Innovation in clean/green technology: Can patent commons help?

Bronwyn H. Hall[1]

Christian Helmers[2]

August 2010

Abstract

This paper explores the differences between approximately 100 patents contributed by major innovators to the Eco-patent Commons, for which a non-assertion pledge has been signed, and patents in the same technologies or held by the same multinationals, in an effort to understand the motives of the contributing firms as well as the potential for such commons to encourage innovation in the climate change area. This study, therefore, indirectly provides evidence on the role of patents in the development and diffusion of green technologies. More generally, the paper sheds light on the performance of hybrid forms of knowledge management that combine open innovation and patenting.

Preliminary draft prepared for the IP Scholars Conference, Berkeley Center for Law and Technology, UC Berkeley, California, 12-13 August 2010. An earlier version of the paper was presented at the Workshop on Innovation without Patents, Sciences Po, Paris, 11-12 June 2010. Please do not cite without permission.

[1] University of Maastricht, UC Berkeley, UNU-MERIT, NBER, and IFS. bhhall@econ.berkeley.edu

[2] Oxford University and LSE. c.r.helmers@lse.ac.uk

Innovation in clean/green technology: Can patent commons help?

Bronwyn H. Hall[3]

Christian Helmers[4]

August 2010

Introduction

Numerous well-known economists have called for policies to encourage both public and private investment in technologies designed to mitigate climate change (Mowery et al. 2010; David et al. 2009; Krugman 2009; Arrow et al. 2008). As Nordhaus (2009), among others, points out, policy in this area confronts a double externality problem: the first is private underinvestment in R&D due to partial lack of appropriability and imperfections in the financial markets and the second is the fact that climate change mitigation and reduction in greenhouse gases is a classical public good, and one with a substantial international component. That is, the benefits of climate change mitigation flow largely to those who do not bear the costs. Hall and Helmers (2010) argue that the existence of the second externality can impact the desirability of policies designed to deal with the first externality, shifting policy makers' preferences towards subsidies and away from intellectual property protection.

To make this argument more explicit, consider the usual policies designed to close the gap between the private and social returns to an activity. These are subsidizing (or issuing tax credits for) the activity, regulating the activity (mandating its performance or controlling the price of inputs), and internalizing the externality by granting property rights that allow some appropriation of the social benefits. In the case of R&D investment, the first approach has been widely used in the past for research directed towards national needs (Mowery 2010), for corporate R&D via tax credits, and for small and medium-size enterprises (SMEs) that face credit constraints. Although the second approach has been used much less (and is probably less suitable for R&D activities due to their uncertainty and the difficulty of such micro-management), examples are the mandate of the State of California for sales of electric-powered automobiles (*reference needed*) and the U.S. federal government

[3] University of California at Berkeley and University of Maastricht. bhhall@econ.berkeley.edu

[4] Oxford University and LSE. c.r..helmers@lse.ac.uk

stimulus package, which mandates the diffusion of electronic medical records and their effective use (*reference needed*).

The most widely available policy designed to encourage private R&D investment in most countries is the intellectual property system. However, in the case of climate change mitigation (as in the case of R&D directed toward other national needs), allowing firms to appropriate social benefits via their market power and pricing behavior has the drawback that without further policy design, it will tend to inhibit the diffusion of the technologies whose creation it encourages. Given the second externality, such diffusion is highly desirable. The conclusion is that the IP system, specifically the patent system, may not be the optimal policy to encourage R&D in this area.

A number of large firms (Sony, IBM, Nokia, etc.) appear to have recognized the problem with patents in this area and have created an eco-patent commons together with the World Business Council for Sustainable Development (http://www.wbcsd.org/). Firms donating patents to this commons are required to sign a non-assertion pledge. The purpose of this commons is described on their website as the following:

- To provide an avenue by which innovations and solutions may be easily shared to accelerate and facilitate implementation to protect the environment and perhaps lead to further innovation.
- To promote and encourage cooperation and collaboration between businesses that pledge patents and potential users to foster further joint innovations and the advancement and development of solutions that benefit the environment.

Obviously, one can imagine an additional purpose: to improve the reputation and public relations of the participating firms at relatively low cost, possibly by contributing patents on inventions of little value. Alternatively, the patents contributed could be those on inventions that need development effort that the firms in question are not willing to undertake. To date, there are 11 participating firms, and 100 patents have been contributed to the commons.[5] Relative to the size of these firms" patent portfolios, this is a fairly small number; however, it could be large given the small share of climate-change related patents in total patenting.[6]

There has been some discussion in the strategic management literature on patent pledges in the context of software. Alexey and Reitzig (2010), for example, argue that firms may

[5] The figure excludes pledged equivalents. The firms that have contributed to date are Bosch, Dow, DuPont, Fuji-Xerox, IBM, Mannesmann, Nokia, Pitney Bowes, Ricoh, Sony, Taisei and Xerox.

[6] In fact, the 87 unique priorities accounted for by these patents are 0.15 per cent of the priorities claimed by these firms between 1989 and 2006. The share ranges from 0.5 per cent for Pitney-Bowes to negligible for Ricoh, Sony, Nokia, and Dow. The same patents are about one per cent of the priorities in the corresponding IPC classes.

choose to pledge patents to mould the wider appropriability regime that governs their business activity. Using software patents as an example, the authors argue that firms which stand to profit from the open source software concept through the production of complementary assets, such as IBM and Nokia, choose to unilaterally pledge patents in order to create an appropriability regime conducive to the open source movement. The establishment of a patent commons would seem consistent with this reasoning as it would enable firms to address the collective action problem involved in shifting the appropriability regime. Nevertheless, the underlying assumption in this argument is that firms pledge "valuable" patents.

Biotechnology offers another example of a similar initiative: the BiOS (Biological Open Source) initiative by the not-fot-profit institute CAMBIA. In the case of BiOS, firms may use patented technologies royalty-free but agree to "share with all BiOS licensees any improvements to the core technologies as defined, for which they seek any IP protection" and "agree not to assert over other BiOS licensees their own or third-party rights that might dominate the defined technologies" (Jefferson, 2006: 459)

Van Hoorebeek and Onzivu (2010) regard the EcoPC initiative as a private response to calls by mostly developing countries for increased climate change related technology transfer. As such, the EcoPC initiative may help deflect increasing pressure exerted by developing countries to apply TRIPS provisions including compulsory licensing or even denying patent protection to specific climate change related to technologies. But again, for this strategy to be viable, patents pledged under the EcoPC initiative should protect enforceable and "valuable" technologies.

Given the possible and varied explanations for these public domain patent donations, we would like to know more about them and the technologies that they cover – are they likely to be valuable? Will they lead to innovations that may diffuse more broadly than otherwise? Or is it a dead end, where lack of patent protection will nip potential innovation in the bud due to a perceived lack of available financial returns? The present paper explores the characteristics of the patents that have been contributed to the eco-patent commons and compares them to two other sets of patents: 1) patents held by the donating firms that are not donated to the commons and 2) a randomly drawn set of patents in the same technology. The first comparison can shed some light on the question of where these patents fit in the firms' portfolios, whereas the second may inform us about how the value of these patents compares with other similar patents that have not been donated to the commons.

To this end we have assembled all of the Patstat data on the contributed patents and a set of alternative patents in the same technology classes, as well as all the patents held by the contributing firms. We believe that a detailed study of such patents will provide insights into the open innovation-patenting relationship in the climate change technology area, insights that may also be useful in other areas where open innovation exists side-by-side with IP protection.

Comments by participants in and observers of the ecopatent initiative suggest some of the conflicting interpretations that we would like to examine using our data:

> [I]t is clear that the donating company did not find the patent to have compelling competitive advantage for them, or they would not have donated it to begin with, so why would any other company necessarily find value in the donated patent?
>
> (Nancy Cronin, Greenbizz - April 2008)
>
> Why would a patent owner contribute a patent, continue to sustain the maintenance costs, yet have the patent commonly available to all having undertaken to not enforce the patent? Why not just allow the patent to lapse (telling the world that you"re doing that to free-up availability of the technology for the greater good to bank the PR benefit)?
>
> (Duncan Bucknell, Think IP Strategy - March 2008)
>
> [P]ledging patents for free use by others is not necessarily a common way companies think about their portfolio of intellectual property [...]. It can be a win for innovators in other parts of the world, who might look at these ideas and further them and use them as the basis of additional solutions. And it can be a win for those who pledge because it could open up opportunities to collaborate with people that you might not otherwise have collaborated with.
>
> (Wayne Balta, Vice President of Environmental Affairs, IBM)
>
> The Eco-Patent Commons offers an effective framework to develop and make available technology that helps combat climate change and reduce the release of carbon dioxide. Our objective for the Eco-Patent Commons is to promote the spread of environmentally conscious technologies that make conservation and preservation a priority.
>
> (Angelo Chaclas, Vice President, Pitney Bowes)

We begin the paper with a discussion of the history and detailed operation of the eco-patent commons,……….

The eco-patent commons

The initial creation of the not-for-profit initiative "Eco-Patent Commons" (EcoPC) is quite recent, in January 2008. It was established by IBM in cooperation with the World Business Council For Sustainable Development (WBCSD) and it allows companies to pledge patents that protect green technologies. Companies as well as individuals can join the commons by pledging at least one patent.[7] Any patent is welcome that protects a technology that confers directly or indirectly some environmental benefit – so-called green patents. "Green" is defined by a classification listing IPC subclasses that are considered to describe environmentally friendly technologies. Yet there appears to exist considerable flexibility as long as a pledging firm can show some (direct or indirect) environmental benefit of the pledged patent. In fact, as we show later, many of the patents contributed appear to be directed towards mitigating environmental damage from manufacturing, but not specifically towards climate change mitigation.

"Pledge" in this context means making patents available for use by third parties free of charge, although the ownership right remains with the pledging party which distinguishes the EcoPC from conventional patent commons. This also implies that the non-assertion pledge cannot be treated as a patent donation and hence the pledged patent is not deductable from a company's taxable income. Potential users do not have to specifically request a license; any pledged patent is automatically licensed royalty-free provided it is used in a product or process that produces some environmental benefit.

While a pledge is in principle irrevocable,[8] there is a built-in mechanism to safeguard a pledging firm's business interests which is called "defensive termination". This means that a pledging firm can "terminate" the non-assertion pledge if a third party that uses a pledged patent asserts its own patent against the pledging company. The possibility to invoke "defensive termination" does not apply to other pledging firms in the commons unless the primary IPC of the asserted patent is on the commons IPC classification list. Hence, even other members of the commons do not benefit from unconditional royalty-free access to the pledged patents. The fact that companies retain ownership rights also means that they have to bear the cost of maintaining the IP right, that is, they must pay any fees required to keep the patent in force.

The initial members of the commons when it was launched in January 2008 were IBM, Nokia, Pitney Bowes, and Sony. In September 2008, Bosch, DuPont, and Xerox joined. Ricoh and Taisei entered the commons in March 2009 and Dow Chemical and Fuji-Xerox in

[7] According to the "Ground Rules" (http://www.wbcsd.org/web/projects/ecopatent/EcoPatentGroundRules.pdf), also "any worldwide counterparts" to the pledged patent are considered to be subject to the non-assertion pledge, i.e., any equivalents to the pledged patent.

[8] The "Ground Rules" (http://www.wbcsd.org/web/projects/ecopatent/EcoPatentGroundRules.pdf) stipulate that "[a] patent approved for inclusion on the Patent List cannot be removed from the Patent List, except that it may be deleted for so long as the patent is not enforceable." However, firms obviously can withdraw from the commons at any point in time, although even in this case "[v]oluntary or involuntary withdrawal [from the commons] shall not affect the non-assert as to any approved pledged patent(s) the non-assert survives and remains in force."

October 2009. All patents pledged to the EcoPC are listed in an online data-base (the data base is reproduced in Appendix A1).

The official objective of the EcoPC is to promote the sharing of climate-change related technologies and thus to assist in environmental protection for the common good. The initiative targets green patents that are either not used or do not represent "an essential source of business advantage" to their owners. Hence, the commons should attract those patents that are neither "worked" nor confer a strategic value to the company even as a "dormant" property right. The initiative endeavours to emphasize potential business benefits for firms from participating in the commons: it can serve as way of diffusing a technology and potentially lead to new collaboration and business opportunities.

> "For companies who choose to participate in this, this can be a catalyst for further innovation and collaboration. [...] it becomes an efficient channel for sharing this knowledge that you have with others so that you make known to others that you have had demonstrable expertise on a given technical problem. And you stand ready to work with them and help diffuse it further."
>
> (Wayne Balta, Vice President of Environmental Affairs, IBM)

But most importantly, participation in the scheme guarantees broad public visibility considering the great deal of (mostly positive) attention in the press the initiative has received so far (NY Times 31 October 2009; Wall Street Journal 14 January 2008; WIPO Magazine April 2009) and innumerable postings and discussions in blogs and climate-change/open-innovation online forums.

EcoPC is currently the only initiative of this type, although Creative Commons in collaboration with Nike and Best Buy is setting up the Green Xchange initiative. In contrast to the EcoPC, pledging firms can choose whether to charge a fixed annual fee for the use of a pledged patent. Contributing firms can also selectively deny other firms the use of a pledged patent. In addition, registration of users of contributed patents is mandatory.

The EcoPC initiative has been discussed extensively in the web community and several, mostly popular press contributions. For example, the Wall Street Journal (14 Januray 2008) notes that the environmental benefit is not obvious for some of the EcoPC patents. As a case in point, the press article provides the example of a patent pledged by Pitney Bowes "that protects electronic scales from being damaged when they are overloaded."[9] In a review of the EcoPC initiative, Srinivas (2008) lists a number of problems with the initiative. He argues that the technologies protected so far by patents in EcoPC "have a very limited application in the further development of technologies in key sectors." However, he does

[9] This patent is a bit of an exception. It is the only one of the patents for which we also could not ascertain the environmental benefit easily. It seems that there is some energy-saving consequence to preventing overload on electronic scales.

not provide any proof for this assertion. Related to this, he claims that more important players in the market for climate-change related technologies have to join the commons in order to make it an effective tool for the dissemination of relevant technologies. He is also sceptical that simply providing royalty-free access to single green patents will have a significant impact on the diffusion of green technologies as most technologies are covered by multiple patents which are not included in the commons. Cronin (2008) argues in her article in Greenbizz that the patents contained in the EcoPC are of little value as they protect outdated technologies. As a solution to this problem, Cronin suggests including novel non-patented inventions that have not been made public before, presumable because they were protected via trade secrecy. This could be done in the form of defensive publications.

The most puzzling aspect of the structure of the commons is highlighted in the first two quotes at the head of this section. Why would firms find it worthwhile to allow non-exclusive royalty-free licenses to a set of patents while simultaneously incurring the cost of keeping them in force? Why not simply allow the patents to lapse, effectively publishing the contents defensively? Is the value of possible defensive termination against future threats that large? Inter alia, our paper attempts to form an impression of whether these patents are still in force, and what kinds of cost these firms are incurring.

Data and descriptive statistics

The data appendix A describes in detail how we created our dataset and control samples. We started with the list of 119 patents contributed to the ecopatent commons by the 12 contributing firms. We then used the April 2010 edition of PATSTAT (*reference*) to draw the following samples of patents:

1. All of the patents that share a priority with these patents. The priority years ranged from 1989 to 2005, so we restricted the matching samples to those years.
2. Control (1) sample: all of the patent applications worldwide that were made by one of the 12 firms.
3. Control (1) sample: all of the patent applications worldwide made by firms in the same IPC class as one of the 119 eco-patents.

A number of complications arose in performing these tasks. First, PATSTAT is based on published applications, whether or not the patents have been granted. This is an advantage because of most our eco-patents are of fairly recent date and may not yet have been granted. However, not all US application are published at 18 months, especially in the earlier part of our sample. Even if they are published, it appears that some firms leave the assignment of ownership off the application until the patent issues, so we will not find all the patent applications that correspond to a given firm. We test whether this makes a difference for the control (2) sample later in the paper.

A second problem is missing priorities. Many of these patents have multiple equivalents, which are patents applied for in several jurisdictions on the same invention. We prefer to perform our analysis using only a single observation for each "invention," preferably the priority application. However a large number of patents are missing priorities and in this case we simply allowed the patent to serve as its own priority, effectively keeping it as a single patent with no equivalents. We have checked this assumption using the equivalents data constructed by Harhoff and co-workers and found that it introduces very little error into the data.[10]

In this section of the paper we present some basic information about the patents contributed to the commons: their ages, legal status, priority authorities, family sizes, the technology areas, and the firms contributing them. Table 2 shows the number of patents contributed by each of the 12 firms, both uncorrected and corrected for equivalents. These patents are a tiny share of the firm's portfolio (less than 0.1 per cent) and the majority of the patent families (81 out of 96) have been contributed by four firms: Bosch, DuPont, IBM, and Xerox. In appendix Table A3 we show that in almost all cases the priority patent was applied for at the USPTO, the German PO, or the JPO, and in most cases at the office corresponding to the headquarters of the applicant. Table 2 also shows the date that each firm entered the commons; to the best of our knowledge this is also the date that all their patents were contributed. The dates are all quite recent, so we have only two years at most to observe these patents after donation, with the inevitable consequence that our analysis will be quite preliminary, but we believe it is useful to set the stage for subsequent analysis performed after some more time has passed.

Table 3 gives a rough idea of the technologies that have been contributed. This table is based on a reading of the abstract and written description of these patents, with a special focus on the description of the problem to be solved, in order to determine their likely application. Two related observations about the data in this table suggest themselves: first, only slightly more than one-third of these patents fall into classes that are designated as a clean technology class by the OECD-EPO definition (Johnstone *et al.* 2010). Second, many of them seem to be related to environmental cleanup or clean manufacturing, and only tangentially to mitigating the effects of global climate change.

The ages of the contributed patents at the time of their donation vary widely. A few are old and nearing the end of their life, but many have substantial statutory life remaining (Figure

---

[10] All the additional equivalents for our eco-patents that were found this way were for unpublished patent applications, which are not in our sample. See http://www.inno-tec.bwl.uni-muenchen.de/forschung/forschungsprojekte/patent_cit_project/index.html for the equivalents data.

1). Age is measured as the exact date the owning firm joined the commons less the exact priority date of the patent. In general, the statutory life of the patents will be twenty years from the date of application (which often coincides with the priority date), and we find a range from 3 years to 20 year, with a peak at 4 years of age. This is suggestive, as most patents are granted by the time the application is four years old, and this age also corresponds roughly to the time when much uncertainty about potential value of the invention is likely to have been resolved (*reference Pakes and Schankerman?*).[11]In Figure 2, we show the priority years of the contributions as a share of the 12 firms' patents and also as a share of patents in the relevant classes. Both follow the same pattern, with a slow decline between 1989 and 2003, and then a sharp increase in contribution rate in the years 2004 and 2005.

One of the questions raised by the commentators quoted in the introduction was whether and why firms would pay to keep a patent in force once it was contributed to the commons. Because many of the donations are quite recent, it is difficult to observe whether firms have chosen to pay renewal fees on their patents after they have been donated. It is also the case that many of these patents have not even been granted as of April 2010. In Table 4, we look at the legal status of all the equivalent patents as reported in PATSTAT (April 2010 edition). It appears that almost 60 per cent have been granted and are still in force, 13 per cent are pending, and almost 30 per cent are withdrawn, rejected by the relevant office, or have expired.[12] So in fact it does appear that in some cases the applicants have chosen to abandon the donated patents before their statutory term has expired, or have chosen not to prosecute them agressively.

Subsequent analysis will compare the legal status of patents in the same classes, and held by the same firms.

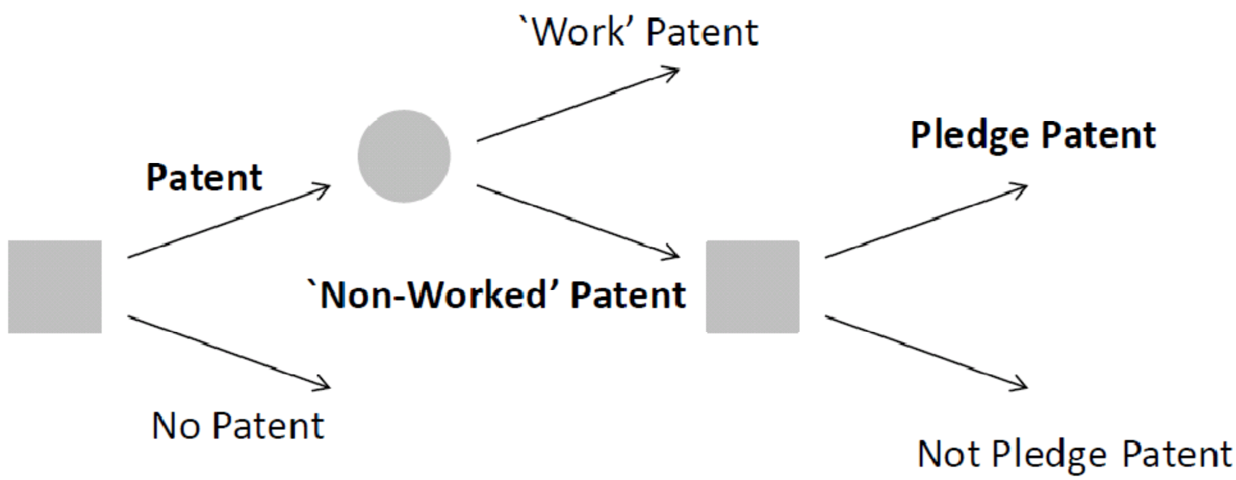
Why do firms contribute?

Figure 1 shows schematically the decision tree of a firm contemplating working a patent or abandoning it.

[11] EPO patents typically take longer to grant than four years, but are relatively underrepresented in our sample, which consists primarily of USPTO, German PO, and Japanese PO patent applications and grants.

[12] As best we can determine, the NA category corresponds to those patent applications that have not yet been examined by the relevant office, either because they are newer, or, in some cases, because examination was not requested by the applicant.

Figure 1: Firm's decision tree



Unfortunately, we only observe some of these decisions. Among the four final outcomes (a - no patent, b - work the patent, c - pledge the patent, d - neither work nor pledge the patent), we observe only c and the combination of b and d. This limits our ability to build a structural model of the decision process. Conditional on patenting, we can however say the following:

1. The firm is more likely to work the patent if it is valuable, if more resources were invested in acquiring it, and if it is related to the firm's own line of business or technology expertise.
2. The firm is more likely to pledge a patent if it is environmentally friendly (obviously), if it is less related to the firm's own line of business or technology expertise, and if it is not suitable for licensing.

Taken together, this suggests that a firm's pledged patents will be less valuable, more "green", and less related to the firm's patent portfolio. We might also expect that these patents are less likely to be prosecuted aggressively if they have not yet issued, and that they are less likely to remain in force.

Regression results to come. Preliminary results show that these patents are similar to the other patents held by the firm, except that they have more backward references, are slightly narrower, and are more distant from the rest of the firm's portfolio.

Conclusions

To be added……

References

Alexy, O., and M. G. Reitzig, (2010). “Gaining it by Giving it Away: Capturing Value in "Mixed" Appropriability Regimes”, available at SSRN: http://ssrn.com/abstract=1430328

Arrow, K. J., , L. Cohen, P. A. David et al. (2008). “A statement on the appropriate role for Research and Development in climate policy,” *The Economists” Voice* 6(1). http://www.bepress.com/ev/vol6/iss1/art6

David, P. A., C. Huang, L. Soete, and A. van Zorn (2009). “Toward a global science and technology policy agenda for sustainable development.” Maastricht, Netherlands: UNU-MERIT Policy Brief No. 4.

Hall, B. H., and C. Helmers (2010). “The role of patent protection in (clean) technology transfer,” *Santa Clara High Technology Law Journal*, forthcoming.

Jefferson, R. (2006). “Science as social enterprise: the Cambia Bios initiative.” Innovations: Technology, Governance, and Globalization, 1(4), 13–44.

Johnstone, N., I. Hascic, and F. Watson (2010). Climate policy and technology innovation and transfer: an overview of recent results. Paris: OECD Report ENV/EPOC/GSP(2020)10.

Krugman, P. (2009). “It’s easy being green,” New York Times, 25 September 2009. http://www.nytimes.com/2009/09/25/opinion/25krugman.html?_r=1

Martinez, C. (2010): `Insight into Different Types of Patent Families,’ OECD Science, Technology and Industry Working Papers, 2010/2, OECD Publishing. doi: 10.1787/5kml97dr6ptl-en

Mowery, D. C. (2010). Military R&D and innovation. In Hall, B. H., and N. Rosenberg (eds.), *Handbook of the Economics of Innovation*, Volume II, 1218-1251. Amsterdam: Elsevier.

Mowery, D. C., R. R. Nelson, and B. Martin (2009). Technology policy and global warming. London, UK: NESTA Provocation 10.

Nordhaus, W. D. (2009). “Economic issues in a designing a global agreement on global warming.” Keynote Address at the Climate Change Conference, Copenhagen, Denmark, March 10-12, available at http://nordhaus.econ.yale.edu/documents/Copenhagen_052909.pdf

Van Hoorebeek, M., and W. Onzivu (2010). “The Eco-patent Commons and Environmental Technology Transfer: Implications for Efforts to Tackle Climate Change,”Carbon and Climate Law Review, Vol. 1, pp. 13-29.

Data Appendix

A 1: List of Patents contained in Eco Patent Commons

#	Description	Number	Equivalents	Pub Auth	Company	IPC
1	Fuel injection valve for internal combustion engine, with actuator acting via needle carrier on valve needle	EP 1084344	DE19915210, EP 1084344, JP2002541375, US6575385	Germany	Bosch	B05B001-08
2	Fuel injection valve for internal combustion engine, with actuator acting via needle carrier on valve needle	US6575385	DE19915210, EP 1084344, JP2002541375, US6575385	Germany	Bosch	B05B001-08
3	Fuel injection valve for internal combustion engine, with actuator acting via needle carrier on valve needle	DE19915210	DE19915210, EP 1084344, JP2002541375, US6575385	Germany	Bosch	B05B001-08
4	Fuel injection valve for internal combustion engine, with actuator acting via needle carrier on valve needle	JP2002541375	DE19915210, EP 1084344, JP2002541375, US6575385	Germany	Bosch	B05B001-08
5	Piezoelectric fluid viscosity sensor	EP1393041	DE10123040, WO2002093136, EP1393041, JP2002093136, US6755073	Germany	Bosch	G01N011-16
6	Piezoelectric fluid viscosity sensor	*JP2004519695*	DE10123040, WO2002093136, EP1393041, JP2002093136, US6755073	Germany	Bosch	G01N011-16
7	Piezoelectric fluid viscosity sensor	DE10123040	DE10123040, WO2002093136, EP1393041, JP2002093136, US6755073	Germany	Bosch	G01N011-16
8	Piezoelectric fluid viscosity sensor	*WO02093136*	DE10123040, WO2002093136, EP1393041, JP2002093136, US6755073	Germany	Bosch	G01N011-16
9	Piezoelectric fluid viscosity sensor	US6755073	DE10123040, WO2002093136, EP1393041, JP2002093136, US6755073	Germany	Bosch	G01N011-16
10	Climate control system in vehicle with heating and cooling circuits	EP1536961	DE50304975, EP1536961, KR2005048623, US20060081355		Bosch	B60H001-00
11	Climate control system in vehicle with heating and cooling circuits	*DE10240712*	DE50304975, EP1536961, KR2005048623, US20060081355		Bosch	B60H001-00
12	Climate control system in vehicle with heating and cooling circuits	*KR20050048623*	DE50304975, EP1536961, KR2005048623, US20060081355		Bosch	B60H001-00
13	Climate control system in vehicle with heating and cooling circuits	US20060081355	DE50304975, EP1536961, KR2005048623, US20060081355		Bosch	B60H001-00
14	Apparatus for removing contaminants from a	1070555		Europe	Xerox	B09C

	contaminated area					
15	Image Forming Device	3375028		Japan	Ricoh	G03G
16	Method for recycling optical disks	3528898		Japan	Sony	B01D
17	The purification method and purges of shallow water regions	3561890		Japan	Taisei	C02F
18	Metallic reflection film recovering device of disklike information recording M medium and its metallic reflection film recording method	3704899		Japan	Sony	B01D
19	Method and device for extracting groundwater using high vacuum	3095851		Japan	Xerox	E03F
20	Recycling of disk-like information	3855377		Japan	Sony	B08B
21	Flocculating agent and a method for flocculation	3876497		Japan	Sony	B01D
22	Method and apparatus for removing contaminant	3805414		Japan	Xerox	B09C
23	Process for removing contaminants and apparatus therefore	3884793		Japan	Xerox	B09C
24	Device for extracting contaminated material from discharged stream and method thereof	3971480		Japan	Xerox	B09C
25	The constructing method of the artificial green space of the watersides	4015958		Japan	Taisei	E02B
26	Motor cable with ferromagnetic casing	DE4027948	DE4027948, BR 9103806, JP324225, US5197444		Bosch	F02D033-00
27	Motor cable with ferromagnetic casing	BR9103806	DE4027948, BR 9103806, JP324225, US5197444		Bosch	F02D033-00
28	Motor cable with ferromagnetic casing	*JP3242425*	DE4027948, BR 9103806, JP324225, US5197444		Bosch	F02D033-00
29	Motor cable with ferromagnetic casing	US5197444	DE4027948, BR 9103806, JP324225, US5197444		Bosch	F02D033-00
30	Hydraulic drive for sheet metal forming machine	4218952		Germany	Bosch	B03B015-18
31	Channel-scanning cordless telephone appts. with microprocessor- begins scanning with particular radio channel assigned to mobile and base stations among number of channels selected by operator.	DE4241838	DE4241838, EP626118, JP3466190, KR274286	Germany	Bosch	H04B007-26
32	Channel-scanning cordless telephone appts. with microprocessor- begins scanning with particular radio channel assigned to mobile and base stations among number of channels selected by operator.	*EP0626118*	DE4241838, EP626118, JP3466190, KR274286	Germany	Bosch	H04B007-26
33	Channel-scanning cordless telephone appts. with microprocessor- begins scanning with particular radio channel assigned to mobile and base stations among number of channels selected by operator.	JP3466190	DE4241838, EP626118, JP3466190, KR274286	Germany	Bosch	H04B007-26
34	Channel-scanning cordless telephone appts. with microprocessor- begins scanning with particular radio channel assigned to mobile and base stations among number of channels selected by operator.	*KR100274286*	DE4241838, EP626118, JP3466190, KR274286	Germany	Bosch	H04B007-26
35	Method of anisotropically etching silicon wafers and wafer etching solution	4941941		United States	IBM	H01L
36	Water soluble solder flux and paste	5011546		United States	IBM	B23K
37	Process for two phase vacuum extraction of	5050676		United	Xerox	E21B

	soil contaminants			States		
38	Tape drive cleaning composition	5080825		United States	IBM	C11D
39	Process and Apparatus For Groundwater Extraction Using a High Vaccum Process	5172764		Germany	Xerox	E21B
40	Apparatus for two phase vacuum extraction of soil contaminants	5197541		United States	Xerox	E21B
41	Catalyst Method for the Dehydrogenation of Hydrocarbons	5258348		United States	Dow	B01J
42	Chemical pre-treatment and biological destruction of propylene carbonate waste streams effluent streams to reduce the biological oxygen demand thereof	5275734		United States	IBM	C02F
43	Solvent stabilization process and method of recovering solvent	5310428		United States	IBM	B08B
44	Supported Catalyst for Dehydrogenation of Hydrocarbons and Method of Preparation of the Catalyst	5354935		United States	Dow	C07C
45	Process and apparatus for high vaccum groundwater extraction	5358357		United States	Xerox	E03B
46	Packaging system for a component including a compressive and shock-absorbent packing insert	5439779		United States	IBM	G03C
47	Apparatus and process for treating contaminated soil gases and liquids	5441365		United States	Xerox	B09B
48	Dual wall multi-extracion tube recovery well	5464309		United States	Xerox	E03B
49	Ink-jet printer having variable maintenance algorithm	5521334		United States	Pitney Bowes	G01G
50	Aqueous soldermask	5571417		United States	IBM	C02F
51	Method for treating photolithographic developer and stripper waste streams containing resist or solder mask and gamma butyrolactone or benzyl alcohol	5637442		United States	IBM	B01D
52	Magnetic Refrigerant Compositions and Processes for Making and Using	5641424		United States	Xerox	G03G
53	High vacuum extraction of soil contaminants along preferential flow paths	5655852		Europe	Xerox	E02D
54	Highly sensitive method for detecting environmental insults	5683868		United States	DuPont	C12Q, C12N
55	Lyophilized bioluminescent bacterial reagent for the detection of toxicants	5731163		United States	DuPont	C12Q, C12N
56	Method for treating photolithographic developer and stripper waste streams containing resist or solder mask and gamma butyrolactone or benzyl alcohol	5824157		United States	IBM	B05C
57	Fluid jet impregnation	5863332		United States	IBM	B05C
58	Vacuum application method and apparatus for removing liquid contaminants from groundwater	5979554		United States	Xerox	E21B
59	Fluid jet impregnating and coating device with thickness control capability	5994597		United States	IBM	C07C
60	Process for recovering high boiling solvents from a photolithographic waste stream comprising less than 10 percent by weight monomeric units	6021402		United States	IBM	G06F
61	Air flow control circuit for sustaining vacuum conditions in a contaminant extraction well	6024868		United States	Xerox	C02F
62	Multiple overload protection for electronic scales	6045206		United States	Pitney Bowes	G07B
63	Automatic aspirator air control system	6048134		United States	Xerox	B09B

64	Risk management system for electric utilities	6127097		United States	IBM	G03F
65	Photoresist develop and strip solvent compositions and method for their use	6178973		United States	IBM	B08B
66	Method and apparatus for ozone generation and surface treatment	6187965		United States	IBM	C07C
67	Process for recovering high boiling solvents from a photolithographic waste stream comprising at least 10 percent by weight of monomeric units	6197267		United States	IBM	F01N
68	Catalytic reactor	6210862		United States	IBM	G03F
69	Composition for photoimaging	6221269		United States	IBM	C03C
70	Method of etching molybdenum metal from substrates	6294028		United States	IBM	C23G
71	Mercury process gold ballbond removal apparatus	6419566		United States	IBM	B24C
72	System for cleaning contamination from magnetic recording media rows	6426007		United States	IBM	C02F
73	Removal of soluble metals in waste water from aqueous cleaning and etching processes	6440639		United States	IBM	G03C
74	Method for deterring drive voltage of fuel injection valve piezoelectric actuator	US6499464	DE10032022, GB2364400, JP2002070683, US6499464, FR2811016		Bosch	F02D041-20
75	Method for deterring drive voltage of fuel injection valve piezoelectric actuator	DE10032022	DE10032022, GB2364400, JP2002070683, US6499464, FR2811016		Bosch	F02D041-20
76	Method for deterring drive voltage of fuel injection valve piezoelectric actuator	GB2364400	DE10032022, GB2364400, JP2002070683, US6499464, FR2811016		Bosch	F02D041-20
77	Method for deterring drive voltage of fuel injection valve piezoelectric actuator	JP2002070683	DE10032022, GB2364400, JP2002070683, US6499464, FR2811016		Bosch	F02D041-20
78	Method for deterring drive voltage of fuel injection valve piezoelectric actuator	FR2811016	DE10032022, GB2364400, JP2002070683, US6499464, FR2811016		Bosch	F02D041-20
79	High-aspect ratio resist development using safe-solvent mixtures of alcohol and water	6503874		United States	IBM	B08B
80	Cleaning method to remove flux residue in electronic assembly	6576382		United States	IBM	G03F
81	Composition for photoimaging	6585906		United States	IBM	B44C
82	Cellular Arrays for the Identificaiton of Altered Gene Expression	6716582		United States	DuPont	C12Q
83	Method for recycling a disk having a layered structure on a glass substrate	6800141		United States	IBM	B08B
84	Semi-aqueous solvent based method of cleaning rosin flux residue	6891640		United States	IBM	G06K
85	Apparatus and method for reusing printed media for printing information	6997323		United States	IBM	B65D
86	Method to accelerate biodegration of aliphatic-aromatic copolyesters by enzymatic	7053130		United States	DuPont	C08G, C08J

	treatment					
87	Systems and methods for recycling of cell phones at the end of life	7251458		United States	Nokia	H04B
88	1,1,1,2,2,4,5,5,5- Nonafluoro-4-(Trifluoromethyl)-3-Pentanone Refrigerant Compositions Comprising a Hydrofluorocarbon and Uses Thereof	7314576		United States	DuPont	C09K
89	1,1,1,2,2,4,5,5,5- Nonafluoro-4-(Trifluoromethyl)-3-Pentanone Refrigerant Compositions Comprising a Hydrocarbon and Uses Thereof	7332103		United States	DuPont	C09K
90	1,1,1,2,2,4,5,5,5- Nonafluoro-4-(Trifluoromethyl)-3-Pentanone Refrigerant Compositions Comprising a Hydrofluorocarbon and Uses Thereof	7338616		United States	DuPont	C09K
91	1,1,1,2,2,3,3,4,4- Nonafluoro-4-Methoxybutane Refrigerant Compositions Comprising Functionalized Organic Compounds and Uses Thereof	7351351		United States	DuPont	C09K
92	1,1,1,2,2,3,3,4,4- Nonafluoro-4-Methoxybutane Refrigerant Compositions Comprising a Hydrofluorocarbon and Uses Thereof	7354529		United States	DuPont	C09K
93	Protecting exhaust gas conducting parts of IC engine	10211152		Germany	Bosch	F02B005-02
94	Electric current generator for motor vehicle	10214614		Germany	Bosch	H02K007-116
95	Mapping route in navigation system	102004022265		Germany	Bosch	G01C02-34
96	Production of a filter element of a particle filter for an internal engine	102004028887		Germany	Bosch	B01D039-00
97	Production of region of filter structure for a particle filter	102004035310		Germany	Bosch	B01D039-20
98	Device for fuel-saving through electrical energy management controls load(s)	102004038185		Germany	Bosch	H02J001-00
99	Filter for removing particles from a a gas stream	102004044338		Germany	Bosch	B01D046-24
100	Equalizing process for Lambda values of engine cylinders	102005005765		Germany	Bosch	F02D041-14
101	Varnishing unit, especially for valve housing	102005006457		Germany	Bosch	B05B005-08
102	Filter device, for an exhaust system of an internal combustion engine	102005006502		Germany	Bosch	F01N003-021
103	Exhaust gas sooty particles filter for diesel internal combustion engines	*102005035593*		Germany	Bosch	B01D046-02
104	Device for energy supply to hybrid motor vehicle	102005042654		Germany	Bosch	B60K006-04
105	Particle filter for e.g. diesel engine	102005046051		Germany	Bosch	F01N003-28
106	Illuminated emergency exit sign, for a building	202004012616		Germany	Bosch	G09F013-18
107	Motor cable with ferromagnetic casing	DE19963301	DE19963301, US20010020542	Germany	Bosch	H01B005-18
108	Motor cable with ferromagnetic casing §	US20010020542	DE19963301, US20010020542	Germany	Bosch	H01B005-18
109	Particle filter bag for use in internal combustion engine	*DE102005042207*		Germany	Bosch	F01N003-022
110	Hydrofluorocarbon Refrigerant Compositions and Uses Thereof	7413675		United States	DuPont	C09K
111	1,1,1,2,2,4,5,5,5-Nonafluoro-4-(Trifluoromethyl)-3-Pentanone Refrigerant Compositions Comprising a Hydrofluorocarbon and Uses Thereof	7479239		United States	DuPont	C09K
112	Wastewater Treatment Process	4140449		Japan	Fuji-Xerox	C02F
113	Wastewater Treatment Process	7468137		United States	Fuji-Xerox	C02F
114	Improved process and apparatus for high vacuum groundwater extraction	0622131		Europe	Xerox	B09C

115	Vertical isolation system for two-phase vaccum extraction of soil and groundwater contaminants	*5709505*		United States	Xerox	E21B
116	Vertical isolation system for two-phase vacuum extraction of soil and groundwater contaminants	0747142		Europe	Xerox	B09C
117	Improved apparatus for high vacuum groundwater extraction	0775535		Europe	Xerox	B09C
118	Apparatus and methods for removing contaminants	*0792700*		Europe	Xerox	B09C
119	Improved process and apparatus for groundwater extraction using a high vacuum process	*0498676*		Europe	Xerox	E03F
120	Apparatus for removing liquid contaminants	0911071		Europe	Xerox	B01D
121	Producing particulates filter	102005032842		Germany	Bosch	B22F003-105

Notes:

1) Corrected numbers in italic red.

2) Shaded rows are missing in our dataset.

3) §: Patent abandoned

A 2: Construction of core dataset

The table in A 1 is used to extract additional information on these Eco Patent Commons (EcoPC) patents from the European Patent Office (EPO) Worldwide Patent Statistical Database (PATSTAT) version September 2008. PATSTAT combines patent information from several sources: DocDB (the EPO master bibliographic database containing abstracts and citations), PRS (the patent register for legal data), EPASYS (the database for EP patent grant procedure data), and the EPO patent register as well as the USPTO patent database for names and addresses of applicants and inventors.

In a first step, we extract all patents from PATSTAT with the same publication number as an EcoPC patent. In a second step, we also match the publication authority and keep the record in PATSTAT that is at the most advanced stage of the grant process as indicated by its patent's publication kind. For example in the case of the US, if both A1 (first published patent application) and B1 (granted patent as first publication) documents are available,[13] we focus on the B1 document.

We then add a range of information covering the application, publication, IPC codes, applicant and inventor, priorities, and patent families as defined in DOCDB and INPADOC (for more information on patent families see Martinez, 2010). We also include backward and forward citations as well as citations of non-patent documents. Since forward citations are truncated by the Patstat version that we are using, we collect in addition the most recent forward citations from Espacenet.[14] We face the same issue in determining whether an EcoPC has been granted. Thus, we also collect the most recent available publication kind from Espacenet in order to create an indicator variable showing whether a patent has been granted. In addition, we collect information on the legal status of EcoPC patents from a various sources, including INPADOC, IPDL, KIPRIS, DPinfo, INPI, and USPTO PAIR.

A 3: Construction of comparison sample 1 (patents from same applicant)

We use a list of standardized firm names of companies that have pledged patents to the EcoPC to extract all other patents assigned to these firms from PATSTAT. We extract the same range of information on these control patents as for the core EcoPC patents (see description in A 2).

Count	Firm Name (standardized)	# Patents in EcoPC	# Patents in PATSTAT
1	Bosch	42§	9,925
2	Dow	2	4,112
3	Du Pont	11	7,006
4	Fuji-Xerox	2	45,745
5	IBM	28	12,396

[13] These definitions apply since 2001.

[14] http://ep.espacenet.com/

6	Nokia	1	5,042
7	Pitney Bowes	2	663
8	Ricoh	1	113,940
9	Sony	4	138,664
10	Taisei	2	7,881
11	Xerox	23	9,598

Notes: Counts shown in Table do not account for families or equivalents

§ Figures includes patents assigned to Mannesmann.

A 4: Construction of comparison sample 2 (patents with same (i) priority authority, (ii) priority year, and (iii) IPC)

The second control group is selected based on a unique list of (i) priority authority, (ii) priority year, and (iii) IPC of the EcoPC patents. This list is used to extract from PATSTAT all other patents which share features (i)-(iii) with the EcoPC patents. In a second step, we eliminated manually all individual and non-profit assignees from the control sample.[15]

Count	Publication Authority	Priority Year	IPC	# Patents in EcoPC	# Patents in PATSTAT	$\frac{\#\ Patents\ in\ EcoPC}{\#\ Patents\ in\ PATSTAT}$
1	DE	1990	B60K	4	14	28.57%
2			F02D	4	40	10.00%
3			F02M	4	50	8.00%
4		1992	B21D	1	26	3.85%
5			B30B	1	15	6.67%
6			H04B	4	79	5.06%
7			H04M	4	119	3.36%
8			H04Q	4	139	2.88%
9		1999	F02M	4	965	0.41%
10			H01B	1	3	33.33%
11			H01L	4	227	1.76%
12		2000	F02D	5	924	0.54%
13			F02M	4	1158	0.35%
14			H01L	4	149	2.68%
15		2001	G01N	5	13	38.46%
16		2002	B60H	3	348	0.86%
17			F01P	3	72	4.17%
18			F02D	1	187	0.53%
19			F16H	1	122	0.82%
20			H02K	1	81	1.23%
21		2004	B01D	3	117	2.56%

[15] Individuals and non-profit owned patents were only kept in the sample when there was no equivalent patent owned by a company with the same priority and application authority, priority year and IPC code. There were seven such cases.

22			B22F	1	11	9.09%
23			B60R	1	164	0.61%
24			C04B	1	6	16.67%
25			F01N	2	91	2.20%
26			F02D	2	109	1.83%
27			F21S	1	11	9.09%
28			G01C	1	57	1.75%
29			G09F	1	2	50.00%
30			H02J	1	28	3.57%
31			H02P	1	32	3.13%
32			H05B	1	47	2.13%
33		2005	B01D	1	65	1.54%
34			B05C	1	4	25.00%
35			B22F	1	12	8.33%
36			B60L	1	10	10.00%
37			C04B	1	6	16.67%
38			F01N	4	154	2.60%
39			F02D	1	130	0.77%
40			H02J	1	64	1.56%
41	JP	1995	C02F	1	5	20.00%
42			G03G	1	464	0.22%
43		1997	B01D	3	39	7.69%
44			B08B	1	32	3.13%
45			B09B	3	60	5.00%
46			B29B	3	23	13.04%
47			C02F	1	21	4.76%
48			C08J	2	31	6.45%
49			C22B	1	20	5.00%
50			G11B	2	213	0.94%
51		2001	B41J	1	72	1.39%
52			B41M	1	58	1.72%
53			G03G	1	272	0.37%
54			H04N	1	49	2.04%
55		2003	C02F	1	18	5.56%
56			E02B	1	na	Na
57		2005	C02F	1	13	7.69%
58	Other	1989	B01J	2	58	3.45%
59			C07B	1	23	4.35%
60			C07C	2	24	8.33%
61		1990	B01J	2	24	8.33%
62			C07B	1	17	5.88%
63			C07C	2	17	11.76%
64		2001	B09B	1	2	50.00%
65			G11B	1	na	Na
66	US	1989	B09C	2	56	3.57%
67			C08F	2	265	0.75%

68			C08G	2	380	0.53%
69			C11D	1	95	1.05%
70			E21B	2	80	2.50%
71			G03F	2	330	0.61%
72			G11B	1	44	2.27%
73			H01L	1	1306	0.08%
74		1990	B23K	1	183	0.55%
75			H05K	1	259	0.39%
76		1991	B09C	3	69	4.35%
77			E03F	3	8	37.50%
78			E21B	3	120	2.50%
79			G03F	3	9	33.33%
80		1992	B01D	1	151	0.66%
81			B29C	1	16	6.25%
82			C02F	1	150	0.67%
83			C12N	1	795	0.13%
84			C12Q	1	429	0.23%
85			G03F	2	234	0.85%
86			H01L	2	1470	0.14%
87		1993	B09C	4	86	4.65%
88			E21B	4	63	6.35%
89			G03F	1	59	1.69%
90		1994	B01D	3	161	1.86%
91			B09C	4	43	9.30%
92			C12N	1	2422	0.04%
93			C12Q	1	1165	0.09%
94			E21B	3	137	2.19%
95			G01G	1	9	11.11%
96		1995	B05C	1	185	0.54%
97			B09C	3	134	2.24%
98			B29B	2	43	4.65%
99			C02F	2	158	1.27%
100			E21B	1	142	0.70%
101			F25B	1	11	9.09%
102			G03G	1	12	8.33%
103			H01F	1	15	6.67%
104			H05K	1	28	3.57%
105		1996	B09C	3	51	5.88%
106			E21B	2	110	1.82%
107		1997	B01D	3	391	0.77%
108			B01J	1	277	0.36%
109			B09C	2	55	3.64%
110			C02F	1	66	1.52%
111			F01N	1	63	1.59%
112			G06Q	1	527	0.19%
113		1998	B01D	1	123	0.81%

114			B01J	1	259	0.39%
115			B08B	1	81	1.23%
116			B09C	1	40	2.50%
117			B41J	1	548	0.18%
118			C07C	2	628	0.32%
119			C07D	1	253	0.40%
120			E21B	1	150	0.67%
121			G07B	1	128	0.78%
122			G07C	1	9	11.11%
123			H01L	1	361	0.28%
124		1999	B01J	1	56	1.79%
125			C02F	1	81	1.23%
126			C04B	1	11	9.09%
127			C22B	1	37	2.70%
128			G01R	1	45	2.22%
129			H05K	1	127	0.79%
130		2000	B24C	1	31	3.23%
131			C12Q	1	966	0.10%
132			G03F	1	163	0.61%
133		2001	C09D	1	97	1.03%
134			C11D	2	497	0.40%
135			C23G	1	51	1.96%
136			H01L	1	3278	0.03%
137			H05K	1	128	0.78%
138		2002	B65D	1	18	5.56%
139		2003	H04B	1	223	0.45%
140		2004	C08J	1	52	1.92%
141			C09K	7	175	4.00%
142			G01M	1	2	50.00%

Table 1: Data on priorities

	Ecopatents	*Control2*	*Eco share*	*Control1*	*Eco share*
N of unique applications	238	95,985	0.25%	681,856	0.035%
N of unique priorities	96	29,259	0.33%	397,126	0.024%
N of applications with multiple priors	36	28,531	0.13%	41,920	0.086%
N of priors with multiple applns	47	21,886	0.21%	110,820	0.042%
N of unique appln-prior combinations	280	172,335	0.16%	744,349	0.038%
Average family size	2.92	5.89		1.87	

Table 2: Patents contributed to the commons compared to the contributing firms' portfolios

		All applications and equivalents			*Unique priorities only*			*Average family size in dataset*	
	Date entered the commons	*Eco-patents*	*Total patents*	*Share*	*Eco-patents*	*Total patents*	*Share*	*Eco-patents*	*Total patents*
DuPont	Jan-08	43	37,493	0.115%	14	11,417	0.123%	3.07	3.28
IBM	Jan-08	53	100,093	0.053%	29	57,130	0.051%	1.83	1.75
Mannesmann	Jan-08	2	7,123	0.028%	1	2,669	0.037%	2.00	2.67
Nokia	Jan-08	3	52,388	0.006%	1	12,790	0.008%	3.00	4.10
PitneyBowes	Jan-08	7	4,608	0.152%	2	2024	0.099%	3.50	2.28
Sony	Jan-08	4	184,422	0.002%	4	119,643	0.003%	1.00	1.54
Bosch	Sep-08	52	92,175	0.056%	23	30,949	0.074%	2.26	2.98
Xerox	Sep-08	56	28,494	0.197%	15	12,574	0.119%	3.73	2.27
Ricoh	Mar-09	1	110,493	0.001%	1	99,790	0.001%	1.00	1.11
Taisei	Mar-09	2	6,794	0.029%	2	6,661	0.030%	1.00	1.02
Dow	Oct-09	9	14,687	0.061%	2	4,189	0.048%	4.50	3.51
FujiXerox	Oct-09	6	43,086	0.014%	2	37,290	0.005%	3.00	1.16
Total		**238**	**681,856**	**0.035%**	**96**	**397,126**	**0.024%**	**2.48**	**1.72**

Table 3

Rough categorization of Eco-patent commons technologies

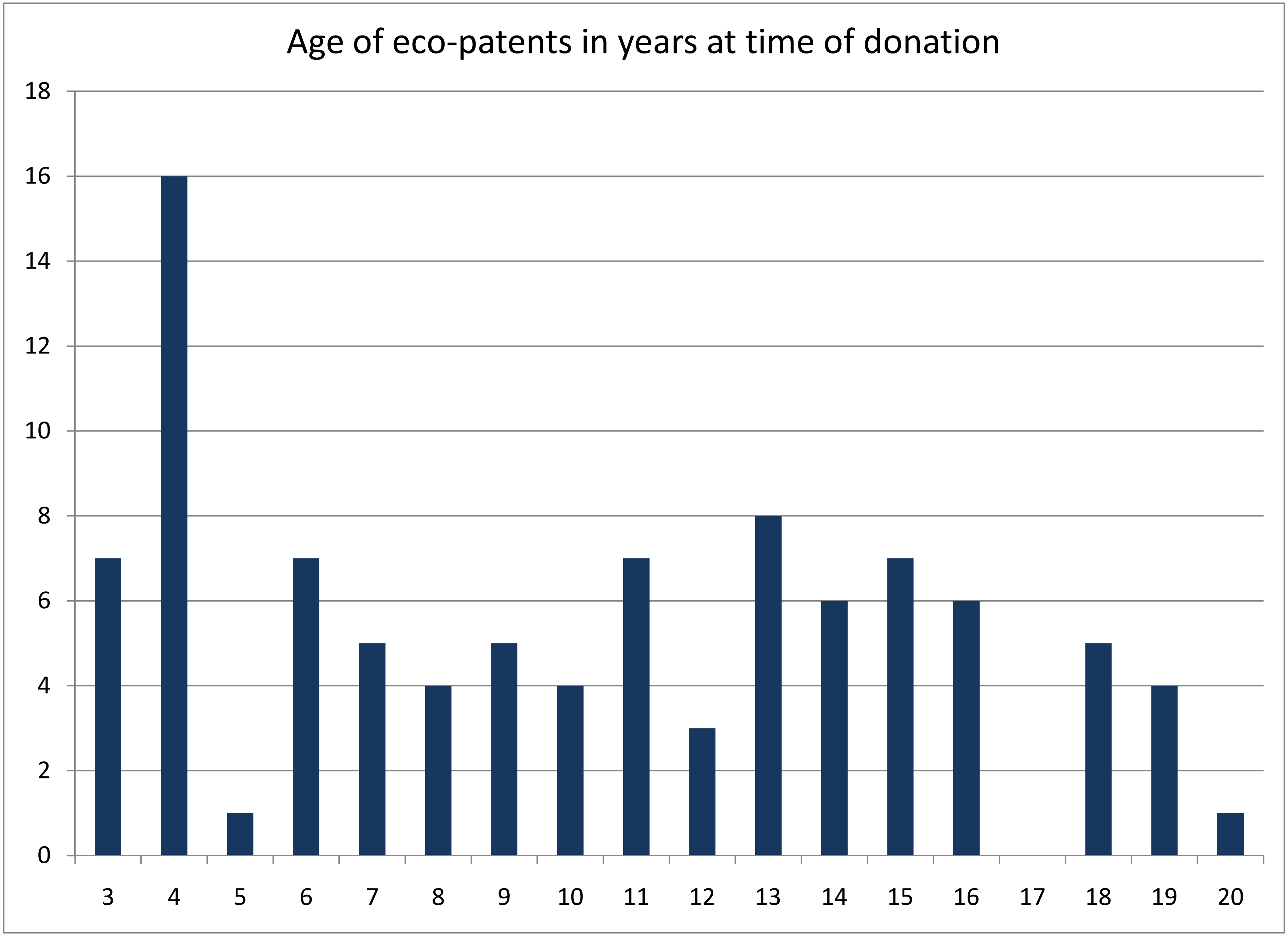
Technology	*Not in OECD sample*	*In OECD sample*	*Total*
Not clear	2	0	2
Clean manufacturing	20	2	22
Clean up soil & groundwater	0	23	23
Electric auto related	1	1	2
Energy efficiency (mostly autos)	35	5	40
Global warming (fluorocarbons)	7	0	7
Pollution	10	7	17
Recycling (mostly disks)	3	4	7
Total	**78**	**42**	**120**

Table 4: Average age in years of patent by legal status

as of April 2010*

	Number	*Share*	*Mean*	*Median*	*Q1*	*Q3*
In force	138	58.0%	11.4	12.9	7.0	15.4
Nonpayment of fees	24	10.1%	12.8	13.6	9.7	18.0
Expired	10	4.2%	17.1	18.2	17.7	18.3
Withdrawn	22	9.2%	10.3	8.4	4.7	17.7
Rejected	14	5.9%	7.3	6.2	4.4	7.8
Exam request	4	1.7%	6.7	7.2	5.2	8.3
Unexamined	8	3.4%	3.8	3.6	3.6	4.1
NA	18	7.6%	13.2	14.2	10.7	18.3
All	**238**		**11.2**	**12.5**	**6.1**	**15.8**

*Age is measured on April 1, 2010, as years since the application date of the patent.


Age of eco-patents in years at time of donation
18
16
14
12
10
8
6
4
2
0
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20

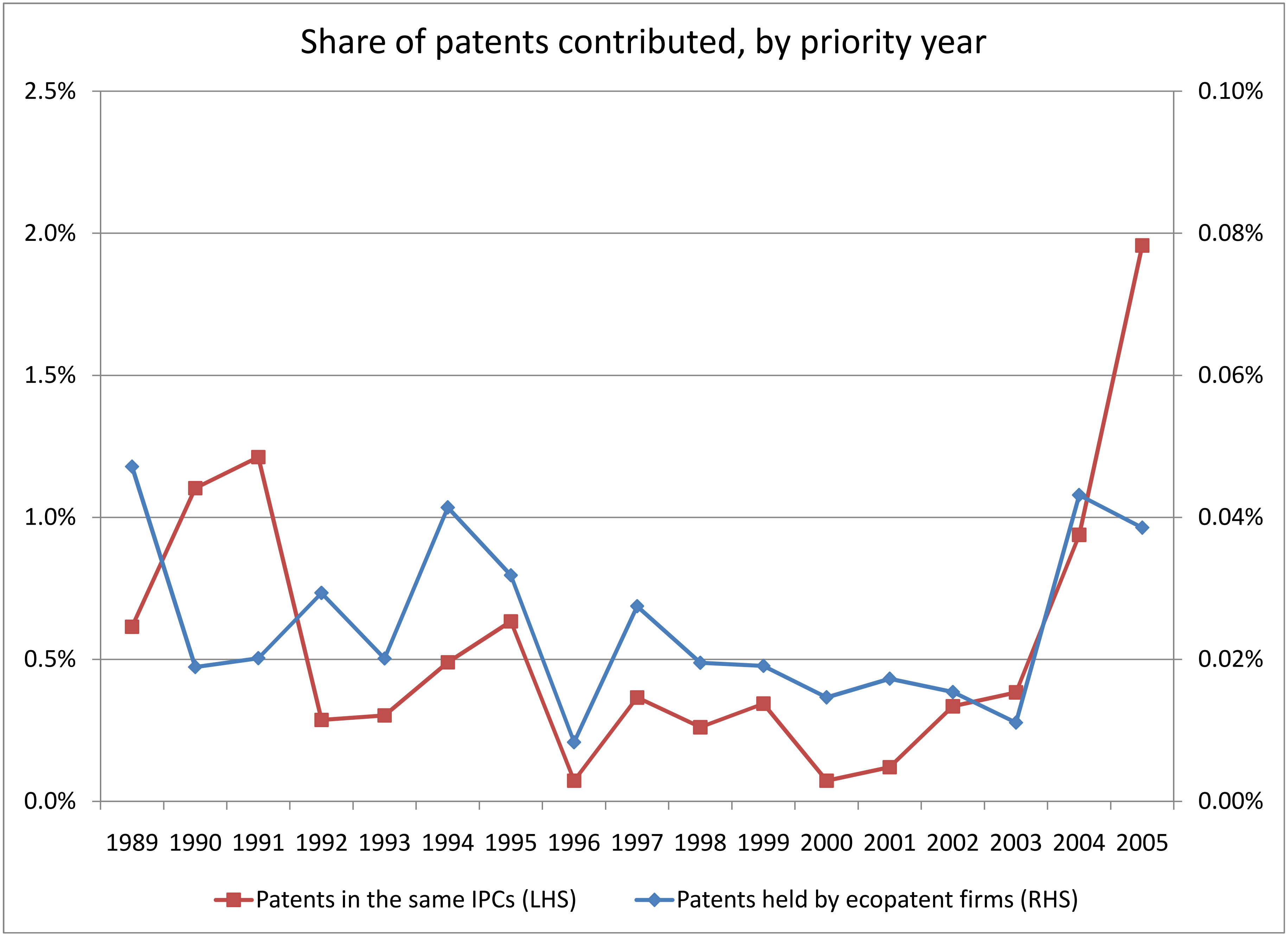

Share of patents contributed, by priority year
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
0.10%
0.08%
0.06%
0.04%
0.02%
0.00%
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
Patents in the same IPCs (LHS)
Patents held by ecopatent firms (RHS)

Table A1: Patents contributed to the commons as a share of firm portfolios and patent classes by priority year

	All applications and equivalents					*Unique priorities only*				
Priority year	*Eco patents*	*Patents in the same class*	*Share*	*All pats held by eco pats firms*	*Share*	*Eco patents*	*Patents in the same class*	*Share*	*All pats held by eco pats firms*	*Share*
1989	34	2,803	1.213%	25,221	0.135%	6	976	0.615%	12,728	0.047%
1990	7	618	1.133%	28,515	0.025%	3	272	1.103%	15,862	0.019%
1991	13	924	1.407%	32,130	0.040%	4	330	1.212%	19,837	0.020%
1992	18	8,785	0.205%	32,395	0.056%	6	2,094	0.287%	20,439	0.029%
1993	7	7,181	0.097%	32,379	0.022%	4	1,323	0.302%	19,886	0.020%
1994	20	8,499	0.235%	32,781	0.061%	8	1,635	0.489%	19,330	0.041%
1995	18	2,305	0.781%	36,872	0.049%	7	1,105	0.633%	21,989	0.032%
1996	5	12,698	0.039%	40,227	0.012%	2	2,749	0.073%	24,032	0.008%
1997	10	3,826	0.261%	43,543	0.023%	7	1,915	0.366%	25,468	0.027%
1998	11	6,578	0.167%	44,391	0.025%	5	1,916	0.261%	25,637	0.020%
1999	10	2,946	0.339%	48,410	0.021%	5	1,453	0.344%	26,219	0.019%
2000	10	13,132	0.076%	51,459	0.019%	4	5,515	0.073%	27,313	0.015%
2001	10	8,568	0.117%	49,513	0.020%	5	4,158	0.120%	28,965	0.017%
2002	8	2,417	0.331%	46,062	0.017%	4	1,195	0.335%	25,994	0.015%
2003	5	1,332	0.375%	46,556	0.011%	3	782	0.384%	27,067	0.011%
2004	37	2,897	1.277%	45,896	0.081%	12	1,279	0.938%	27,821	0.043%
2005	15	959	1.564%	45,506	0.033%	11	562	1.957%	28,539	0.039%
Total	**238**	**86,468**	**0.275%**	**681,856**	**0.035%**	**96**	**29,259**	**0.328%**	**397,126**	**0.024%**

Table A2: Patent family sizes

	Number of priorities		*Average family size from docdb*		*Average family size from inpadoc*	
	Eco-patents	*Same firms*	*Eco-patents*	*Same firms*	*Eco-patents*	*Same firms*
Bosch	23	30,949	2.30	4.07	2.35	5.17
Dow	2	4,189	10.00	7.09	11.00	26.06
DuPont	14	11,417	8.75	6.23	186.92	10.93
FujiXerox	2	37,290	3.50	2.12	3.50	2.39
IBM	29	57,130	2.07	3.07	4.59	3.88
Mannesmann	1	2,669	2.00	3.95	2.00	5.00
Nokia	1	12,790	4.00	5.67	4.00	6.83
PitneyBowes	2	2024	3.50	3.49	3.50	4.15
Ricoh	1	99,790	1.00	2.43	1.00	3.57
Sony	4	119,643	1.00	2.71	11.50	3.72
Taisei	2	6,661	1.00	1.90	1.00	1.99
Xerox	15	12,574	6.13	3.66	9.33	4.84
All	**96**	**397,126**	**3.80**	**3.01**	**28.31**	**4.26**

Table A3: Patents contributed to the commons by application authority

	Application authority; equivalents included						*Priority appln authority; equivalents and mutliple priorities removed*					
Authority	*Eco patents*	*Share*	*Patents in the same class*	*Share*	*All pats held by eco pats*	*Share*	*Eco patents*	*Share*	*Patents in the same class*	*Share*	*All pats held by eco pats*	*Share*
DE Germany	45	18.9%	9,950	10.4%	76,711	11.3%	24	25.0%	2,530	8.6%	31,874	8.0%
JP Japan	34	14.3%	13,503	14.1%	281,533	41.3%	10	10.4%	2,064	7.1%	262,886	66.2%
US USPTO	75	31.5%	17,318	18.0%	140,601	20.6%	58	60.4%	24,132	82.5%	86,126	21.7%
Other	84	35.3%	55,214	57.5%	182,991	26.8%	4	4.2%	533	1.8%	16,240	4.1%
Total	**238**		**95,985**		**681,836**		**96**		**29,259**		**397,126**	

Table A4: Patent legal status by firm contributing

	Uncorrected for equivalents					*Priority patents only*				
	Number	*Granted*	*Share granted*	*In force or pending*	*Share in force*	*Number*	*Granted*	*Share granted*	*In force or pending*	*Share in force*
Bosch	52	39	75.0%	33	63.5%	23	19	82.6%	15	65.2%
Dow	9	8	88.9%	6	66.7%	2	2	100.0%	1	50.0%
DuPont	43	30	69.8%	23	53.5%	14	12	85.7%	9	64.3%
FujiXerox	6	4	66.7%	5	83.3%	2	2	100.0%	2	100.0%
IBM	53	44	83.0%	30	56.6%	29	27	93.1%	23	79.3%
Mannesmann	2	1	50.0%	1	50.0%	1	0	0.0%	0	0.0%
Nokia	3	3	100.0%	2	66.7%	1	1	100.0%	1	100.0%
PitneyBowes	7	7	100.0%	5	71.4%	2	2	100.0%	1	50.0%
Ricoh	1	1	100.0%	1	100.0%	1	1	100.0%	1	100.0%
Sony	4	4	100.0%	4	100.0%	4	4	100.0%	4	100.0%
Taisei	2	2	100.0%	2	100.0%	2	2	100.0%	2	100.0%
Xerox	56	51	91.1%	39	69.6%	15	14	93.3%	12	80.0%
All	**238**	**194**	**81.5%**	**151**	**63.4%**	**96**	**86**	**89.6%**	**71**	**74.0%**