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Assessing the Effectiveness of the Eco-Patent Commons

A Post-mortem Analysis

Jorge L. Contreras, Bronwyn H. Hall and Christian Helmers

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Christian Helmers is an assistant professor of economics at the Leavey School of Business at Santa Clara University. Before joining Santa Clara, Christian was an assistant professor at Universidad Carlos III de Madrid. Prior to that, he worked as a research economist at the London School of Economics. He has been a visiting research scholar at the University of California, Berkeley; Stanford University; the World Intellectual Property Organization; the Hoover Institution; and Ludwig Maximilians University of Munich. His research focuses on innovation, intellectual property and the economics of digitization. Christian earned his B.A. in economics from the Faculty of Business and Economics at the University of Lausanne, and his M.Sc. in economics for development, as well as his Ph.D. in economics, from the University of Oxford.

About the ILRP

The International Law Research Program (ILRP) at CIGI is an integrated multidisciplinary research program that provides leading academics, government and private sector legal experts, as well as students from Canada and abroad, with the opportunity to contribute to advancements in international law.

The ILRP strives to be the world's leading international law research program, with recognized impact on how international law is brought to bear on significant global issues. The program's mission is to connect knowledge, policy and practice to build the international law framework — the globalized rule of law — to support international governance of the future. Its founding belief is that better international governance, including a strengthened international law framework, can improve the lives of people everywhere, increase prosperity, ensure global sustainability, address inequality, safeguard human rights and promote a more secure world.

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Acronyms and Abbreviations

APO	Australian Patent Office
EcoPC	Eco-Patent Commons
ELI	Environmental Law Institute
EPO	European Patent Office
ESR	environmental and social responsibility
IP	intellectual property
IPCs	International Patent Classifications
JPO	Japan Patent Office
PATSTAT	Worldwide Patent Statistical Database
PR	public relations
WBCSD	World Business Council for Sustainable Development
WIPO	World Intellectual Property Organization

Executive Summary

The authors revisit the effect of the "Eco-Patent Commons" (EcoPC) on the diffusion of patented environmentally friendly technologies following its discontinuation in 2016. Established in January 2008 by several large multinational companies, the not-for-profit initiative provided royalty-free access to 248 patents covering 94 "green" inventions. In previous work, Bronwyn Hall and Christian Helmers (2013) suggested that the patents pledged to the commons had the potential to encourage the diffusion of valuable environmentally friendly technologies. The updated results in this paper now show that the commons did not increase the diffusion of pledged inventions, and that the EcoPC suffered from a number of structural and organizational issues. The authors hope these findings will inform future efforts to make environmentally friendly technologies more broadly available for use.

Introduction

Although patents give their owners the right to exclude others from practising a patented technology, or to charge them for the privilege of doing so, an increasing number of firms have begun to make voluntary pledges intended to limit their ability to enforce their patents to the fullest degree (Contreras 2015). Yet the pledging of patents, even to the extent that they will not be asserted against infringers, stops short of abandoning or contributing them to the public domain.[1] Thus, under a pledge model, patent assets are retained by their owners, who continue to incur maintenance and other fees, but the offensive use of such patents is significantly curtailed.

Patent pledges are made for a variety of reasons, including the promotion of broad product interoperability through common technical standards, the advocacy of new technology platforms and the pursuit of social goals (ibid.). Over the past few decades, significant patent pledges have been made in areas such as open-source software (for example, IBM, Sun, Google and Red Hat have each pledged that they will not assert hundreds of patents against open-source software implementations), electric vehicles (Tesla's famous proclamation that "all our patents are belong to you" [*sic*]), and biotechnology (for example, Monsanto's pledge not to assert patents covering genetically modified seeds against farmers inadvertently growing them) (Contreras 2015; Reynolds, Contreras and Sarnoff 2017).

The EcoPC was an innovative not-for-profit initiative undertaken by a group of large industrial firms with the goal of pledging "green technology" patents for broad, royalty-free use in addressing environmental challenges. The 13 EcoPC participants collectively pledged a total of 248 "green technology" patents (94 priority patents or distinct inventions) to the EcoPC between its formation in 2008 and its discontinuation in 2016.

The EcoPC had the ambitious objective of promoting the diffusion of green technologies to increase and accelerate adoption and to encourage follow-on innovation. Following its creation, the EcoPC attracted substantial attention in both the scholarly literature (Mattioli 2012; Hall and Helmers 2013; Awad 2015; Contreras 2015) and the popular media (Tripsas 2009). In addition to accolades, the EcoPC attracted some skepticism regarding its potential effectiveness. The skepticism focused on whether such a commons could offer sufficient incentives to attract valuable patent pledges and thereby achieve its ambitious goals. In contrast to other mechanisms designed to share patents, such as cross-licensing and patent pools, patent owners in the EcoPC committed to maintain ownership of their patents, which is costly, while making those patents freely accessible to third parties, including competitors.[2] For these reasons, it was not obvious what benefits the commons offered to participants beyond reputational enhancement. This in turn meant that participants could have had incentives to minimize their costs by pledging only patents with little commercial value and allowing them to lapse shortly after they were pledged. A second possible benefit might be that

1 Several large patent holders, including IBM, have a well-articulated strategy for abandoning unused patents (Crouch 2012). Other coordinated industry efforts, in particular in the biomedical sector, have contributed substantial intellectual property (IP) assets to the public domain for a variety of reasons (Contreras 2014).

2 Some competitive safeguards were left in place, notably a defensive termination right in case a different patent was asserted against the pledger by another firm using the patented technology.

those building on these technologies might find other (commercial) outputs of the contributing firm useful, or might add to a knowledge base from which the firm would benefit.[3]

In an earlier study (Hall and Helmers 2013), two of the authors of this paper studied the characteristics of the patents pledged to the EcoPC. This study confirmed that the pledged patents did claim environmentally friendly technologies. Moreover, pledged patents were of similar value to other patents in the pledging firm's portfolio, but of lower value than other patents in their class, using the usual patent value indicators (based on citations, family size, number of International Patent Classifications [IPCs], etc.). The findings suggested that the EcoPC participants had in fact pledged patents with the potential to diffuse environmentally friendly technologies that were potentially useful, but there was little evidence of such diffusion in the patent data itself.

In order to study whether the EcoPC increased the diffusion of green technologies, Hall and Helmers (2013) looked for changes in forward citations to pledged patents following their addition to the commons. They constructed a set of control patents that matched the publication authorities, priority years and IPC classes of the EcoPC patents, adding to these control patents all their equivalents, that is, the filings that shared a priority application with them. They examined the pattern of citations by subsequent patent applications to the set of EcoPC patents and their controls over time, before and after contribution, and found that the EcoPC patents tended to be cited *less* than the patents in the control group *before* contribution to the EcoPC. However, the results after contribution were inconclusive, because most of the patents were contributed in late 2008 and there was little data post-pledge as citation data was available only through early 2012.

In the current study, the authors revisit the effect of the EcoPC on technology diffusion and assess its impact more broadly, using two different approaches. The first is a set of interviews with participants in the EcoPC and those responsible for it, described in the "Qualitative Analysis" section. The second is an updated look at the data on the patents pledged to the EcoPC, described mainly in the "Data" and "Empirical Results" sections. With the passage of time, more citation data has become available (through 2016, as opposed to early 2012 in Hall and Helmers [2013]). This allows the authors of this paper to re-examine the data and provide a more definitive answer to the question of whether the commons had any effect on technology diffusion. The fact that the commons was discontinued in 2016 also motivates the authors to revisit the viability of such patent commons more generally.

To summarize the paper's main findings, the authors do not find any evidence that the EcoPC increased the diffusion of pledged patents. Pledged patents are cited less than the matched control patents before they enter the commons and their pledge does not change this. Looking at the EcoPC priority patents, 82 percent had lapsed by July 2017 due to expiration (26 percent), rejection or withdrawal (18 percent), or nonpayment of renewal fees (38 percent). This indicates that participating companies, in most cases, did not consider the benefits of the commons sufficiently large to maintain the patents in force, and expired patents were not replaced by new patent pledges. The authors' interviews with representatives of the EcoPC participants reveal several common critiques of the EcoPC's structure and operational processes, in particular its inability to provide information regarding the usage of contributed technologies.[4] These are discussed in greater detail in the next section.

This study both updates the authors' previous work and fills gaps in the understanding of the functioning and performance of the EcoPC and patent commons more generally. Providing a definitive answer to the question of diffusion, and the functioning of the EcoPC more broadly, is important for several reasons. First, it offers insight regarding the manner in which patent pledges can support the diffusion and implementation of (green) technologies around the world. Second, it can inform the design of other pledge communities, in both the environmental space and other key technology areas, such as biotechnology and agriculture.

The remainder of this paper is structured as follows. The next section reviews the institutional

3 Sharon Belenzon (2006) showed that focal firm citations to patents are positively valued by the market, suggesting this kind of feedback effect from others' use of the firm's technology.

4 This feature also limits the authors' ability to study their subsequent use, which is why the authors chose to focus on citations to these patents, which is public data.

design and history of the EcoPC. The "Findings" section summarizes the results from the authors' interviews of participants in the EcoPC. In the "Data" and "Empirical Results" sections, the authors turn to an updated qualitative analysis of these patents and their citations. The last section offers conclusions in the form of a few lessons that emerge from the authors' analysis for the design and functioning of patent commons.

The EcoPC: Structure and Development[5]

The conception of the EcoPC as a collective mechanism for permitting broad usage of patents covering environmental technologies was originally developed by IBM in the mid-2000s as one of several corporate initiatives directed toward environmental protection and sustainability (IBM 2010). Given IBM's well-known patent strength,[6] a program to promote environmental causes would capitalize on one of the company's principal assets. As noted above, IBM had already made significant commitments to the sharing of patents and other IP in the area of open-source code software (Merges 2004; Wen, Ceccagnoli and Forman 2013; Contreras 2015). Accordingly, extending these initiatives to the environmental area was consistent with IBM's existing corporate culture.[7]

The animating theory behind the EcoPC is that industrial firms with large patent portfolios likely hold patents covering technologies with environmental applications, but because those technologies are not core to the firms' business, they are languishing unused. If, however, the patents covering these technologies could be made freely available to users around the world, then a significant public service could be rendered at a minimal cost to the patent holder. Thus, the hope is not that the patent holder will find a "Rembrandt in the attic" that will render it a substantial financial return, but that it will find a box of old baby clothes that could benefit others at little cost to the owner.[8]

IBM publicly announced the concept for the EcoPC at its Global Innovation Outlook conference in 2006 (IBM 2008). The company then initiated discussions with other large firms with which it had existing business ties and which it believed might be sympathetic to a collective approach to making environmental technologies more broadly available. In January 2008, IBM announced the launch of the EcoPC together with Nokia, Pitney Bowes and Sony (IBM 2008). A total of 13 firms joined the EcoPC as summarized in Table 1. The stated mission of the EcoPC was "to manage a collection of patents pledged for unencumbered use by companies and intellectual property rights holders around the world to make it easier and faster to innovate and implement industrial processes that improve and protect the global environment" (EcoPC 2013). Accordingly, patents eligible for inclusion in the EcoPC were required to belong to one of 60 enumerated IPC codes[9] relating to environmental or sustainability technology. Technologies sought by the EcoPC included those aimed at energy conservation, pollution control, environmentally friendly materials, water or materials use, or reduction and recyclability (EcoPC 2013). As discussed in greater detail in the "Data" section, below, 248 patents were pledged to the EcoPC, with the last such contribution occurring in 2011.[10]

To pledge a patent to the EcoPC, the owner was required to make an irrevocable covenant not to assert the patent — or "any worldwide counterparts" (EcoPC 2013) — against any infringing machine, manufacture, process or composition of matter that "reduces/eliminates natural resource consumption, reduces/eliminates waste generation or pollution, or otherwise provides

5 The material in this section is derived from the works cited and the interviews described in the "Qualitative Analysis" section. Additional information regarding the organization and history of the EcoPC can be found in Mattioli (2012), Hall and Helmers (2013) and Awad (2015).

6 According to statistics from the United States Patent and Trademark Office, IBM regularly receives more US patent grants than any other company in the world (about 7,000 to 9,000 patents per year in 2014 to 2017).

7 The EcoPC explicitly compared itself to the open-source movement, noting in its promotional materials, "As has been demonstrated by the open source software community, the free sharing of knowledge can provide a fertile ground for new collaboration and innovation. Sharing environmental patents can help others become more eco-efficient and operate in a more environmentally sustainable manner, enabling technology innovation to meet social innovation" (EcoPC 2017).

8 See Rivette and Kline (2000), using IBM as an example of a firm that has extracted significant financial value from licensing otherwise "unused" patents.

9 The IPC system was established by the 1971 Strasbourg Agreement Concerning the International Patent Classification. It divides technologies into eight principal sections with approximately 70,000 subcategories.

10 This number is arrived at as follows: there were 238 patents pledged at the time of the authors' work in Hall and Helmers (2013). Since then, Hewlett-Packard added nine and Hitachi added one, for a total of 248.

Table 1: Firm Participation in the EcoPC

Firm	Date Joining EcoPC	Number of Patents Pledged*
IBM	January 14, 2008	29
Nokia	January 14, 2008	1
Pitney Bowes	January 14, 2008	2
Sony	January 14, 2008	4
Bosch	September 8, 2008	24
DuPont**	September 8, 2008	11
Xerox	September 8, 2008	13
Taisei	March 23, 2009	2
Ricoh	March 23, 2009	1
Dow	October 20, 2009	1
Fuji Xerox	October 20, 2009	2
Hewlett-Packard	July 1, 2010	3
Hitachi**	July 25, 2011	1

* Priority patents (patent families)

** DuPont and Hitachi withdrew from the EcoPC in 2013, as of the transfer of management from the World Business Council for Sustainable Development (WBCSD) to the Environmental Law Institute (ELI).

Source: EcoPC 2013b, 2017 and ecopatentcommons.org.

environmental benefit(s)" (EcoPC 2013). This being said, contributing patent owners retained the right to assert pledged patents against any EcoPC participant that asserted any environmental patent against them, or any non-EcoPC participant that asserted any patent against them (ibid.).[11]

The initial administrator of the EcoPC was the WBCSD, a Geneva-based non-governmental organization focused on environmental and sustainability issues. The WBCSD is supported in part by dues paid by corporate members. As a significant member of the WBCSD, IBM persuaded the organization to serve as the focal point for the EcoPC. The WBCSD's initial duties in this regard consisted primarily of hosting the EcoPC website and promoting the EcoPC to other WBCSD members for recruitment purposes. The WBCSD publicized the EcoPC among its members and attracted several of the participants that joined following the EcoPC's formation (see Table 1).

Participation in the EcoPC was open to all individuals and companies in the world; the only requirement for participation was the pledging of one or more patents according to the EcoPC's rules.[12] Neither membership in the WBCSD nor any additional dues or charges were required for EcoPC participation, a characteristic that some have identified as a weakness of the EcoPC (see the "Findings" section, below). The EcoPC itself was characterized as an unincorporated, non-profit association (EcoPC 2013).

Alhough various governance procedures are built into the EcoPC's ground rules, it appears that few of these procedures were actually observed in practice. For example, the ground rules provide for an executive board charged with management and leadership of the group. Executive board members were to be appointed based on a majority vote of EcoPC members for two-year terms and were supposed to meet quarterly by

11 This is a so-called "defensive termination" provision.

12 Members of the EcoPC were required to complete a membership application/pledge form, which bound them to comply with the EcoPC's non-assertion pledge, ground rules and governance structure (EcoPC 2013a).

telephone and annually in person. However, of those individuals that the authors of this paper interviewed, none recalled voting on EcoPC-related matters; they recalled only a handful of telephone conferences and no in-person meetings. In effect, the EcoPC appears to have been managed in a minimal manner by the WBCSD, with business-related decisions made largely by IBM.

In 2013, the administration of the EcoPC was transferred from the WBCSD to the ELI, a Washington, DC-based trade and advocacy organization. This transition was apparently orchestrated by IBM, which had withdrawn as a member of the WBCSD, thereby eliminating the primary driver of the WBCSD's involvement. The WBCSD had also begun to view the EcoPC — which could be seen as treating patents as obstacles to be overcome in promoting sustainable development — as misaligned with the generally pro-IP stance of many of its members. The WBCSD thus willingly parted with the EcoPC after IBM's withdrawal from the organization. The ELI, of which IBM was a significant member, hosted the EcoPC website from 2013 through 2016, but was not actively engaged in recruiting new participants. Two members, Hitachi and DuPont, withdrew from the EcoPC at the time of this administrative shift. No new patents were contributed to the EcoPC after 2011, when Hitachi joined. By 2016, very little activity was occurring at the EcoPC. Accordingly, in 2016, the EcoPC was formally discontinued (EcoPC 2016).[13]

Although the EcoPC has been shut down, the ELI has, throughout the writing of this paper, continued to host the EcoPC website at ecopatentcommons.org. In addition, pursuant to the EcoPC ground rules and pledge terms, the "irrevocable" non-assertion pledge made with respect to each pledged patent will continue in accordance with its terms indefinitely.[14]

Qualitative Analysis

This section of the paper describes the results of the authors' interviews of some of the participants in the EcoPC.

Methodology

Using a series of semi-structured interviews,[15] the authors sought to gain an understanding of the motivations that originally led firms to participate in the EcoPC, their assessment of the EcoPC's strengths and weaknesses during the course of its operation, and their rationales for discontinuing the EcoPC in 2016.

As noted in this paper's introduction, the EcoPC included 13 corporate participants. It was hosted by the WBCSD from 2008 to 2013, and by the ELI from 2013 to 2016. The authors identified individuals employed by EcoPC corporate participants who had been personally involved with their employer's decision to join the EcoPC and/or its ongoing participation in the EcoPC. Through online searches and informal inquiries, current contact details for representatives of nine of the 13 EcoPC corporate participants were obtained. Seven of these individuals consented to be interviewed for this study (five by telephone and two by written correspondence).[16] In addition, representatives of the WBCSD and the ELI who were directly involved in EcoPC activities were interviewed. Interview scripts differed for individuals representing EcoPC participants versus administrators. Each interview lasted approximately 30 to 60 minutes. Responses were coded by the interviewer. No compensation was offered to interview subjects.

The authors do not claim that the information gathered through these interviews is necessarily representative of the views held by all member companies of the EcoPC. It is possible that interviewees agreed to be interviewed based on their own subjective views of the performance of the EcoPC (for example, those that had more

13 Based on the interviews described in the "Findings" section, below, the authors understand that each EcoPC participant was consulted by IBM regarding the decision to wind down the EcoPC. Apparently, there was no resistance to this course of action.

14 The ground rules make it clear that a patent owner's EcoPC pledge will survive that owner's withdrawal from the EcoPC (EcoPC 2013a): "Voluntary or involuntary withdrawal shall not affect the non-assert as to any approved pledged patent(s) – the non-assert survives and remains in force." For example, Hitachi pledged a patent to the EcoPC in 2011, but withdrew from the EcoPC in 2013. This patent should remain pledged. See Contreras (2015, 598).

15 Interviews were conducted by Jorge Contreras pursuant to a determination of "no human subject research" by the University of Utah Institutional Review Board (26 June 2017, IRB 00102447). Interview subject information is held by Contreras.

16 The authors have agreed not to disclose the identities of either the individuals interviewed or the EcoPC participant companies that they represented, with the exception of IBM, given its central role in forming and managing the EcoPC.

positive views of the EcoPC may have agreed to be interviewed). That said, information was gathered from a relatively diverse sampling of company representatives (relative to the number of people involved in the project) across different geographical regions (companies based in the United States, Europe and Japan). The authors are therefore optimistic that these interviews offer relevant information with regard to a significant portion of the EcoPC participants' views regarding the organization.

Findings

Each interview subject responded to questions relating to his or her employer's reasons for joining the EcoPC, how patents were selected for inclusion in the EcoPC, the company's ongoing engagement with the EcoPC, views regarding the discontinuation of the EcoPC, the company's overall satisfaction with the EcoPC, whether the company's goals in joining the EcoPC were achieved, and the relative strengths and weaknesses of the EcoPC structure. In addition, representatives of the WBCSD and the ELI were asked questions relating to their operation and management of the EcoPC. These responses are summarized below.

Joining EcoPC

Based on the sample of EcoPC participants interviewed, it appears that the primary drive to participate in the EcoPC came from management within each corporation's environmental, sustainability or corporate social responsibility unit (for convenience, the paper will refer to such business units as "environmental and social responsibility" or ESR). Although in most cases, the corporate legal or IP department was consulted, it was not the primary internal champion of participation in the EcoPC. In several cases, the decision to join the EcoPC was made by an executive or manager within the ESR unit, with the legal department being involved only later (for example, to help identify suitable patents for contribution).

Given the origin of EcoPC participation in corporate ESR units, it is not surprising that the rationales for joining the EcoPC were largely focused on improving global environmental conditions and sustainability. Several respondents mentioned a corporate culture of ESR, while a few expressed a desire to ensure that environmentally valuable technologies were made available in the developing world. Responses evoked themes of environmental preservation and stewardship, as well as of corporate social responsibility.

With respect to each of the corporate EcoPC participants other than IBM, the company was approached directly by a representative of either IBM or the WBCSD regarding participation in the EcoPC. In several cases, a personal relationship at the managerial or executive level facilitated the decision to participate.

One attractive feature that weighed in favour of joining the EcoPC was the lack of any financial commitment on the part of the participants. The only requirement for EcoPC participation was the identification and contribution of one or more patents. Several respondents indicated that their employers would probably not have joined the EcoPC had a membership fee been required. Probably due to the lack of a financial commitment, the corporate approval required for joining the EcoPC was, in some cases, handled at the level of the ESR unit. In at least one case, however, the company was required to obtain corporate approval at the board level.

It is interesting to note that none of the individuals who were interviewed identified a public relations (PR) benefit as a principal justification for joining the EcoPC. While several interviewees acknowledged that positive PR associated with the EcoPC may have contributed to the decision to join, in particular at the executive level, the principal support for EcoPC participation within firms originated in, and was championed by, ESR business units with express goals directed at environmental sustainability. This observation runs counter to several prior analyses of the EcoPC, which speculated that PR benefits may have been significant motivators for firms to join (Contreras 2015, 591; Van Hoorebeek and Onzivu 2010, 18). Indeed, even the promotional materials created by the WBCSD to recruit additional EcoPC members emphasize these PR benefits.[17] Yet, it seems that PR may have played a relatively modest role in the decision of firms to join the EcoPC.

17 See EcoPC (2013b, 3) listing "global recognition" as the first "benefit" for member companies that have pledged patents to the EcoPC.

Selection of Patents

It was a starting premise of most firms that the patents pledged to the EcoPC would not be central to the firm's commercial interests. In fact, this feature was a "selling point" for membership in the commons: the patents that would be contributed were not expected to "represent an essential source of business advantage" for their owners (EcoPC 2017).

The manner in which specific patents were selected for contribution to the EcoPC varied among participants. IBM, reputedly the largest patent holder in the world, utilized a variety of internal searching and analysis tools to determine which of its patents were suitable candidates for contribution: namely that they fit into the EcoPC's approved technology categories and were not actively being commercialized by IBM. Other firms used similarly sophisticated patent searching methodologies, including analysis of external citations to patent documents, to determine whether patents had potential financial value. Some firms, even those with large patent portfolios, used less formal approaches. In one case, a patent was identified because a senior environmental manager at the company was named as an inventor on it. Another company asked its internal managers at the product division level to recommend patents for contribution. At one company, the majority of patents contributed originated within the ESR business unit, which championed EcoPC membership within the company. In all cases, EcoPC participants selected patents for contribution through internal mechanisms and did not engage external consultants or attorneys to assist with the search or selection process, which also helped keep the costs of participating in the EcoPC low.

Ongoing Engagement

All respondents indicated that a meaningful, although not overwhelming, amount of effort was required at the initiation of EcoPC participation, largely to identify relevant patents to contribute. After that initial determination was made, however, most firms (IBM being the notable exception) indicated that they engaged very little with the EcoPC. As noted above, there were occasional telephone conferences during which participants were updated regarding the EcoPC's activities, but after 2011, when the last new member joined, there was little in the way of updates. As previously noted, none of the individuals that were interviewed recalled participating in any formal vote of EcoPC members, even when the decision to wind down the organization was made. This being said, most of the respondents did not object to this minimal level of involvement and did not feel the need to be involved to a greater degree.

Discontinuation

Each respondent was satisfied with the decision to wind down the EcoPC, indicating that the organization had run its course and provided comparatively little value by the time that it concluded. None of the respondents expressed disappointment or disagreement with the decision to discontinue the EcoPC. In fact, at least three respondents were unaware, at the time they were interviewed, that the EcoPC had been discontinued more than a year earlier, demonstrating that, at least in these cases, the EcoPC was a fairly insignificant activity for these companies.

Strengths and Weaknesses of the EcoPC

Most respondents viewed the EcoPC as a valuable demonstration of corporate willingness to collaborate to achieve environmental and sustainability goals. The PR benefits of EcoPC participation were viewed as valuable by some companies. IBM's efforts at organizing the project were also commended by several respondents.

However, each of the respondents expressed dissatisfaction with at least some aspects of the EcoPC, as described below.

- **Membership and recruitment:** At its height in 2011, the EcoPC had 13 corporate participants. Although these firms were all major global enterprises with large patent portfolios, they still represented only a tiny fraction of the total potential membership in the organization. In particular, given that the EcoPC charged no membership fee, it was somewhat puzzling that so few firms joined. While the WBCSD appeared to promote membership in the EcoPC, few of the WBCSD's many members elected to join. Based on interviews with EcoPC members, the authors believe that possible impediments to recruitment included the perceived difficulty and expense of identifying suitable patents for contribution; a belief among potential members that they lacked patents that were suitable for contribution; and

a general aversion to the idea of contributing potentially valuable patents to the EcoPC without compensation, a view generally held by legal and IP departments, although not shared by ESR business units. Accordingly, EcoPC membership may have been limited to those large firms with ESR business units having sufficient internal authority, willingness and social capital to cause their companies to join an effort viewed, at least initially, with suspicion by corporate legal departments.

- **No tracking of usage:** All respondents observed that there was no effective way to determine whether the technologies covered by patents pledged to the EcoPC had been utilized.[18] As a result, it was difficult for them to draw conclusions regarding whether the EcoPC was worth the effort and to determine whether the goals of improving environmental conditions and sustainability were being met. Moreover, without clear success metrics, it was difficult to justify ongoing participation within the EcoPC to upper management at some companies. Several respondents indicated that the EcoPC made a conscious decision *not* to require users to register with the website or report back to the EcoPC, as it was felt that such requirements would serve as barriers to use of the website. Running somewhat counter to these comments, one interviewee noted that, in the early phase of the EcoPC, he/she received informal approaches from potential users seeking to understand the technology that had been made available through the EcoPC. This respondent indicated that during group calls with EcoPC representatives, they would share information regarding how many inquiries of this nature they had received. However, such informal inquiries dropped off after the initial years of the EcoPC, which may suggest that the technologies were no longer perceived as useful. The WBCSD, at least initially, tracked hits to the EcoPC website and shared this information with the participants.[19] However, as noted above, identifying information about visitors was not collected, and it was not clear whether visitors were academics, students, attorneys, journalists or potential users of technology.

- **Website not user-friendly:** It was noted by several interview respondents that the cataloguing of patents on the EcoPC website, which was organized by contributing company rather than by technology area, was not particularly intuitive or informative. It required potential users to look up the relevant patents one by one in order to understand the technology being offered. Moreover, usually only a single patent family member was listed, requiring users to identify the remaining members themselves. This procedure would have required substantial effort on the part of potential users, as well as a high degree of familiarity with the format and terminology of patent documents.[20] Perhaps some form of usage testing or assessment could have helped the organizers of the EcoPC make the technology being offered more accessible or understandable. As documented by Hall and Helmers (2013), the website also listed a number of erroneous patent numbers, another potential source of frustration for users.

- **No technology transfer:** Another issue raised by several respondents was that the EcoPC sought to promote the dissemination of green technologies through patents alone. Yet, complex technologies often cannot be understood and implemented, especially by non-experts working in the developing world, exclusively through patent disclosures (McManis and Contreras 2014). Some form of technology assistance or transfer is generally required to enable local users to take advantage of patented technologies, or even to realize that such technologies are available and applicable to local problems. Thus, even with a more explicit statement describing the technology covered by the contributed patents, it is not clear that the EcoPC would have achieved significant technology transfer. One of the issues that emerged in this regard was uncertainty regarding the intended users of the EcoPC system. Who was expected to read the EcoPC patents and then employ them in environmentally friendly technologies? Several

18 This weakness was identified by commentators soon after the EcoPC's formation (Bowman 2009).

19 The authors analyzed the data on web hits in their earlier study to find a highly skewed distribution of hits: only 36 patents received any hits. Nevertheless, the analysis also indicated a positive correlation between web hits and forward citations by other patents (Hall and Helmers 2013).

20 It is worth pointing out that this situation is changing rapidly, since Google patent search now includes members of the patent family in its results. However, this feature was not available during most of the life of the EcoPC.

of the individuals interviewed believed that intended users of EcoPC technology would be from the developing world. However, this belief evidences a misunderstanding of the global patent system. Patents prevent usage of a patented technology only in the countries where patents are issued. Most companies do not seek patent protection in the least-developed countries, either because protection is uncertain in those countries, or because their markets are underdeveloped and the cost of procuring patent protection is not viewed as cost-effective. Even in middle-income countries, multinationals tend to focus on pharmaceutical patenting and patenting in specific areas where the country in question is competitive (Hall and Helmers 2017; Abud et al. 2013). Accordingly, many technologies that are patented in the developed world are not patented in the developing world. This general rule certainly applies to the patents contributed to the EcoPC, most of which have "family" members throughout the developed world, such as North America, Europe and Asia Pacific, but few, if any, patent family members in the developing world. Thus, organizations in the developing world *already* have the right to seek to exploit many technologies disclosed in patents filed in the developed world. But they do not do so because, as discussed above, the utilization of even moderately complex technologies is not possible without significant training and technology transfer activity that is not accomplished through the grant of patent rights alone. In addition, technologies patented in the developed world may not be targeted to needs in the developing world without extensive further development. Ironically, the entities that would have most benefitted from the non-assertion covenants made by EcoPC members were sophisticated firms in developed countries. At least one representative acknowledged this, noting that the most likely user of some of the company's contributed patents would be environmental service companies. Yet because the EcoPC made no concerted outreach to promote the availability of contributed technologies, even sophisticated firms were unlikely to find and use these technologies.

→ **Shift in corporate priorities:** Several interview respondents noted that internal corporate support for ESR initiatives within their own companies had flagged during the life of the EcoPC, and that budgetary and resource constraints had resulted in a de-emphasis of ESR initiatives within their corporate organizations. Some speculated that these industry-wide trends may have affected the willingness of new members to join the EcoPC.

Data

For the purpose of the authors' quantitative analysis in the section below, they updated the database used in Hall and Helmers (2013). This means that for comparison purposes, the authors restricted the set of patents to all patents pledged prior to July 2010, which excludes the four patent families pledged by Hewlett-Packard and Hitachi.[21] The authors also included the original control patents, which had been obtained by matching on priority year, IPC subclass and publication authority.

Updating the data turned out to be somewhat complicated, partly because the original data was drawn from a European Patent Office (EPO) Worldwide Patent Statistical Database (PATSTAT) version with non-permanent identifiers, and partly because PATSTAT itself changes over time, with some data disappearing due to changes in data at the contributing national or regional patent offices. In addition, the list of patents on the EcoPC website appears to have changed slightly, to some extent in response to the authors' comments on the original list (for example, incorrect numbers). The authors used the April 2017 PATSTAT version and identified a correspondence between the prior identifying numbers and the permanent (as of April 2011) identifiers using information on the application number and authority of the relevant patents. In a few cases, the authors were unable to find the application number/authority combination on the new version of PATSTAT. There were four such applications from the Japan Patent Office (JPO), which apparently have been withdrawn and are no

21 In the case of the Hitachi patent, it is not clear that the patent was ever listed on the EcoPC's public website. All versions of the EcoPC's list of patents that the authors were able to locate using web archive tools were current only as of May 2011, prior to Hitachi's joining.

Table 2: Data Set Construction

	Old (2011 Data)	New (2017 Data)
Number of Applications	711	698
Controls	473	461
Eco-patents	238	237
Number of Equivalence Groups	184	184
Controls	94	94
Eco-patents	90	90
Number of Citations	1,872	4,056
Controls	1,205	2,713
Eco-patents	667	1,343

Source: Authors.

longer on its website.[22] The authors included them in their forward citation analysis as having zero cites, for completeness. In addition, 24 applications from the Australian Patent Office (APO) were reduced to 12 applications in the new PATSTAT file.

The resulting data set contains 698 applications rather than the original 711, with the following distribution: From Table 2, one can see that although the set of applications has changed slightly, the same number of equivalent groups for the patents have to be analyzed. It is also clear that the number of citations to both the EcoPC patents and the controls have grown considerably, more than doubling in both cases.

Empirical Results

Next, the authors used the data on patents pledged to the EcoPC and their matched controls to analyze, first, the legal status of EcoPC patents, to gauge whether member companies considered continued ownership of their pledged patents as sufficiently important to incur the associated costs, and, second, the diffusion of the technologies protected by patents pledged to the EcoPC, as measured by citations received from other patents.

Legal Status of the Pledged Patents

The authors began by looking at the legal status of the EcoPC pledged patents as of July 2017, summarized in Table 3. This data was collected from PATSTAT's legal status tables from April 2017 and supplemented with information from web searches. The World Intellectual Property Organization (WIPO) Patent Cooperation Treaty patents in the authors' database do not have a post-grant legal status since they are granted on a national basis, and a few patent applications from the JPO could not be found, probably because the PATSTAT entries were for translations, or they were utility model applications in Japan, even though they might have been patent applications elsewhere. There are 15 such patents for which either the authors do not have legal status or legal status is meaningless. Of the remaining 221 patent applications, almost 20 percent of the 90 priority patents were still in force as of July 2017,

22 One problem with searching for JPO patents, especially the earlier ones, is that the numbering systems are quite complex and some numbers are apparently reused occasionally (for further information on Japanese patent numbering, see Prior Art, "Tips of Performing Japanese Patent Numbers Search", online: <www.searchpriorart.com/search_tips/patent_no_search.htm>). This problem leads to apparent errors on the Espacenet and Google patents websites. The authors also found that at least two of the equivalent patents they had identified for the controls became utility model patents when they were granted in Japan.

Table 3: Legal Status of Eco-patents – July 2017

	All	Priority	All	Priority
Pending	8	3	3.4%	3.3%
Granted and in Force	19	14	8.1%	15.6%
Total Still Active	27	17	11.4%	18.9%
Nonpayment of Fees	90	29	38.1%	32.2%
Expired at Term	61	30	25.8%	33.3%
Rejected	18	7	7.6%	7.8%
Withdrawn	24	7	10.2%	7.8%
Total Not Active	193	73	81.8%	81.1%
Missing (from JPO)*	5	0	2.1%	0.0%
WIPO Applications	11	0	4.7%	0.0%
Total	**236**	**90**		

* These appear to be translation entries or utility models.
Source: Authors.

but only 11 percent of all the equivalent patents were still in force. Of the 27 patents still in force or pending, 12 are US patents, six are Japanese, four are European Patent or German, and the remainder are Chinese (one), Russian (two), Mexican (one) and Korean (one). Almost half the patents have expired for nonpayment of fees, although almost as many expired at the end of their terms.

Figure 1 shows the distribution of patent lifetimes (approximated by the lapse [expiration or nonpayment] dates minus the application filing date).[23] In the case of patents still in force, the authors measured the lifetime to July 2017. The distribution is fairly flat for those patents that did not remain in force for their full terms.

Figure 2 breaks down the different reasons why patents lapsed. It shows that a significant number of patents have expired since 2007. A few patents were rejected by the relevant patent offices or were withdrawn by applicants, but the majority lapsed due to nonpayment of renewal fees.

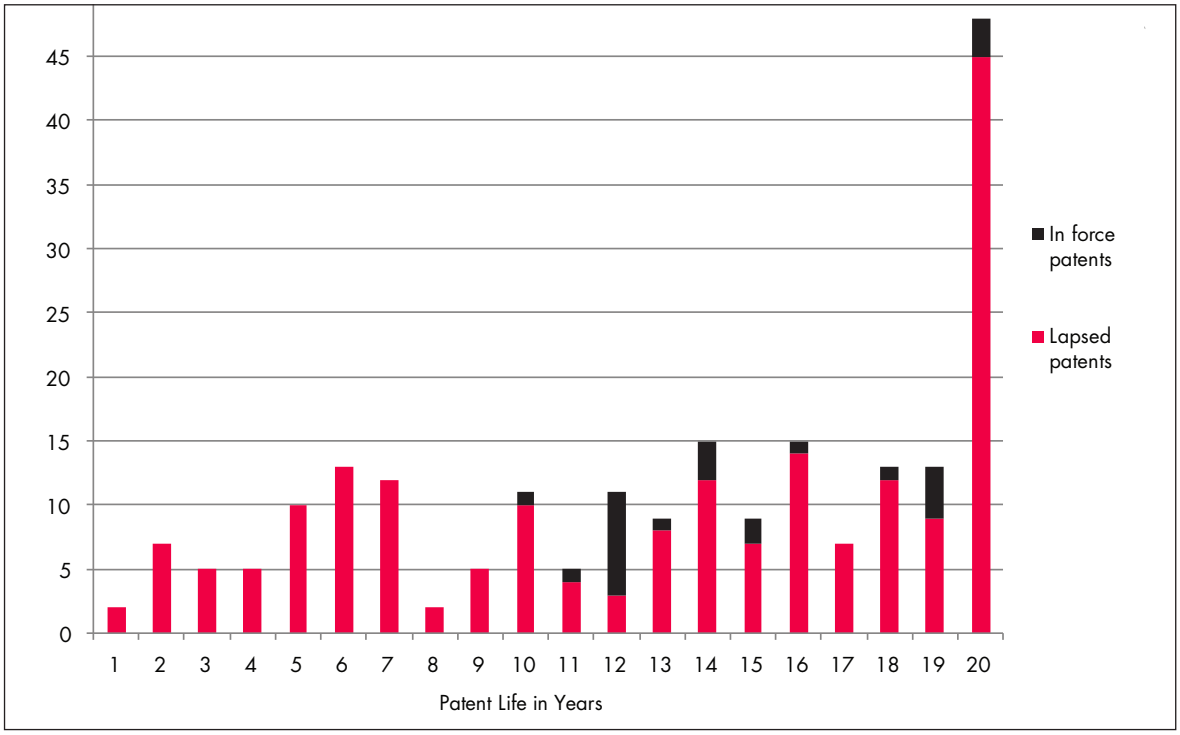
Table 4 shows the geographic coverage of the EcoPC patents. Ninety percent of the priority patent applications were made to the four most important jurisdictions: the United States, Germany, Japan and the EPO, and these jurisdictions account for 80 percent of the patents overall. There is very little evidence that the patents in the commons ever covered less-developed countries. The only patents in middle-income countries are in Brazil (seven), Mexico (four) and Argentina (one), and there are none in low-income countries. So, patents cannot have been an obstacle to the use of these technologies in less-developed countries.

Technology Diffusion and Follow-on Innovation

Next, the authors re-examine the question of technology diffusion by looking at the updated citation data. Table 5, below, shows the authors' updated version of data from Table 6 in Hall and Helmers (2013). As indicated earlier, there are slightly fewer equivalents of the EcoPC patents and controls due to missing data and the consolidation at the APO. The share of patents that have citations has increased, approaching close to 90 percent for the equivalence groups, and the average citations per equivalence group have more than doubled. None of these results are unexpected, given the additional five years of data, as well as probable improvements in the PATSTAT coverage itself.

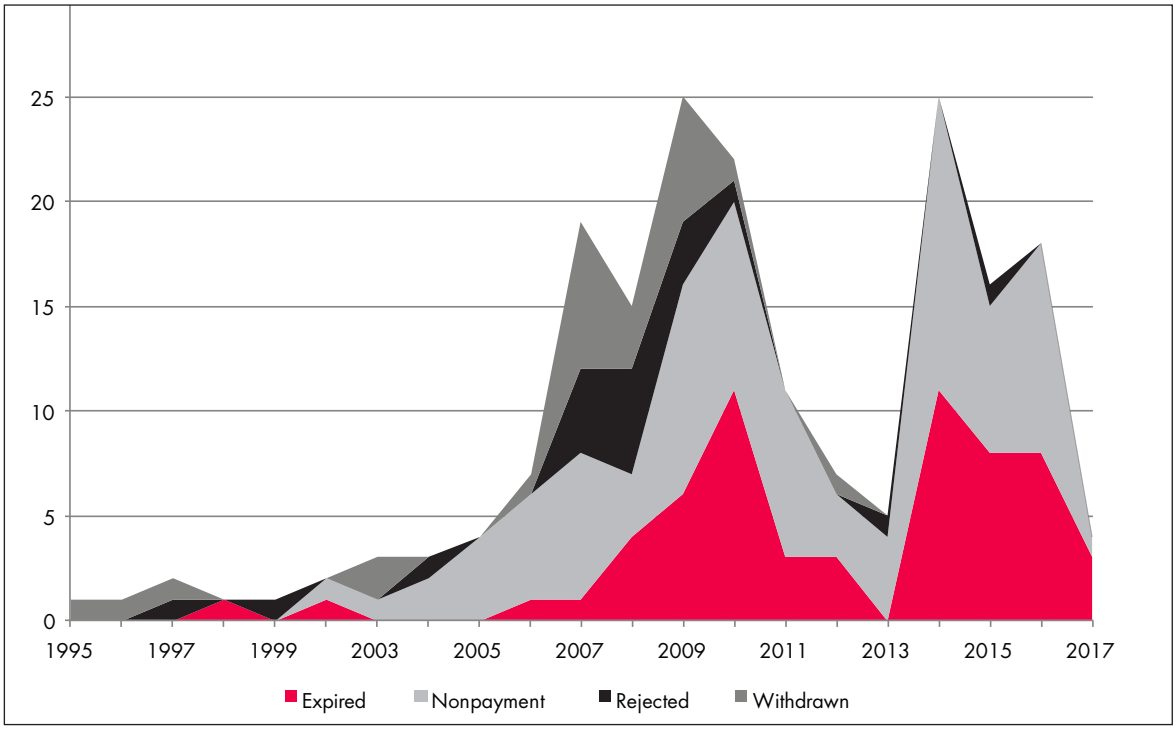
23 Most offices now have a common patent term of 20 years from filing date, but there are various exceptions, and older patents in the authors' sample may have been issued under different rules. When the authors were able to obtain the actual expiration date, they used that (in most cases).

Figure 1: Cites per Patent by Citing Year (as of May 2017)



Source: Authors.

Figure 2: Cites per Patent by Citing Year (as of May 2017)



Source: Authors.

Table 4: Application Authority Distribution

Authority	Priorities	All
United States	34	75
Germany	20	45
Japan	17	34
EPO	10	34
South Korea	2	7
China	2	3
Austria	1	4
Spain	1	4
United Kingdom	1	2
Norway	1	2
Denmark	1	1
Brazil		7
Canada		7
Mexico		4
Australia		2
Russia		2
Argentina		1
France		1
Hong Kong		1
Israel		1
Total	**90**	**237**

Source: Authors.

Table 6 and Figure 3, below, show the key results of the authors' new analysis. The results are essentially the same as in the authors' 2013 paper, but much more precisely estimated. Poisson and negative binomial models of citations at the patent level show that EcoPC patents are half as likely to be cited as the controls (an elasticity of 0.4 to 0.6), and even less likely after donation, although this last result is only marginally significant. These regressions control for both priority year and the citation lag using dummies.

The Jaffe-Trajtenberg model of citation decline and diffusion (Jaffe and Trajtenberg 1999), shown in the final three columns of Table 6, uses a parametric model for the citation lag that is given by the following equation:

$$c_{st} = b_0(1 + d_{eco}D_{eco} + d_{after}D_{after})\,f(t)\,\exp[-b_1(1+b_{1e}D_{eco})s][1-(b_2(1+b_{2e}D_{eco})s)]+e_{st}$$

Where t is the priority year of the cited patent, s is the citation lag and c_{st} is the citation rate (the number of citations at that lag per sample patents available to be cited). $f(t)$ is modelled as a set of priority year dummies. That is, the unit of observation is the average cites per patents with a given priority year, citation lag and patent type (EcoPC patent before and after or control). Prior experience with this specification suggests that although it is an appealing model in that it captures both the initial increase in citation due to knowledge diffusion and the decline due to knowledge age, it is quite difficult to estimate successfully (Hall, Jaffe and Trajtenberg 2001). The authors accomplish this in two ways: non-linear least squares with a dependent variable equal to average cites per patent; and Poisson with a dependent variable equal to the total cites at the given lag to patents with a given priority year. In the latter case, the authors multiply the right side of the model by the number of patents, so the models are equivalent. The results from the two estimation strategies are similar. Once the authors impose a model on the citation lag, the EcoPC patents are cited an average of 25 percent less than the controls, and there is no change after donation. The decay (obsolescence) and diffusion parameters are similar to those obtained by Hall et al (2001) for the US patent data, with obsolescence increasing by about five percent per year, and diffusion by about 50 percent. However, keep in mind that one reason the first parameter is relatively low and the second relatively high is that there is a secular growth in citation that is not completely captured by the priority year dummies. That is, this model imposes a fixed citation lag structure on the data, which is then allowed to be higher or lower, depending on priority year and EcoPC status.

Table 6 and Figure 3 show that there is little change in aggregate citation differences between EcoPC patents and controls before and after being pledged to the commons, although EcoPC patents are cited less overall. One thing that is important to remember, however, is that because the pledging firms retain a defensive termination right, there may be continuing innovation building

Table 5: Citation Counts for EcoPC Patents and Controls

	All Patents	Equivalence Group	All Patents	Equivalence Group	All Patents
	Total Patents		Share with Citations		Total Citations
Eco-patents	237	90	73.0%	85.6%	1,343
Controls	461	94	57.1%	93.6%	2,713
	Average Citations*		Average Citations**		
Eco-patents	10.5	17.4	5.7	14.9	
Controls	13.2	30.8	5.9	28.9	

Citations are measured as all forward citations in the patent literature between the application date and April/May 2017, adjusted for citations by equivalent patents in other jurisdictions.
* Average over patents with nonzero citations.
** Average over all patents.

Source: Authors.

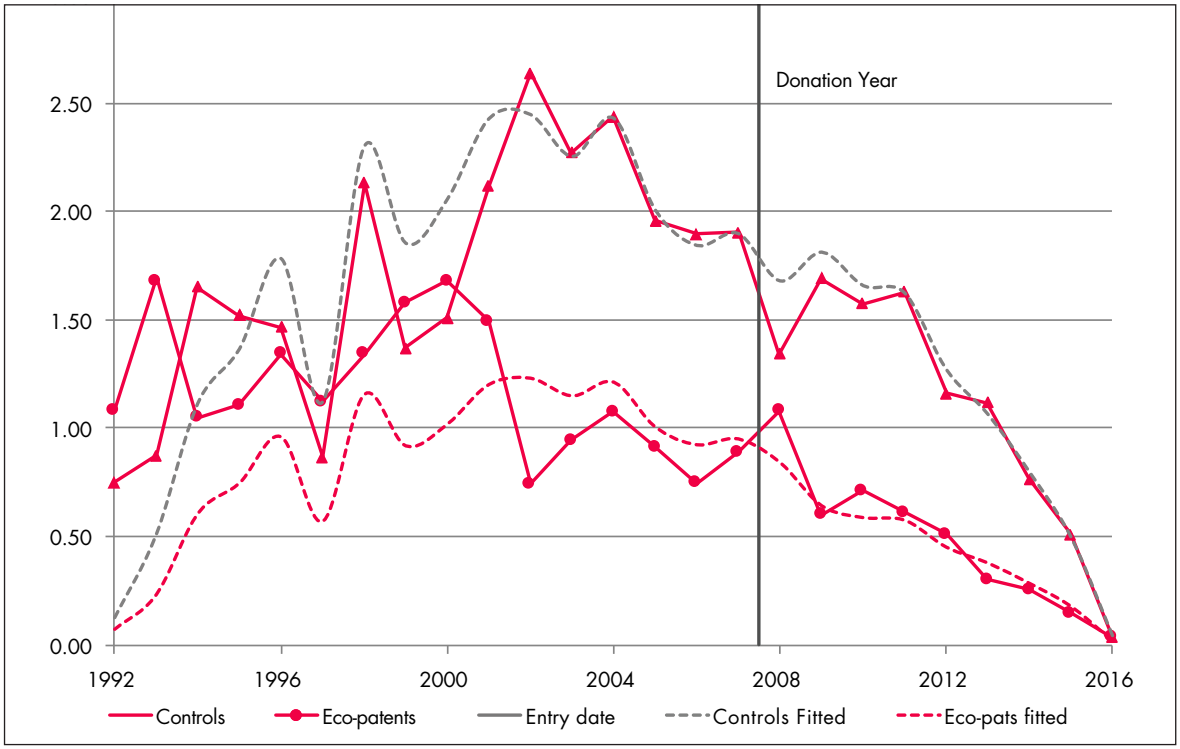
Table 6: Estimation of Citation Lag Models

Model	Semi-parametric			Jaffe-Trajtenberg	
Dependent Variable Method	Cites Poisson	Cites Negative Binomial	Cites/Patent NLLS	Cites Poisson	Cites Poisson
EcoPC Patent	-0.60 (0.11)***	-0.42 (0.10)***	-0.33 (0.09)***	-0.22 (0.04)***	-0.25 (0.05)***
EcoPC Patent after Donation	-0.35 (0.21)	-0.33 (0.17)*	-0.10 (0.18)	-0.01 (0.08)	0.01 (0.08)
Decay Parameter			0.07 (0.02)***	0.04 (0.01)***	0.05 (0.01)***
Diffusion Parameter			0.49 (0.21)**	0.76 (0.19)***	0.64 (0.21)***
EcoPC Decay					0.47 (0.38)
Dispersion Parameter		3.21 (0.17)***			
Citation Lag Dummies	yes	yes	no	no	no
Priority Year Dummies	yes	yes	yes	yes	yes
Observations **Log Likelihood**	**3,071** **-6,143.0**	**3,071** **-3,745.2**	**518** **-845.6**	**518** **12,062.8**	**518** **12,068.6**

Sample: 94 controls and 90 EcoPC patents with priority years between 1992 and 2005 and citing years between 1992 and 2016. The unit of observation in the first two columns is a priority patent-citing year and in the next three columns a priority year-citing year. Standard errors are robust to heteroskedasticity. Significant at the one per cent (***), five per cent (**) and 10 percent (*) levels.

Source: Authors.

Figure 3: Cites per Patent by Citing Year (as of May 2017)



Source: Authors.

Table 7: Citation to the Eco-patents by Citer Type

	Unweighted				Weighted			
Firm	Before Donation	After Donation	Share Before	Share After	Before Donation	After Donation	Share Before	Share After
Self-citation	141	24	9.9%	4.6%	127.1	12.9	12.3%	3.9%
Other Eco-patent	11	13	0.8%	2.5%	8.0	7.3	0.8%	2.2%
Other Firm	645	248	45.1%	47.1%	627.5	229.8	60.5%	68.8%
Individual	589	219	41.2%	41.6%	243.0	71.7	23.4%	21.5%
Institution	43	22	3.0%	4.2%	31.7	12.4	3.1%	3.7%
Total	**1,429**	**526**			**1,037.3**	**334.1**		

These totals are for cites to the contributed eco-patents only. Weighted cites are weighted according to the number of applicants.

Source: Authors.

on these patents that does not result in new patent applications (and citations). That is, there are limits created on the enforcement of patent rights by the firms that use the technologies in these patents, which may reduce the benefits of subsequent patenting, and thus reduce citations to the pledged patent. This issue is related to a broader problem: the authors' analysis of diffusion only looks for diffusion that leads to follow-on innovation that is patented. This excludes simple use of pledged patented technologies and even of follow-on innovation if it does not lead to a patent filing. However, in the absence of any information on the use of pledged patents (see the discussion above), the forward citation analysis offers an opportunity to assess the impact of the patent pledge on diffusion.

It is also possible that the nature of the citation changes, in that the technology in the patents becomes more useful to individuals and non-profit institutions, given the absence of royalty requirements. The authors investigate this question by looking at the source of the citations to the EcoPC patents and controls before and after donation. They divide the cites into five groupings according to their source: self-citations from the firm that owns the pledged patent, citations from other EcoPC participants, citations from other firms, citations from individual patentees, and citations from non-profit institutions (universities, hospitals, public research organizations and governments). The authors then define the before and after period for each grouping of citations according to the relation between the earliest priority date for the citing patent and the date the cited patent was donated to the commons. The results are shown in Table 7. In some cases, sample sizes are fairly small, but it appears that self-citation falls relative to all the other categories, with the largest (percentage) increases in citations by other EcoPC participants and non-profit institutions.

One issue that arises when counting the source of citations is that many patents have multiple applicants of different types. Given the non-rivalry of knowledge, which implies that one citer's use of the knowledge in a patent does not depend on use by another citer, it might be appropriate to simply count all the applicant citations as citations (as in the first panel of Table 6). Nevertheless, the authors also show a weighted version of the table in the second panel, where the weights are proportional to the inverse of the number of applicants on the citing patent.[24] Although the distribution of cites changes dramatically when the authors weight, due to the tendency of individuals to share in applications, the qualitative conclusions with respect to the post-commons citing behaviour are the same.

Conclusion: Lessons for a (Green) Patent Commons

The authors summarize here what they have learned from the experience of this patent commons and related work on knowledge transfer.

- The EcoPC was conceived and implemented by the suppliers of technology without consulting the demand side (potential users of these patents/technologies). As such, the EcoPC was constructed in a way that was not easy for users to consume. More outreach and technology transfer assistance is probably needed, or perhaps a way to simply *tell* potential users about the technologies that are available (other than a passive website with patent listings).[25]
- Related to the previous point, the EcoPC was organized as a volunteer effort. Members paid no fees, and the WBCSD and the ELI participated largely as an accommodation to IBM. Without payment, there are not likely to be many ancillary value-added services. This being said, some members stated that they would not have joined had they been required to pay a membership fee. So, there is a clear trade-off, or perhaps a need for public support or a tax incentive, if the activity is viewed as socially desirable. This also means that the ability to distribute the fixed costs associated with managing such an institution favours an approach that brings together a larger number of participating companies than the EcoPC did.
- Low membership can be attributed, in part, to the cost of the internal patent analysis that was

24 The authors removed individual inventor applicants where there was also a firm applicant before computing the weights, on the grounds that these applicants usually are employed by the firm in question.

25 A similar supply-side model for patents can be found in the IPXI Exchange, an attempt to offer unitized licences of pooled patents essential to certain industry standards. Like the EcoPC, the IPXI failed to achieve significant take-up and eventually discontinued its operations. See Contreras (2016).

required to contribute. Several of the original EcoPC participants were large, sophisticated organizations with internal patent analytical resources and a clear understanding of which patents would, or would not, advance corporate goals. Did other firms feel that they did not want to risk giving away a patent that could have potential value? Or was the internal effort of identifying these patents, without a clear payoff, seen as not worth the effort for overworked patent counsel?

- Low membership in the EcoPC may also be attributable to the lack of a formal membership recruitment campaign, which is likely due to the lack of any independent funding for the EcoPC. Most trade associations have dedicated personnel for membership development, and enrolling members takes significant time and effort.[26] Without these resources, it is not surprising that the EcoPC was unable to recruit a larger body of members.

- The most common critique of the EcoPC was its lack of tracking of patent utilization. Without knowledge of how or whether patents were being utilized, companies could not justify expending further effort on the activity. Moreover, even the PR benefit of belonging to the EcoPC waned after the initial contributions, given that there were no "success stories" to promote. More generally, the lack of information on usage meant that it was very difficult to gauge the success of the initiative and to make adjustments to its structure and management to improve its performance. Finally, the lack of demonstrable results from the project eroded the potential PR benefits that member firms may have hoped to achieve from participation in the EcoPC.

- Effective technology diffusion requires more than patent non-assertion, especially in the developing world. Technical assistance and know-how are far more essential for environmental technologies than they are for software or pharmaceuticals (Barton et al. 2002; McManis and Contreras 2014). Patent disclosures alone are not sufficient to enable someone to implement a technology (see Ouellette [2012] for the results of a survey of patent readers).

- Several interview respondents expressed disappointment with a general trend within the industry and their own companies to less aggressively pursue ESR goals and programs over the course of the EcoPC project. This trend, which the authors have only anecdotal evidence to support, may have contributed to the lack of enrolment of new members in the EcoPC. If this is the case, then new commons efforts in the environmental space will need to develop strategies to rekindle corporate interest in ESR and green technology solutions.

- The results of the empirical analysis suggest fairly strongly that the technologies covered by the contributed patents were in fact not very valuable, even before contribution to the commons. In addition to the citation evidence, this view is supported by the fall off in inquiries from others. These observations suggest that future commons efforts may benefit from the contribution of patents that have a greater inherent value, at least to the markets that they are intended to benefit, and that contributors may benefit the commons by more specifically identifying potential applications for contributed patents.

Future initiatives seeking to make green technologies more widely available should consider the lessons learned from the EcoPC. There are clear trade-offs between costs and benefits that organizers of future efforts need to consider. The experience of the EcoPC, even though it may not have fully realized its ambitious goals, has helped to advance our understanding of how patent commons can work and fail to work. As such, the EcoPC has made an undeniable contribution to the study of patent commons and pledges.

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26 *Ibid*, relating to the failed IPXI effort.

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Works Cited

Abud, Maria Jose, Carsten Fink, Bronwyn Hall and Christian Helmers. 2013. "The Use of Intellectual Property in Chile." INAPI-WIPO Report, Economic Research Working Paper No. 11.

Awad, Bassem. 2015. *Global Patent Pledges: A Collaborative Mechanism for Climate Change Technology*. CIGI Papers No. 81. Waterloo, ON: CIGI.

Barton, John et al. 2002. "Integrating Intellectual Property Rights and Development Policy." Report of the UK Commission on Intellectual Property Rights.

Belenzon, Sharon. 2006. "Knowledge Flow and Sequential Innovation: Implications for Technology Diffusion, R&D and Market Value." SSRN. http://dx.doi.org/10.2139/ssrn.893060.

Bowman, Jo. 2009. "The Eco-Patent Commons: Caring through Sharing." *WIPO Magazine*. www.wipo.int/wipo_magazine/en/2009/03/article_0004.html.

Contreras, Jorge L. 2014. "Constructing the Genome Commons." In *Governing Knowledge Commons*, edited by Michael J. Madison, Katherine J. Strandburg and Brett M. Frischmann, 99–136 Oxford, UK: Oxford University Press.

———. 2015. "Patent Pledges." *Arizona State Law Journal* 47(3): 543–608.

———. 2016. "FRAND Market Failure: IPXI's Standards-Essential Patent License Exchange." *Chicago-Kent Journal of Intellectual Property* 15(2): 419–440.

Crouch, Dennis. 2012. "IBM's Patent Abandonment Strategy." *Patently-O* (blog), March 1. https://patentlyo.com/patent/2012/03/ibms-patent-abandonment-strategy.html.

EcoPC. 2013a. "Joining or Submitting Additional Patents to the Commons." www.otromundoesposible.net/wp-content/uploads/2012/07/EcoPatentGroundRules.pdf.

——— 2013b. "The Eco-Patent Commons: A Leadership Opportunity for Global Business to Protect the Planet." www.leanbusinessireland.ie/includes/documents/Eco-Patent%20Commons%20Brochure_011008%5b1%5d.pdf.

——— 2016. "Important Statement from the Board: Eco-Patent Commons to Cease Active Operations Effective May 18, 2016." https://ecopatentcommons.org/.

——— 2017. "About the Eco-Patent Commons." https://ecopatentcommons.org/about-eco-patent-commons.

Hall, Bronwyn H. and Christian Helmers. 2013. "Innovation and diffusion of clean/green technology: Can patent commons help?" *Journal of Environmental Economics and Management* 66 (1): 33–51. doi:10.1016/j.jeem.2012.12.008.

———. 2017. "The impact of joining the regional European Patent Convention system." UC Berkeley and University of Santa Clara Working Paper.

Hall, Bronwyn H., Adam B. Jaffe and Manuel Trajtenberg. 2001. "The NBER Patent Citation Data File: Lessons, Insights and Methodological Tools." NBER Working Paper No. 8498.

IBM. 2008. "Corporations Go Public with Eco-Friendly Patents." IBM news release, January 14.

——— 2010. *IBM and the Environment: 2009 Annual Report*. www.ibm.com/ibm/environment/annual/IBMEnvReport_2009.pdf.

Jaffe, Adam B. and Manuel Trajtenberg. 1999. "International Knowledge Flows: Evidence from Patent Citations." *Economics of Innovation and New Technology* 8: 105–36.

Mattioli, Michael. 2012. "Communities of Innovation." *Northwestern University Law Review* 106 (1): 103–55.

McManis, Charles R. and Jorge L. Contreras. 2014. "Compulsory Licensing of Intellectual Property: A Viable Policy Lever for Promoting Access to Critical Technologies?" In *TRIPS*

and Developing Countries: Towards a New IP World Order?, edited by Gustavo Ghidini, Rudolph J. R. Peritz and Marco Ricolfi, 109–31. Cheltenham, UK: Edward Elgar.

Merges, Robert P. 2004. "A New Dynamism in the Public Domain." *University of Chicago Law Review* 71: 183–203.

Ouellette, Lisa L. 2012. "Do Patents Disclose Useful Information?" *Harvard Journal of Law and Technology* 25 (2): 545–603.

Reynolds, Jesse, Jorge L. Contreras and Joshua D. Sarnoff. 2017. "Solar Climate Engineering and Intellectual Property: Toward a Research Commons." *Minnesota Journal of Law, Science and Technology* 18 (1): 1–110.

Rivette, Kevin G. and David Kline. 2000. *Rembrandts in the Attic*. Cambridge, MA: Harvard Business School Press.

Tripsas, Mary. 2009. "Everybody in the Pool of Green Innovation." *New York Times*, November 1.

Van Hoorebeek, Mark and William Onzivu. 2010. "The Eco-Patent Commons and Environmental Technology Transfer: Implications for Efforts to Tackle Climate Change." *Climate Change Law & Regulation* 2010 (1): 13–29.

Wen, Wen, Marco Ceccagnoli and Chris Forman. 2013. "Patent Commons, Thickets, and Open Source Software Entry by Start-up Firms." NBER Working Paper No. 19394.

About CIGI

We are the Centre for International Governance Innovation: an independent, non-partisan think tank with an objective and uniquely global perspective. Our research, opinions and public voice make a difference in today's world by bringing clarity and innovative thinking to global policy making. By working across disciplines and in partnership with the best peers and experts, we are the benchmark for influential research and trusted analysis.

Our research programs focus on governance of the global economy, global security and politics, and international law in collaboration with a range of strategic partners and support from the Government of Canada, the Government of Ontario, as well as founder Jim Balsillie.

À propos du CIGI

Au Centre pour l'innovation dans la gouvernance internationale (CIGI), nous formons un groupe de réflexion indépendant et non partisan qui formule des points de vue objectifs dont la portée est notamment mondiale. Nos recherches, nos avis et l'opinion publique ont des effets réels sur le monde d'aujourd'hui en apportant autant de la clarté qu'une réflexion novatrice dans l'élaboration des politiques à l'échelle internationale. En raison des travaux accomplis en collaboration et en partenariat avec des pairs et des spécialistes interdisciplinaires des plus compétents, nous sommes devenus une référence grâce à l'influence de nos recherches et à la fiabilité de nos analyses.

Nos programmes de recherche ont trait à la gouvernance dans les domaines suivants : l'économie mondiale, la sécurité et les politiques mondiales, et le droit international, et nous les exécutons avec la collaboration de nombreux partenaires stratégiques et le soutien des gouvernements du Canada et de l'Ontario ainsi que du fondateur du CIGI, Jim Balsillie.

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