribution and use in Spain of oilseed biodiesel, used oil and diesel biodiesel, and their impacts on climate change and energy consumption throughout the process have been quantified; Mostajo and Guede[6], analyzed the control of emissions of persistent pollutants in the use of alternative fuels in the cement industry, others like Estrada and Meneses[7], that focused on the biomass gasification for the production of low-powerful heat fuels, which are alternative fuels, and their use in generating power and heat.

All the previous studies show an applicative panorama of fossil fuels, so the present study will show a record of how many works have been done regarding alternative fuels.

Methodology

This study is based on the data collected from the HistCite software which shows a set of published articles, organized according to the frequency with which they were cited in different works.

Data downloading

All the records exposed here were extracted from information provided by the Universidad del Atlantico, which were subsequently processed on the HistCite platform, which is a useful program when categorizing data from a set of information. There were problems in handling the data in the software due to a bad characterization of the data, which are from different sources. They were analyzed in total 396 articles, 49 review documents, 18 proceedings papers, 15 editorial materials, 14 meetings abstract reports, 5 correction documents 3 new items.

Data standardization

As accuracy was required in the data used, each record was reviewed and it was found that some documents in other areas were related to the search results, due to the presence of keywords such as "oil", "bioethanol", "alcohol", etc., but they were not of importance for the investigation of interest. Therefore, these irrelevant documents published in those journals were excluded, which resulted in 500 records. Thomson Reuters and Moed[8], suggest that the names of the authors and their affiliations should be standardized due to various factors .Each record was analyzed and standardized so that the database is authentic and susceptible to a considerable and reliable analysis. Also, in certain registers there was no information on the affiliation of the authors, this was solved with the affiliation information provided by the author of the reprint. The HistCite platform only showed data, so the description of the articles that it showed had to be extracted from reliable sources from published reports and articles.

Data enrichment

After standardization, the data was enriched with several parameters, such as the number of authors, the number of institutions, the nature of the collaboration, the research sectors. After completing all of the above, appointments were updated to allow the maximum possible appointment window, thiswas done in November of 2017.

Objectives of the study

- Examine the growth pattern of research production in alternative fuel research during the period 2013-2017.
- Identify the different sectors of performance and change in activity during 2013-2015 and 2015-2017 using HistCite.
- Identify the most prominent institutions, how their publications were and their impact using various indicators.
- Analyze how the research was conducted over a period.
- Analyze the effect of the appointment of the research result.
- Identify the prominent authors, the highly cited articles and the most common journals used to publish research results.

Indicators used

The following indicators have been used in the data analysis: number of publications; number of appointments; citation by article; Impact Factor of the journal (IF); co-authorship index; Transformative Activity Index (TAI); Domestic Collaboration Index (DCI) and International Collaboration Index (ICI). The data were divided into two blocks of 3 years, 2013-2015 and 2015-2017, to study the change, in this case, from the first block to the other in parameters such as the result of the publication, the co-authorship and the nature of the collaboration, etc. The numbers of publications and the number of citations were obtained from the data downloaded from Web of Science. The citations per article have been widely used in scientometric evaluation to normalize the inconsistencies in the volumes of literature published by different institutions, sectors, countries, etc., and also the global citation score (GCS) supports this by showing the demand for an article. The impact factor values for the different publishing journals were obtained from the Journal Citation Reports (JCR) 2010.

The change in the productivity of the research from the first to the second block has been analyzed with the use of the Transformative Activity Index (TAI) used by Guan and Ma[9], very similar to the Activity Index suggested by Schubert and Braun[10]. The TAI means the change in research effort during different periods.

$$TAI\ =\ \{(Nij\ /\ Nio)\ /\ (Noj\ /\ Noo)\}\ X\ 100$$

Where,

Nij: number of documents of entity i in block j;

Nio: number of documents of entity i for all blocks;

Noj: number of documents of all entities for block j;

Noo: number documents for all entities and all blocks.

The TAI = 100 value indicates that the research effort in a particular block corresponds to the average of the total, TAI> 100, which suggests more than the average, and TAI <100 indicates a less than average effort in that entity.

To examine the change in the pattern of collaboration, the DCI, and the ICI are used, which were suggested by Garg and Padhi[11] in their research work and used by Dutt, Garg, and Bali[12].

$$DCI\ =\ \{(Di\ /\ Dio)\ (Do\ /\ Doo)\}\ X\ 100$$

where,

Di:number of articles written in US co-authorship for Block I;

Dio:total output of block i

Do:total number of US co-authorship documents

Doo:total production.

Equally,

$$ICI = \{(Ii / Io)\ (Io / Ioo)\}\ X\ 100$$

where,

Ii:number of documents with international co-authorship (outside the United States) for block i

Iio:total production of block i

Io:number of international co-authorship documents for all blocks

Ioo:total production.

The value of DCI or ICI = 100 suggests that the country's collaborative effort corresponds to the world average. DCI or ICI> 100 indicates a collaboration more significant than the world average and DCI or ICI <100 reflects a below-average collaboration**.**

Results

Behavior of the production of articles

During the period of 5 years from 2013 to 2017, a total of 500 articles were published in journals indexed on the Web of Science platform, on a variety of uses of alternative fuels, such as the use of them in automobiles, searches of better fuels, the comparison of different fuels, among many more investigations about them.All the research work was done by different authors of many nationalities working in various institutions. In the first year the least amount of publications was presented, so it is considered as the year of least production, the two following years showed a constant amount of publications, and then a sudden decrease in recent years. Figure 1.

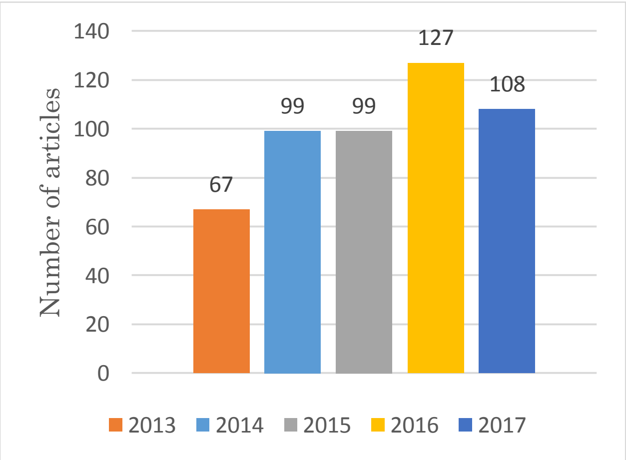

Figure 1. The number of publications for each year. The respective values are indicated above the bar

Activity and transformation index

Alternative fuels today are characterized by the variability with which they can be acquired from many sources such as coal, oil shale, tar sand, plants and animal fats. There has been a progressive evolution of alternative fuels in search of finding non-aggressive solutions to the environment in order to achieve a cleaner and more functional world, evidenced by initiatives taken by different countries, such as the United States, through its Department of Defense launched the Clean Fuels Initiative that includes two programs: Total

Energy Development Program (TED) and Joint Battlefield Use Future Fuel (J-BUFF), being the first destined to catalyze the commercial production of fuels from the alternative energy resources and the second to developed specifications of alternative fuels to reaction that allow a single fuel for the whole battle space.

The society has been faced with the challenge of balancing the energy and environmental demands that are in conflict, by decarbonizing our energy chain and finding clean and viable sources of fuel. Concerns about the increase in the price of fuel, the supply of energy, energy security, emissions and climate change have led to more attention and use of alternative fuels in reaction.

In the last decade, many aircraft based on alternative fuels, such as synthetic fuels, biofuels, alcohol fuels, liquid hydrogen, liquid methane, etc., have been proposed and analyzed by important entities that have given a good endorsement of the benefits of the use of them. It is important to take considerations of alternative fuels since figures such as that world aviation consumes around 5 million barrels of oil per day, which represents approximately 5.8% of total world oil consumption. It prompts a future estimate of global aviation fuel demand growth of 38% from 2008 to 2025 at an average growth rate of 1.9% per year[13].

United States is shown as the only leader in publication of articles, with more than 25% of all articles published, it does not surprise these results of such a prolific nation, but as for the change in the publication effort (Table1) it was quite weak comparing it with the rest of the countries which were very much above, behavior very likely supported in the no need to give more than how much we have.

Figure 2 shows the productivity of the countries in terms of the change to articles. The United States is below the rest and Spain, and the countries without registration are leading the change in the TAI. Most of the countries show a high value of productivity, which is contrasted with a poorvalue of countries such as India, Malaysia, and Iran; all this being understood, due to the notable difference between the countries in terms of technological development. The decrease in production was almost even with the increase.

Prolific institutions – output and impact

The institutions have been rated according to the number with the percentage of publications made by them based on the total of publications, the most productive being those whose percentage is above one percent. Table 2 illustrates the classification of the institutions responsible for the publications according to the percentage that their publications represent of the total (% P), the local citation score (TLCS) and the global citation score (TGCS). The first of the list that is the Indian technological institutes that shows a clear superiority to be a set of institutions, at the same time it should be noted that the Indian country shows a technological develop with some 4,750 emerging technology companies, surpassed only by States United and United Kingdom, which is very close to overcoming them. There are success stories like Flipkart, Amazon's rival in India, or Big Basket online supermarket.

From the rest of institutions such as Arizona State University, can be attributed its influence on performance to the firm commitment it has with the inclusion and academic excellence that has led it to create the most innovative higher education programs in the United States. This country stood out, given that the majority of prosperous institutions are located in the same, although USA, is not far from the rest of institutions, which met the minimum score of categorization, such as the French institution IFP who focuses in providing solutions to face the challenges that society faces in terms of energy and climate.

Table1. The TAI for the two periods of time

Country	TAI (2013-2015)	TAI (2015-2017)	Total papers
USA	110,0328235	89,60360516	129
India	68,38735494	187,8329397	35
China	91,31590136	104,5573716	35
Spain	66,45064337	117,8498851	26

UK	67,22265122	118,2000953	25
without registration	215,5631141	32,92533123	24
Canada	105,9271029	97,10223394	23
Germany	139,2218892	80,98684388	22
South Korea	95,69327731	101,9667413	20
Turkey	52,93138761	121,6319567	18
France	160,5326877	70,21445592	17
Australia	121,4285714	90,42553191	16
Iran	102,031302	99,12293314	13
Italy	110,7539683	95,36989578	12
Japan	195,9104938	59,33352028	12
Malaysia	93,88341544	102,2199046	12
Brazil	169,4139194	74,54667562	11
Denmark	45,45225498	117,6489769	9
Greece	85,44973545	105,1139005	9
Israel	94,31216931	102,0515267	8
Mexico	0	136,4425163	8
Poland	40,55059524	126,4920424	8
Sweden	0	151,8945634	7
Taiwan	35,14739229	144,4099379	7
Austria	106,8027211	94,01197605	6
Belgium	144,8773449	61,74661747	6
Portugal	85,26077098	109,4614265	6
Egypt	0	172,4137931	5
Netherlands	110,4761905	72,5	5
Others	100	100	1,904761905

Behavior of the research trend

The series of words that most appeared in the titles of the published articles were taken, dividing the account for each year. Each word characteristic of the title is a clear indication of the kind of article that is going to be read, of its content and above all of its central aspect by which the same was written. In table 3it can be seen the results, having to the alternative word as the first in total number, but for each year during the period from 2015 to 2017 was not presented, a strange case having as a central theme the alternative fuels. In the case of biodiesel, it has to be one of the most promising since for the operations of marine vessels, based on a perspective of technical integration, biodiesel blends, which can be up to 20%, have been reported as mentioned. Biodiesel can be used in marine diesel engines and mixed with distillate fuels. It is also possible that low blends of biodiesel up to 20% could be used without any degradation of the fuel system[14], and biodiesel can easily replace diesel due to its derivability from natural sources and cleaner and at the same time renewable that makes it less polluting. Although it is considerable the difference in prices that may exist between the fuels of plant origin that exist, being a determining factor for this the cost that compares the use of fuel evaluated based on what constitutes the total operating cost, which are three things: cost comparative of operation, comparative cost of capital, environmental costs and others[15].

Impact factor

The evaluation of the impact of the result, measured with the impact factor, is made based on three different parameters: impact factor for the journals where the research work was exposed, the country responsible for the existence of the journals and citations of the results of the investigations.

Behavior of research productivity according to the impact factor

The impact factor of the journal refers to the evaluation of the prestige of it. There are opinions of various authors, on this factor focused on the fact that experience shows according to the specialty, it can trust that the best journals are the most demanding to accept an article, and magazines thus they are those that have a high impact factor. In the literature, several studies have been registered that have applied impact factors to analyze the performance of the investigations, of institutions. Then, the impact factor is an indicator of enough confidence to evaluate the result of the investigation. All the productivity of the magazines regarding the production of alternative fuel items was divided into four groups to make the analysis easy. The results are shown in Table 4. This categorization showed that most of the research results appeared in journals of low impact factors. They have published 15 percent of articles in journals that have a high impact factor of 4 up. The remaining percentage appeared in journals with a high and medium impact factor, that is, between 2-3% and 1-2%. The general distribution of the behavior of the product according to the impact factors that occur daily establishes that there is a suggested value of a substantial proportion for can see if the visibility is medium, high or very high, so that the research work of alternative fuels by the various authors can be seen if it was connected to international trends, and precisely it was.

Quotation trend of articles

In addition to the impact factor and the publishing countries, another indicator to evaluate the quality of the investigations was the analysis of the citations; this is complementary in the references that are derived from analyzing the impact factor of the result of the articles. The use of quotations, the name of the person loyal to the person in which the work was done, the indication that the author has been documented, has read the last previous contributions of more expert people of the subject, and therefore the document has been subjected to a careful study. Quality documents are frequently cited, which allows them to gain greater visibility and publicity in academic circles. The analysis of citations showed that 265 articles had a total globalization score (TLGS) of 1969 (Table 5). The number of articles that received 233 to 506 citations was around 5.4%. About 3 percent of the documents received 157 citations. After this, the number of articles decreased with the number of appointments also decreasing. 2 percent of the articlesreceived 16 to 99 citations and 0.8 percent of 1-56 citations. The general distribution of research production based on the ranges of citations corresponding to the articles, definition that half of the production of articles had received six or more than six citations. An analysis of the result related to the behavior of the collaboration in the realization of the articles and the history received from the document that comes from the United States, had more questions than in many references. According to Moed[8], the international collaboration with advanced countries is beneficial in impact terms of citations compared to purely national publication.

Trend of collaboration

Gone are the days when science consisted of looking for scientists to work alone. Now a days, well-developed scientific research must be carried out as a team. Many countries with their governments using different policies make it easier for better interaction between scientists and collaborative research programs. The issue of collaboration can be treated as a consequence of science reaching a "stable state"[16]in which synergistic effects will play an increasingly important role in obtaining scientific knowledge[17].

Therefore, collaboration can be treated as one of the sets of scientific policy tools that are required in a situation in which scientific growth cannot be based on a growing expansion of workforce. These leaders have different forms of collaboration at the local, national and international levels. Rodriguez[18]has exposed several reasons to enter into partnership. This document analyzed collaboration trends in alternative fuels research using two different forms: The first was the change in the pattern of co-authorship during the two 5-year blocks, that is, 2013-2015 and 2015-2017; and the second with the change in the pattern of the behavior of the collaboration during the two mentioned blocks in question.

Pattern of co-authorship

In the analysis of the co-authorship pattern, all the data were divided into two blocks of 3 years, with the articles that were of a single author, two authors, several authors that are 3 to 4 authors and mega authors, corresponding to 5 authors or plus. These results can be visualized in Table 6, where a progressive increase of the articles is noted as the authorship range increased. This implied that during the first three years, mega author's works dominated the scenario. The second block of years indicated a similar behavior, with the difference that from the beginning there were slight decreases in the articles, but at the same time demonstrating that the authors preferred group work.

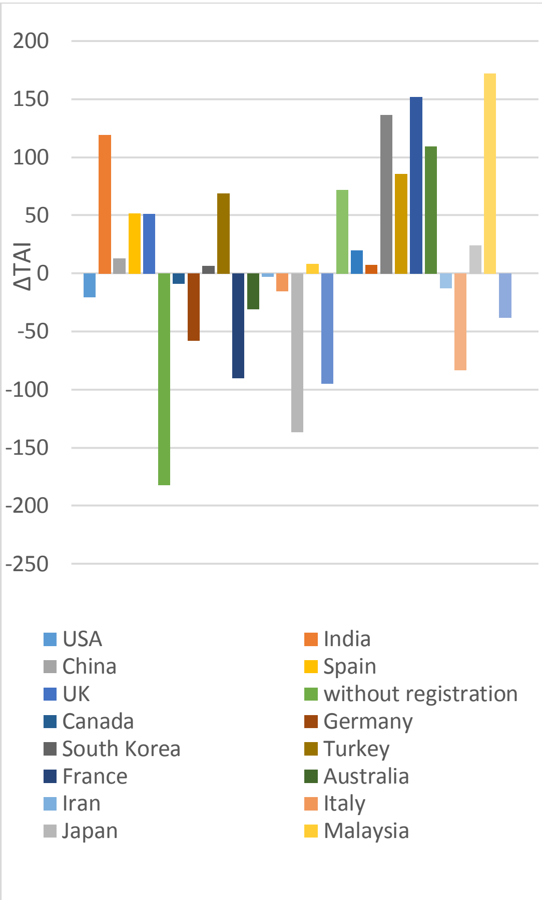

Figure 2. Change in TAI for all countries

Table 2. Institutions ordered according to their number of publication

Institution	%P	TLCS	TGCS
Indian Institutes Technology	1,2	9	242
University of kMalaya	1	6	148
Chinese Academic Sciences	1	0	18
University of Illinois	1	3	73
Tianjin University	1	0	69
Arizona State University	1,4	14	67
T. Univ. Denmark (DTU)	1	0	64
Tsinghua University	1	2	52
Penn State University	1,4	7	50
MIT	1,2	8	43
IFP Energies Nouvelles	1	1	38
Israel Institute of Technology	1	9	34
University of Castilla-La Mancha	5	0	33
University of Central Florida	1,2	7	32
Stanford University	1	3	31
Argonne Natl Lab	5	0	20

Nature of collaboration

Two forms of cooperation were analyzed, categorized in a database, a significant aspect that was observed was that many articles have various origins in many parts of the world. There are definitions of similar forms of collaboration, such as those of Bordon[19]. The change in the pattern of collaboration (DCI), is a measure of the partnership of a certain entity in the production of articles, in this case, this applies to the United States. The other parameter of the collaboration to analyze is the Index of international collaboration, that is, of the countries other than the United States. The most dominant international collaborating countries other than the USA were India, China, Spain and the United Kingdom. Approximately half of the production arose due to the collaborative research of various the all international institutions. Table 7suggests that during the first block approximately 4 percent of the publicationswere produced without any help. In the remaining block, international collaboration predominated, however, the values of the parameters indicated collaborative activity above the average in both types of collaboration. During the last block, only 2 percent of the articles appeared without any collaboration, which was a substantial change. A more detailed analysis of the data on collaboration indicates that 11% of the national collaboration was due to the Arizona State University, and 5% of the collaboration was due to the University of Pennsylvania. The institutions that most stood out in international collaboration were the Indian technological institutes and Argonne National Laboratory.

Table3.Words most popular in the articles

Words	2013	2014	2015	2016	2017	Total
ALTERNATIVE	64	426	0	0	0	490
FUEL	42	272	1	0	0	315
DIESEL	6	10	10	14	11	51
ENGINE	8	10	6	6	8	38
COMBUSTION	9	8	9	8	4	37
EMISSIONS	7	5	7	11	7	37
CEMENT	3	5	6	10	5	29
CELLS	3	5	3	13	4	28
OIL	4	5	4	5	7	25
ENERGY	4	6	8	5	0	23
GAS	5	5	6	2	5	23
JET	4	6	6	3	4	23
VEHICLE	2	5	3	5	8	23
BIODIESEL	3	2	3	6	8	22

Table 4. Values for impact factor

Impact Factor	No. of papers
Low (1%-2%)	**359**
Medium (2% - 3%)	50
High (3% - 4%)	17
Very high (4% and more)	74

Table 5. Ranks of TLGS according to the number of publications

# Journal	RECORDS	TLCS
1	27	(233-506)
2	20	4
3	17	97
4	13	157
5	12	(65-157)
6	11	106
7	9	0
8	8	(16-99)
9	7	58
10	6	(23-91)
11	5	(4-5)
12	4	(1-56)
13	3	(8-23)

Prolific authors, highly cited papers, and most commonly used journals

Total output was produced by 1650 authors, which were different nationalities. Authors who contributed 0.8 percent or more of the totalproductionare considered as a prolific author. Eight authors are on the list, shown in Table 8, of these, two belong to the RS ADVANCES, and the rest were scattered.

Highly cited papers

Articles that scored higher than 50 on the Global Citation Score (GCS) were designated as highly cited articles, which are listed below, of these, three belonged to the Renewable &Sustainable Energy reviews affiliation. The highly citedarticles are much appreciated today as they show a good example.

	Paper	**GSC**
1	Kakati N, Maiti J, Lee SH, Jee SH, Viswanathan B, et al. ***Anode Catalysts for Direct Methanol Fuel Cells in Acidic Media: Do We Have Any Alternative for Pt or Pt-Ru?*** *Chemical reviews. 2014 dec 24; 114 (24): 12397-12429*	128
2	Hackbarth A, Madlener R ***Consumer preferences for alternative fuel vehicles: A discrete choice analysis*** *Transportation research part d-transport and environment. 2013 dec; 25: 5-17*	60
3	Hossain AK, Davies PA ***Pyrolysis liquids and gases as alternative fuels in internal combustion engines - A review*** *Renewable & sustainable energy reviews. 2013 may; 21: 165-189*	59
4	Mustafi NN, Raine RR, Verhelst S ***Combustion and emissions characteristics of a dual fuel engine operated on alternative gaseous fuels*** *Fuel. 2013 Jul; 109: 669-678*	59

5	Park SH, Lee CS ***Applicability of dimethyl ether (DME) in a compression ignition engine as an alternative fuel*** *Energy conversion and management. 2014 Oct; 86: 848-863*	58
6	Meng XG, Wang T, Liu LQ, Ouyang SX, Li P, et al. ***Photothermal Conversion of CO2 into CH4 with H-2 over Group VIII Nanocatalysts: An Alternative Approach for Solar Fuel Production*** *Angewandtechemie-international edition. 2014 Oct 20; 53 (43): 11478-11482*	54
7	Salvi BL, Subramanian KA, Panwar NL ***Alternative fuels for transportation vehicles: A technical review*** *Renewable & sustainable energy reviews. 2013 Sep; 25: 404-419*	52
8	Uson AA, Lopez-Sabiron AM, Ferreira G, Sastresa EL ***Uses of alternative fuels and raw materials in the cement industry as sustainable waste management options*** *Renewable & sustainable energy reviews. 2013 Jul; 23: 242-260*	47

The most commonly used journals

The total production was distributed in 221 journals published in 71 different countries. The journals that published 1.6% or more of the totalproduction along with their impact factor have been listed in Table 9. More than half of the result has been published in 100 journals while the rest of the medium is covered in more than 70 magazines.

Table 6. Distribution of output according to number of authors

Year block	**Distribution of authors**			
	One	**Two**	**Multi**	**Mega**
2013-2015	47	80	140	233
2015-2017	30	79	124	267
Total	77	159	264	500

Conclusions

The study is based on data from 5 years (2013-2017) that revealed that the investigation of alternative fuels received an impetus during the last period, that is, 2015-2017. Academic Institutions, Indian Institutes of Technology, Councils of Science and Industrial Research, the Department of Science and Technology and engineering institutes accounted for more than 90% of production, while institutions from less industrialized countries had less contribution. Despite the fact that academic institutions outperformed all other performance sectors regarding thequantum of publications, even the visibility of their work was much lower than that of private organizations, the Department of AtomicEnergy, among others. Two US state universities were among the top 22 institutions in productivity. The Indian technological institutes and the MIT of the United States stood out.

Table 7. Distribution of output according to nature of collaboration

Year block	Nature of collaboration		Total papers
	DCI	ICI	
2013-2015	4,0764	84,2	233
2015-2017	2,58	90	267
			500

Some of the leading institutions were activated only in the last decade. In the first decade, the dominance of unique author research was highlighted, while in the last decade team sizes of larger authors were highlighted. Thus there was more national and international collaborative work. In the investigation of alternative fuels, it was noticeable to the scientists who seemed to be well connected to the global research trends in more than 90 percent. The research papers were published in journals from the USA, United Kingdom and diversity of countries in Europe. In addition to this, three-fifths of the Indian solar cell research appeared in journals that have medium, high or very high impact factor.Until mid-2010 around 40 million vehicles of alternative fuel and advanced technology had been sold in the world. The largest fleets of alternative fuel vehicles and advanced technology.But while beverages are made from grapes or grains, ethanol fuel can be made from all kinds of plant material, including wood chips, corn husks,and sugarcane. In the United States, ethanol is usually made with corn.

Table 8. Prolific authors and their citations received

Author	**Affiliation**	**No. Of papers**	**citations received**
Dana AG	RSC ADVANCES.	5	34
Grader GS	ENERGY TECHNOLOGY.	5	34
Kuby M	EUROPEAN JOURNAL OF OPERATIONAL RESEARCH.	5	55
Kumar A	JOURNAL OF ENVIRONMENTAL BIOLOGY.	5	17
Shter GE	RSC ADVANCES.	5	34
De Souza-Santos ML	ENERGY & FUELS.	4	18
Domingo JL	SCIENCE OF THE TOTAL ENVIRONMENT.	4	28
Kayali I	JOURNAL OF COLLOID AND INTERFACE SCIENCE.	4	2

Table 9. Most influential journals in the production of articles, together with their country of origin and the impact factor

Journal	**No. Of papers**	**Country**	**IF**
Fuel.	27	USA	4,2
Renewable&sustainableenergyreviews.	27	USA	3,5
Zkginternational.	20	Germany	3,6
Energy & fuels.	17	USA	2,6
Energy conversion and management.	13	USA	3,2
International journal of hydrogen energy	12	USA	2,8
Journal of cleaner production	12	Spain	3,4
Transportation research part d-transport and environment	12	Canada	3,9
Energy	11	England	3,6
Abstracts of papers of the american chemical society	9	France	4
Applied energy	8	Korea	3,8
Environmental science & technology	8	Germany	2,5
Journal of engineering for gas turbines and power-transactions of the asme	8	USA	4,1

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Appendix I – Search Strategy

Search strategy 1

ts=(“alternative fuel*” or “bioethanol*“ or “amorphous silicon photovoltaic duel*” or collaboration*” or “journal about fuel*” or “Hydrogen alternative fuels*” or “most popular fuel*” or “carbon As a alternative*” or “conjugated polymer fuel*” or “concentrating fuel*” or “concentrating bioethanol*” or “copper used in fuels*” or “cis fuel*” or “*advantages of alternative fuels” or “copper indium gallium in fuels*” or “cigs alternative fuel*” or “crystalline silicon used by scientific *” or “wind power*” or “ethanno*” or “alcohol” or “Ethanol Production of Banana*” or “foil solar*” or “gallium arsenide *” or “energy obtained from gas*” or “hybrid inorganic*” or “hybrid organic*” or “alternative fuels for transportation *” or “*” or “Applicable technologies *” or “indium*” or “castor oil *” or “liquid junction*”) and (cu=USA**)**

Search strategy 2

ts=(“microcrystalline*” or “Diesel engine *” or “Diesel fuel*” or “monocrystalline *” or “emission of gases *” or “multijunction *” or “nanofuels*” or “energy scenario *” or “nano particle *” or “Solar energy*” or “Waste as alternative fuels *” or “o*” or “osc” or “Gas turbine”or “organic fuel*” or “cement industry*” or “lifecycle *” or “polymer *” or “economics *” or “fuels of corn*” or “plastic *” or “methanol *” or “vehicle emissions *” or “self assembling*” or “silicon wafer *” or “thin film *” or “tandem silicon photovoltaic*” or “tandem*”) and (cu=USA)

Appendix II – Full names of institutions

ASU-Arizona State University
PSU-Pennsylvania State University
NPL-National Physical Laboratory
IITD-Indian Institute of Technology Delhi
ASU-Arizona State University
MIT-Massachusetts Institute of Technology
UCF-University Central Florida
ANL-Argonne National Laboratory
CAS-Chinese Academy of Sciences
IEN-IFP Energies nouvelles
NIST-National Institute of Standards and Technology
SU-Stanford University
TUD-Technical University Denmark
TIIT-Technion Israel Institute Technology
TU-Tianjin University
TSU-Tsinghua University
UCLM-University Castilla La Mancha
UI-University of Illinois
UM-University Malaya
AQU-Al QudsUniversity

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