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RESEARCH

Incentive Analysis of Green Technologies in The Patent System Using Value Indicators

Análise de Incentivos às Tecnologias Verdes no Sistema de Patentes Utilizando Indicadores de Valor

Análisis de incentivos de tecnologías verdes en el sistema de patentes utilizando indicadores de valor

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ABSTRACT

This article aims to present a summarized version of the dissertation study defended on 03/02/2018, under the supervision of Dr. Suzana Borschiver, at the UFRJ School of Chemistry. The study analyzes the value of patent inventions and patent applications that make use of incentives to green technologies in the patent system, namely the *Programa de Patentes Verdes* (PPV) [Green Patent Program] of the *Instituto Nacional da Propriedade Industrial* (INPI) [National Institute of Industrial Property] and the Y02 classification (Y02 or marker), related to Clean Energy Technology (CET), from the Cooperative Patent Classification (CPC). For the analysis the value indicators of *patent family size* and *triadic patent families* were used and a methodology based on six steps was developed, wherein and in one of them was created a replication logic to increase the comparability between the applications/patents participating the PPV and non-PPV participants (called "Replicas") considering filing date, international patent classification, deposit models, nationality and types of depositors. The results obtained with the two indicators show that the most valuable inventions are those classified with Y02 ("Y02"), followed by participants in PPV, then by Replicas and, finally, by those not classified with Y02 ("not-Y02") (*patent family size* indicator: family size average - Y02 set = 12.09, PPV set = 11.36, Replicas set = 8.05, not-Y02 set = 7.45/*triadic patent families* indicator: triadic families percentage - Y02 set= 19.33%, PPV set = 12.47%, Replicas set = 11.91%, not-Y02 set = 7.95%). Verifying the relationship between PPV and Y02 classification, both indicators show that the most valuable inventions are those of patent applications and patents which use of the two incentives in combination (family size average = 14.52 /triadic families percentage = 22.79%). Thus, the inventions of patent applications and granted patents which participate the PPV and are classified with Y02 by the European Patent Office (EPO) in combination have greater capability of monetary return to inventors and would portray greater environmental benefits.

Keywords: Patents, Green technologies, Value indicators, Patent family size, Triadic families.

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RESUMO

O presente artigo visa apresentar uma versão resumida do estudo realizado em Dissertação defendida em 02/03/2018, sob a orientação da Dra. Suzana Borschiver, na Escola de Química da UFRJ. O estudo analisa o valor de invenções de patentes e pedidos de patentes que fazem uso de incentivos às tecnologias verdes no sistema de patentes, a saber do Programa de Patentes Verdes (PPV) do Instituto Nacional da Propriedade Industrial (INPI) e da classificação Y02 (ou marcador Y02), relacionada a tecnologias de energia limpa (*Clean Energy Technology* – CET), da Classificação Cooperativa de Patentes (sigla em inglês, CPC). Para a análise foram utilizados os indicadores de valor *tamanho de família de patentes e famílias de patentes triádicas* e foi desenvolvida metodologia baseada em seis etapas, sendo que em uma delas foi criada uma lógica de replicação para aumentar a comparabilidade entre os pedidos/patentes que participam do PPV e aqueles que não participam do PPV (chamados de "*Réplicas*") levando em consideração data de depósito, classificação internacional de patentes, modelos de depósito, nacionalidade e tipos de depositantes. Os resultados obtidos com os dois indicadores mostram que as invenções de maior valor são aquelas classificadas com Y02 ("Y02"), seguidas pelas participantes do PPV, então pelas Réplicas e, por fim, por aquelas não classificadas com Y02 ("ñ-Y02") (indicador *tamanho de família de patentes:* média de tamanho das famílias - conjunto Y02 = 12,09, conjunto PPV = 11,36, conjunto Réplicas = 8,05, conjunto ñ-Y02 = 7,45 / indicador *famílias de patentes triádicas:* percentual de famílias triádicas – conjunto Y02 = 19,33%, conjunto PPV = 12,47%, conjunto Réplicas = 11,91%, conjunto ñ-Y02 = 7,95%). Verificando a relação entre PPV e classificação Y02, ambos os indicadores mostram que as invenções de maior valor são aquelas de pedidos de patentes e patentes que fazem uso dos dois incentivos em combinação (média de tamanho das famílias = 14,52 / porcentagem de famílias triádicas = 22,79%). Assim, as invenções de pedidos de patentes e patentes que participam do PPV do INPI e são classificados com Y02 pelo EPO em combinação possuem maior capacidade de retorno financeiro aos inventores e retratariam maiores benefícios ao meio ambiente.

Palavras-chave: Patentes, Tecnologías verdes, Indicadores de valor, Tamaño de la familia de patentes, Familias triádicas.

RESUMEN

Este artículo tiene como objetivo presentar una versión resumida del estudio de tesis defendido el 3/2/2018, bajo la supervisión de la Dra. Suzana Borschiver, en la Facultad de Química de la UFRJ. El estudio analiza el valor de los inventos de patentes y las solicitudes de patentes que hacen uso de incentivos para las tecnologías verdes en el sistema de patentes, *Programa de Patentes Verdes (PPV)* [Programa de Patentes Verdes] del *Instituto Nacional da Propriedade Industrial (INPI)* [Oficina Nacional de Patentes] y la clasificación Y02 (marcador Y02), relacionado con la Tecnología de Energía Limpia, de la Clasificación Cooperativa de Patentes. Para el análisis, utilizamos los indicadores de valor del *tamaño de la familia de patentes* y las *familias de patentes triádicas* y se desarrolló una metodología basada en seis pasos, y en uno de ellos se creó una lógica de replicación para aumentar la comparabilidad entre las solicitudes/patentes participantes. Participantes *PPV* y no *PPV* (denominados "réplicas") teniendo en cuenta la fecha de presentación, la clasificación internacional de patentes, los modelos de presentación, la nacionalidad y los tipos de depositantes. Los resultados obtenidos con ambos indicadores muestran que las invenciones más valiosas son las clasificadas con Y02 ("Y02"), seguidas por los participantes de *PPV*, luego por las réplicas y, finalmente, por los no clasificados con Y02 ("no-Y02") (Indicador del *tamaño de la familia de patentes:* tamaño promedio de la familia: conjunto Y02 = 12.09, conjunto *PPV* = 11.36, conjunto de réplicas = 8.05, conjunto no-Y02 = 7.45 / indicador de familias de patentes triádico: porcentaje de familias triádicas: conjunto Y02 = 19.33%, conjunto *PPV* = 12.47%, conjunto Réplicas = 11.91%, conjunto no-Y02 = 7.95%). Al observar la relación entre la clasificación *PPV* y Y02, ambos indicadores muestran que los inventos más valiosos son los de las solicitudes de patente y las patentes que hacen uso de los dos incentivos en combinación (tamaño promedio de familia = 14.52/porcentaje de familias triádicas = 22,79%). Por lo tanto, las invenciones de patentes que participan en el *INPI PPV* y están calificadas como Y02 por la Oficina Europea de Patentes (EPO) en combinación tienen un mayor rendimiento financiero para los inventores y representarían mayores beneficios ambientales.

Palabras clave: Patentes, Tecnologías verdes, Indicadores de valor, Tamaño de la familia de patentes, Familias triádicas.

INTRODUCTION

The concern about the environment and climate change has been growing since the last century and discussions have been carried out in an attempt to create solutions that can mitigate the impacts on climate change (MMA, 2009). In this line, companies, universities and research institutes have been investing in research technologies that cause less impact or bring benefits to the environment (Helm; Tannock; Iliev, 2014, p. 3, 4, 34).

In 2009, the *Copenhagen Communiqué* on Climate Change indicated that "the problem of climate change is solvable - many required technologies are available today, while others can be developed if the right incentives occur." In this sense, the patent system can help accelerate technological innovation and diffusion by providing information to policymakers and others about emerging technologies, players and evolving value chains associated with *Tecnologias de Mitigação de Mudanças Climáticas* (TMMC) [Climate Change Mitigation Technologies]. (Helm; Tannock; Iliev, 2014, p. 9).

In fact, from 2009, incentives began to be made in the patent system to stimulate the development of inventions related to green technologies (Dechezleprêtre, 2013, p. 5; Pinto, 2017, p. 161), namely:

> (a) Priority Examination of patent applications related to green technologies or that bring environmental benefits;
> (b) Y02 Classification of Y02 symbol inserted in the Cooperative Patent Classification (CPC) released on January 1st, 2013 by the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO) (EPO, 2017a); and
> (c) WIPO GREEN platform in partnership with various offices and interested in disseminating green technologies globally (Pinto, 2017, p. 20).

Despite the creation of these incentives in the patent system, it remained to be seen how they relate to the value of patent inventions and patent applications. Among the incentive measures, due to the data complementarity between the INPI and EPO databases and the access to

WIPO GREEN only to platform users or partners, only the Priority Examination in Brazil was the object of the study (*Programa de Patentes Verdes* (PPV) [Green Patent Program]) and the Y02 Classification.

Therefore, the study aimed to analyze the value of patent applications that participate in the Green Patent Program in Brazil (INPI) and/or are classified with Y02 by the EPO, to identify if inventions that use such incentives have greater value and, consequently, would bring a greater return to investors and greater benefit to society for the environment.

II.The incentives for green technologies analyzed

II.1. Green Patent Program (PPV)

According to the INPI, the Green Patents Program aims to contribute to global climate change and seeks to accelerate the examination of patent applications related to environmentally friendly technologies (INPI, 2016).

Basically, "Green Patent" is the patent application considered by INPI to be eligible for priority examination under the conditions established by such Authority (*INPI*, Resolution No. 175, of November 5th, 2016). The "Priority Examination", self-explanatory name, portrays an examination conducted primarily on a green technology patent application so that a patent can be granted faster and thus title-holders can license protected technologies or enjoy environment-friendly technologies ahead of time.

At the *INPI*, the Priority Examination began in its Pilot Program established from Resolution No. 283/2012 published in the *Revista da Propriedade Industrial (RPI)* [Industrial Property Review] No. 2154 of April 17th, 2012. After Program updates through the Resolutions No. 75/2013, 83/2013, 122/2013, 131/2014, 145/2015, it became a permanent service of INPI by the Resolution No. 175/2016, published in RPI No. 2396 of December 6th, 2016, known as Green Patent Program and having an attached listing containing what is understood by the INPI as "green technology". Green technologies include technologies related to: alternative energies (biofuels, solar energy, wind energy, geothermal energy, fuel cells, pyrolysis or gasification of biomass, harnessing energy from human waste, etc.); transport (electric vehicles, charging stations for electric vehicles, vehicles with regenerative brakes, etc.); energy conservation (electricity storage, thermal insulation of buildings, etc.); waste management (waste disposal, waste treatment, etc.); and agriculture (reforestation techniques, alternative irrigation techniques, etc.).

Despite INPI's understanding of "green technologies", patent applications eligible to participate in the Program are not limited to international patent classifications in the Resolution; that is, they may be of any international patent classification as long as they relate to the technologies listed above.

II.2. Y02 Classification.

Although it did not establish incentive from a green patent priority screening program, the European Patent Office (EPO) conducted a study jointly with United Nations Environment Programme (UNEP) and the International Center for Trade and Sustainable Development (ICTSD), whose final report was presented on September 30th, 2010 (EPO, 2016). In this report, it is stressed that the development of technologies and their rapid diffusion are considered crucial to meeting the challenge of climate change; and also the role of intellectual property rights in the transfer of climate change technologies. The study focuses on the role of patents in the transfer of Clean Energy Technology (CET), defined as technologies that have the potential to reduce greenhouse gas emissions (UNEP; EPO; ICTSD, 2010, p. 15).

One of the results of the study is the creation of a new EPO classification scheme, the Y02 symbol classification inserted in the Cooperative Patent Classification (CPC) launched on January 1st, 2013 by EPO and USPTO (EPO, 2017a), to technical attributes of technologies that can be referred to as clean energy technologies - a specific subsector of climate change mitigation technologies (UNEP; EPO; ICTSD, 2010, p. 88). In this way, the EPO was able to provide a simpler and faster search system for clean energy technologies related to climate change mitigation. The sections of Y02 classification are shown below:

Table I – Description of Y02 Classification

Seção	Description
Y02A	Climate change adaptation
Y02B	Buildings
Y02C	Greenhouse gases capture and storage
Y02D	Information and Communication Technologies (ICT) aiming at reducing the energy use
Y02E	Energy production, distribution and transport
Y02P	Industry and agriculture
Y02T	Transportation
Y02W	Wastes and effluents

Source: EPO (2018)

Basically, for each patent application in the European Patent Office (EPO) database, Espacenet, its classification is assigned according to the invention proposed therein. When the invention proposed by the patent application relates to climate change adaptation, buildings, greenhouse gas capture and storage, ICT aiming at reducing energy use, energy production, distribution and transport, industry, and agriculture, transportation, wastes and effluents, it is classified in the CPC as having the respective Y02 classification. Thus, it is possible to identify patent applications whose inventions are related to the mitigation of environmental impacts.

For example, Brazilian Patent Application No. BR102012022721-5, relating to a mineralized charge--containing composition obtained from solid waste, was classified by the EPO as Y02W 30/91, relating to technologies for solid waste management using wastes such as concrete or mortar fillers (EPO, 2017d).

III. Value analysis: patent indicators.

To investigate the value of patent inventions and patent applications, value indicators were used. Classical measures of value in this regard can be divided into two broad categories: those that come from outside the patent system and those that come directly from it, respectively, "market-based" and "patent-based" measures (van Zeebroeck e de la Potterie, 2008, p. 4).

Market-based measures consist mainly of economic and financial indicators, such as action in the stock market, creation of a new company, Research and Development (R&D) performance, while patent-based measures are much more diverse in nature and rationalization, for example, geographic scope of a patent (patent families), annuity payment time, concession decision, and legal disputes (van Zeebroeck e de la Potterie, 2008, pp.4-5).

Within the study, "patent value indicators" were the patent-based measures for indicating the patent value, and two geographical scope indicators were addressed because of the faster and more accessible information/ data acquisition, namely: patent family size and triadic patent family.

III.1. Patent family

The Organization for Economic Co-operation and Development (OECD) defines patent families as a set of patents (or patent applications) filed in several countries that are related to one another or several priority filings (OCDE, 2009, p. 71).

When a patent application is filed in a first country, and will subsequently be filed in another country claiming the earlier date, this first patent application is considered a "priority" and the subsequent patent application forms a patent family with it. This priority document is usually mostly deposited in the depositor's country (Martinez, 2010, p. 6).

There are several ways to define a patent family, and each definition of family can lead to a different patent count (Martinez, 2010, p. 10) - i.e. a number of related patents/applications in the same family. As mentioned by Adams (2005, p.15), "the definition of a family is not defined by law, but by each database producer for their convenience" (Martinez, 2010, p. 10). As discussed by Martinez (2010, p. 11), the most popular patent family definitions are:

i. **equivalents:** the family represents patent applications having exactly the same priority or the same combination of priorities.
ii. **extended families:** the family represents patent applications directly or indirectly linked by priorities.
iii. **single priority families:** The family represents patent applications that originate from a single priority.
iv. **examiner technology-based families:** The family represents patent applications with exactly the same "active" priorities, understood as those that add new technical content.
v. **Commercial novelty-based families:** The family represents patent applications with technical content matching existing records based on the novelty principle.

As mentioned by Martinez (2010, p. 11), extended families are used as bases for filters to set economic thresholds for patent indicators. Thus, considering that the study uses this filter (triadic families) and the availability of the INPADOC database of extended EPO patent families, the concept of **extended patent family** will be used here. INPADOC's extended patent family covers a technology rather than a single invention and may contain more than one invention (EPO, 2017f). In the EPO Espacenet patent database, the extended patent family is displayed by clicking "INPADOC patent family".

In general terms, the extended patent family refers to patent applications with related priorities. For example, a patent application (D1) with priorities P1 and P2, a patent application (D2) with priorities P2 and P3, and a patent application (D3) with priority P3 make up a family of patents even if there are two patent applications without the same priority (see D1 and D3).

The value indicator of patent family size, therefore, refers to the extended patent family size from the INPADOC database. That is, a patent family here represents patent applications directly or indirectly related by priorities (Martinez, 2010, p. 13) and covering a technology (EPO, 2017f).

III.2. Patent Family Size

As indicated by Dernis and Khan (2004, p. 6), a problem with using patent indicators from a single patent office is the tendency for domestic advantage where domestic filers tend to file more patent applications compared to foreign filers.

Many inventions are extremely valuable while others hardly have any commercial value. Thus, an advantage of using a patent family is that it limits data to "high quality" inventions (Popp, 2005, p. 5) - those for which protection is sought in more countries.

Since a company's decision to patent in a particular country signals an intention to enter the local market and sell a new product or use a new technology, patent families can be used to measure international diffusion of technologies and measure the market size of the invention (Eaton e Kortum, 1999 e Dechezleprête et al., 2011 em Dechezleprêtre, Ménière e Mohnen (2017), p. 794; Harhoff et al. (2003) em Dechezleprêtre, Ménière e Mohnen (2017), p. 794).

In particular, filing for patent applications in other countries increases patenting costs for the inventor as it will incur additional costs of filing fees, annuities, translation costs, office costs to work with the Official Patent Office, etc. (Dernis and Khan, 2004, p. 8). Because of the additional value of filing abroad, lower value patents are usually filed only in the inventor's country of origin (Popp, 2005, p. 5), and only a portion of domestic patent applications are subsequently filed abroad (Dernis e Khan, 2004, p. 8).

The inventor will only accept these costs on the condition that the expected returns are greater than the costs of obtaining patents. Consequently, patent families tend to capture the most economically important inventions and to some extent the inventions included in the dataset are comparable (Dernis e Khan, 2004, p. 8).

Additionally, counting the number of patent families avoids a double counting of patent applications filed in several countries, thus providing a count of inventions (from Rassenfosse et al. (2013) in Dechezleprêtre, Ménière and Mohnen (2017), p. 794).

III.3 Triadic Patent Family

According to Dernis and Khan (2004, p. 17), triadic patent families are defined by the OECD as the set of patents in the European Patent Office (EPO), the Japanese Patent Office (JPO) and the United States Patents and Trademark Office (USPTO) that directly or indirectly share at least one priority.

Compared to traditional indicators based on single-office patent filings, triadic patent families cover a homogeneous set of inventions as the most important inventions are taken to be protected by EPO, JPO and USPTO patents (Dernis e Khan, 2004, p. 17).

Dernis and Khan (2004, p. 19) indicate that to measure inventive performance it is preferable to use patent application data rather than already granted patent data. They point out, in this sense, that each country has its law and regulations for the analysis of patent applications, so that if patent data (already granted) were considered, there would be a drastic reduction in the volume of families and would deteriorate the time of the data – since each official organ would take a certain time for the exam.

Therefore, the scope of the study considered patent (and non-patent) filing data in the three offices (EPO, JPO, and USPTO) that share a priority directly or indirectly. This choice was also made in the study by Sternitzke (2009, p. 97), where the triadic patent family is used for published patent applications (whether the pending application or the patent already granted) rather than counting only those patents.

Regarding the patent indicator, among patents belonging to a patent family, when it was filed with the European Patent Office (EPO) in the United States and Japan, it is suggested that the inventor anticipates his patent being of great value (Popp, 2005, p. 5).

When choosing patent applications filed in these three countries, a geographic filter is applied to the official offices encompassing the main business areas that (a) account for a significant portion of the world's patent filings, (b) are advanced in technology, and (c) represent the majority of R&D efforts in the world (Dernis e Khan, 2004, p. 10).

That is, the triadic patent family indicator improves the quality (by capturing important inventions) and the international comparability (by eliminating domestic trends) of the patent indicator (Dernis and Khan, 2004, p. 17). That is, counting the number of patent applications from triadic families indicates whether a given set has inventions of higher (or lower) quality and value.

IV. Methodology used for analysis

For the analysis of the *INPI Programa de Patentes Verdes (PPV)* [Green Patent Program], a comparison was made of *PPV*-participating patents and patent applications against those of similar non-*PPV* technologies, hereafter referred to as "replicas", using patent value indicators. In particular, a "replica" is a patent or patent application that does not participate in the *PPV* but has characteristics (i.e. patent classification, filing model, depositor nationality, and depositor type) similar to one participating in the PPV.

For the analysis of the Y02 classification, we compared the Brazilian patent applications and patents classified with Y02 by the EPO (called in the study "Y02") and those not classified with Y02 (called in the study "not-Y02") also using the patent value indicators.

To carried out these analyzes, the following methodology is performed:

i. Establishment of guidelines for the construction of the analysis group;

ii. Identification of patent documents participating in the *INPI*'s Green Patent Program (*PPV*);

iii. Obtaining data from *PPV* participating patent documents, including Y02 classification, where applicable;

iv. Replication of *PPV*-participating[1] patent applications and patents to obtain patent documents related to similar and non-*PPV*-participating technologies and

to obtain their data, including on Y02 classification (if applicable);

v. Preparation of a table with all necessary information for the analysis (e.g. patent family size, Y02 classification, etc.); and

vi. Performing the analyzes.

Because of the length of details related to the methodology and each of its steps, it will not be addressed in this article. The results obtained by the study follow below.

V. Results

Initially, from the information contained in RPI 2154 of April 17th, 2012 to RPI 2414 of April 11th, 2017, it was possible to reach a total of 392 patent documents for which the participation in the *PPV* was granted. Among these, removing the utility models and certificates of addition, 361 documents remained. Therefore, the analyzed PPV set comprised 361 documents, which the information is contained in **Appendix A** in an electronic *Excel* file attached to the Thesis defended and present in the library of the School of Chemistry of *UFRJ* for consultation. Considering that the *PPV* set has 361 patent documents, this is the same number as the Replica set, the information of which is also in **Appendix A**.

Having created the *PPV* set of documents that participate in the *PPV* and Replica set of documents that do not participate in the *PPV*, but that have similar characteristics to the documents that participate, we obtained the set Y02, from documents classified with Y02 classification, and the not-Y02 set, of documents that are not classified with the Y02 classification. Identifying from the data of each patent application and each patent of the 722 *PPV* and Replica documents, 269 Y02 classified documents and 453 non Y02 classified documents were obtained. So, in short, the sets under analysis are as follows:

Table 2 – Sets under analysis – Green Patents

Set	Number of documents
PPV	361
Replica	361
Total	722

Source: Bastos, 2018.

Table 3 – Sets under analysis – Y02 classifications

Conjunto	N° de documentos
Y02	269
ñ-Y02	453
Total	722

Source: Bastos, 2018.

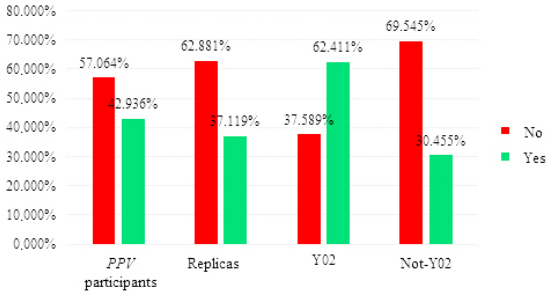
Among these documents, to use the patent indicators of patent family size and triadic patent family size, we must first check how many participate in a patent family and how many do not belong to a patent family[2]. The result of this check is presented below:

Table 4 – Number of documents belonging to and not belonging to a patent family

Belonging to the patent family	No. of documents			
	PPV participants	Replicas	Y02	Not-Y02
No	206	227	121	312
Yes	155	134	148	141
Total	361	361	269	453

Source: Bastos, 2018.

Figure 1 - Percentage of belonging or not to a patent family



Source: Bastos, 2018.

V.1. Patent Family Size

After identifying the number of patent documents belonging to a patent family and taking into account the sum of the documents of each family (indicated in **Appendix A** of the Thesis), the family size of each set and the average size were obtained of the patent families for each set. The results are as follows:

Table 5 – Average family size of analyzed sets

Sets	Family documents	Family size	Average family size
PPV Participants	155	1761	11.36
Replica	134	1079	8.05
Y02	148	1789	12.09
not-Y02	141	1051	7.45

Source: Bastos, 2018.

Patent documents were also analyzed regarding participation in the green patent program and Y02 classification, that is, regarding the performance of the two incentives analyzed to understand how these incentives work in combination. The results are given below:

[1] Here a replication logic has been developed to increase comparability between applications/patents participating in *PPV* and non-participating in *PPV* (called "Replicas") taking into account filing date, international patent classification, filing models, nationality and types of depositors.

[2] Patent Cooperation Treaty (PCT) international deposits were considered as members of patent families.

Table 6 – Average family size of sets analyzed considering both incentives simultaneously

Set	Family documents	Family size	Average family size
PPV and Y02 participants	88	1278	14.52
PPV e not-Y02 participants	67	483	7.21
Replica and Y02	60	511	8.52
Replica and not-Y02	74	568	7.68

Source: Bastos, 2018.

V.2. Triadic Patent Family

With the data contained in the electronic file of **Appendix A** of the Thesis, it was identified which of these documents belong to a triadic family, that is, depositors want to have protection of their inventions in the United States, Japan and the European Union (European Patent Office). The results are presented below:

Table 7 – Percentage of triadic families for analyzed sets

Triadic family	*PPV* Participants		Replica	
	No. of documents	%	No. of documents	%
Yes	45	12.47	43	11.91
No	316	87.53	318	88.09
Total	361	100.00	361	100.00
Triadic family	Y02		not-Y02	
	No. of documents	%	No. of documents	%
Yes	52	19.33	36	7.95
No	217	80.67	417	92.05
Total	269	100.00	453	100.00

Source: Bastos, 2018.

Similarly, we identify the percentage of documents belonging to triadic families for both participants or not of *PPV* and classified or not with Y02:

Table 8 - Percentage of triadic patent families with or without both incentives

Triadic family	*PPV* and Y02 participants		*PPV* and not-Y02 participants	
	No. of documents	%	No. of documents	%
Yes	32	22.79	13	5.91
No	109	77.30	207	94.09
Total	141	100.00	220	100.00
Triadic family	Replica and Y02		Replica and not-Y02	
	No. of documents	%	No. of documents	%
Yes	20	15.63	23	9.87
No	108	84.37	210	90.13
Total	128	100.00	233	100.00

Source: Bastos, 2018.

From the results presented it is possible to conclude from the two indicators (average family size and percentage of triadic families) that (i) document technologies participating in *PPV* have greater value than "replicas" documents (i.e. documents that do not participate in the *PPV* but have characteristics similar to those that do); (ii) document technologies classified with Y02 have greater value than documents that are not classified with Y02 ("not-Y02"); and (iii) document technologies that participate in *PPV* and are classified as Y02 have greater value than the others.

The results show that applications and patents that participate in *PPV* or are classified with Y02 classification refer to inventions of higher value than those that do not make use of these incentives, that is, they are included in Replicas or not-Y02, respectively. Furthermore, it appears that patent documents that make use of both incentives in combination refer to the most valuable inventions; In other words, incentives are positively related and thus show that inventions using both incentives would bring greater returns to inventors and result in greater benefits to society and the environment.

Also, evaluation using a geographic filter, such as that provided by the triadic patent families indicator, is required to be able to have better comparability between patents and patent applications, excluding those of lower value, and focusing on those of higher quality and seeking protection in the largest global markets.

It is also noted that the results for the indicators, patent family size, and triadic patent family (with geographic filter) result in the same conclusions, in other words:

- patent documents classified with Y02 refer to higher value inventions, followed by those participating in the *PPV,* then replicas and those not classified with Y02;
- The most valuable inventions are those of applications and patents that participate in the *PPV* and are classified with Y02, followed by those from Replica and Y02, then Replica and not-Y02, and finally *PPV* and not-Y02.

The possible reason for documents not classified with Y02 and Replica to refer to inventions of higher value than those not classified with Y02 and *PPV* participants could be that foreign depositors are not aware of the *PPV* program - which makes them less likely to increase the size of the patent family - or the lack of sedimentation of certain green technologies in the country which leads to the discouragement of having their invention protected quickly – i.e. less search for *PPV*.

CONCLUSIONS

Green technologies are becoming increasingly prominent in a growing commitment to global public policy to reduce environmental impacts and climate change. Therefore, there is interest in finding out how the value of inventions of patent applications and green technology patents relate to incentives in the patent system, namely the INPI Green Patent Program (*PPV*) and the Y02 classification used by the European Patent Office (EPO).

For this analysis, we used patent value indicators (patent family size and triadic patent families) and for the application

of the indicators it was necessary to create our own methodology to generate four sets of analysis ("*PPV*", documents that participate in the Green Patent Program; "Replicas" of documents that do not participate in the *PPV*, but have characteristics similar to those who participate, "Y02", documents classified with the Y02 classification, and "not-Y02", of unclassified Y02 classified documents) following six steps with the creation of a replication logic to increase the comparability between patent applications and *PPV* participating patents and those not participating in the *PPV* ("Replicas").

From the use of the methodology, the study concludes, in terms of value, it is advantageous to develop technologies classified with Y02 and require participation in the *PPV* as they portray higher value technologies according to the patent value indicators used in the study (size patent family and triadic patent families). In particular, the study demonstrates that green patent technologies and Y02-classified patent applications - that is, clean energy technologies - are those of higher value, followed by those participating in *PPV*, after those not participating in *PPV* and then those that are not classified with Y02. On the other hand, there is a positive interaction between the two incentives, being the green technologies of patents and patent applications classified with Y02 and those that participate in the *PPV* those of higher value than the others that use only one incentive or none. This portrays an advantage in developing these green technologies and participating in the INPI *PPV* as greater value would translate into greater financial return to inventors and the environment and society.

Thus, it was demonstrated the importance of creating and maintaining these incentives to meet and meet the growing demands of global public policies aimed at reducing impacts on the environment and climate change.

REFERENCES

BASTOS, Rafael Quaresma. Análise de incentivos às tecnologias verdes no sistema de patentes utilizando indicadores de valor. 2018. 124 f. Dissertação (Mestrado) - Curso de Engenharia de Biocombustíveis, Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2018.

DECHEZLEPRÊTE, Antoine. Fast-tracking Green Patent Applications: An Empirical Analysis. Issue Paper No. 37. Genebra: 2013. International Centre for Trade and Sustainable Development.

DECHEZLEPRÊTE, Antoine; MÉNIÈRE, Yann; MOHNEN, Myra. International patent families: from application strategies to statistical indicators. Scientometrics, [s.l], v. 111, n. 2, p. 793-828, 28 fev. 2017. Springer Nature. http://dx.doi.org/10.1007/s11192-017-2311-4.

DERNIS, Hélène; KHAN, Mosahid. Triadic Patent Families Methodology. Paris: 2004. OCDE Science, Technology and Industry Working Papers 2004/2. OCDE Publishing, Paris. http://dx.doi.org/10.1787/443844125004

EPO. Patents and clean energy report, 2016. Disponível em: https://www.epo.org/news-issues/technology/sustainable-technologies/clean-energy/patents-clean-energy.html. Acesso em: 1 de julho de 2017.

EPO. Updates on Y02 and Y04S, 2017a. Disponível em: https://www.epo.org/news-issues/issues/classification/classification/updatesYO2andY04S.html. Acesso em: 1 de julho de 2017.

EPO. Updates on Y02 and Y04s, 2018. Disponível em: https://www.epo.org/news-issues/issues/classification/classification/updatesYO2andY04S.html. Acesso em: 13 de julho de 2018.

EPO. Bibliographic data: BR102012022721 (A2) – 2014-10-14. Última atualização: 26 abr. 2017 (2017d). Disponível em: https://worldwide.espacenet.com/publicationDetails/biblio?II=0&ND=3&adjacent=true&locale=en_EP&FT=D&date=20141014&CC=BR&NR=102012022721A2&KC=A2. Acesso em: 23 de janeiro de 2018.

EPO. Patent families at the EPO. Julho de 2017 (2017f). Disponível em: https://www.epo.org/searching-for-patents/helpful-resources/first-time-here/patent-families/inpadoc.html. Acesso em: 2 de dezembro de 2017.

INPI, Resolução N° 175, de 5 de novembro de 2016. Disciplina o exame prioritário de pedidos de "Patente Verde". [s.l.]: 2016. Revista da Propriedade Industrial N° 2396.

INPI. Patentes Verdes. Última modificação 14 de dezembro de 2016. Disponível em: http://www.inpi.gov.br/menu-servicos/patente/patentes-verdes-v2.0 Acesso em: 13 de julho de 2018.

HELM, Sarah; TANNOCK, Quentin; ILIEV, Ilian. Renewable Energy Technology: Evolution and Policy Implications – Evidence from Patent Literature. Genebra: 2014. Global Challenges Report, WIPO.

MARTINEZ, Catalina. Insight into different types of patent families. STI WORKING PAPER 2010/2. Paris: 2010. OCDE.

MINISTÉRIO DO MEIO AMBIENTE (MMA). Agenda Ambiental na Administração Pública. 5ª Edição. Brasília/DF: 2009. Disponível em: http://www.mma.gov.br/estruturas/a3p/_arquivos/cartilha_a3p_36.pdf. Acesso em: 27 de junho de 2017.

OCDE. Patent Statistics Manual. Paris: 2009, OCDE.

PINTO, Ana Paula Gomes. Patentes e mudanças climáticas: um estudo sobre as políticas públicas prioritárias de tecnologias ambientais no instituto nacional da propriedade industrial (INPI) e no escritório europeu de patentes (EPO). 2017. 282 f. Tese (Doutorado) - Curso de Propriedade Intelectual e Inovação, Instituto Nacional da Propriedade Industrial, Rio de Janeiro, 2017.

POPP, David. Using the Triadic Patent Family Database to Study Environmental Innovation, [ENV/EPOC/WPNEP/RD(2005)2], Paris: 2005. OECD.

STERNITZKE, Christian. Defining triadic patent families as a measure of technological strength. Scientometrics, [s.l.], v. 81, n. 1, p.91-109, 18 de março de 2009. Springer Nature. http://dx.doi.org/10.1007/s11192-009-1836-6.

UNEP; EPO; ICTSD. Patents and clean energy: bridging the gap between evidence and policy. Final Report. The United Nations Environment Programme (UNEP), the European Patent Office (EPO), and the International Centre for Trade and Sustainable Development (ICTSD): 2010. Disponível em: <https://www.epo.org/news-issues/technology/sustainable-technologies/clean-energy/patents-clean-energy.html>. Acesso em: 01 de julho de 2017.

VAN ZEEBROECK, Nicolas; DE LA POTTERIE, Bruno van Pottelsberghe. Filing Strategies and Patent Value. C.E.P.R Discussion Papers, n. 6821, 2008. Disponível em: https://econpapers.repec.org/paper/cprceprdp/6821.htm. Acesso em: 13 de maio de 2017

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