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Foresight

International Dimensions of Climate Change

Discussion Paper 4: Proprietary environments: Innovation paradox and policy

Dr David E. Martin, Executive Chairman, M·CAM Inc. Batten Fellow, Darden Graduate School of Business Administration, University of Virginia.

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Proprietary Environments: Innovation Paradox and Policy

Abstract

Resurgence of interest in innovating humanity out of climate challenges has brought innovation incentives and proprietary business models into public discourse again. Not unlike the periods of energy shocks in the past three decades, a general social response is to call for "new technologies" to address present problems. However, due to historical innovation practices – including extensive prior patenting of proposed solutions to environmental challenges – patented, but undeployed technologies now stand as obstacles to legacy investment and business models. With over 100,000 environmental technology patents in the U.K. issued, expired and abandoned on technologies never brought to market, and considering the fact that double patenting (the filing of new patents on previously patented subject matter) is illegal, governments and business need to innovate the business of climate innovation. Specifically this paper examines the legacy of U.K. and global patenting behavior, the market consequence of environmental patent practices, and concludes with recommendations for innovation in capital markets and business required for today's vexing challenges.

Background

When the United Nations Conference on Trade and Development (UNCTAD) issued its *Trade and Development Report 2009*, the inspiration for a number of its recommendations was laudable. Like many initiatives before – including the 2008 European Patent Forum in Ljubljana, the EU Parliament 2008 workshop on Intellectual Property Rights and Green Energy Technologies, and the World Intellectual Property Organization (WIPO) Promoting Green Innovation conference – a fundamental lack of understanding of innovation practice over the past thirty years has adversely impacted the dialogue. Informed by a review of historical responses to energy and environmental challenges, an opportunity exists to impact not only the climate on an ecosystem and species level but thaw the financial ecosystem of economic incentives which have obstructed climate technology adoption in the past.

Since the modernization of the intellectual property system and sponsored research programs of the past four decades, economic development and exclusionary innovation property rights have gone hand-in-hand. However, as far back as 1980, these property systems were altered with a growing practice of using patents and other intellectual property regimes to block commercial access and market use. It is no accident that some of the largest patent estates were filed and restrained from market adoption by companies who had the most market share to lose. Oil companies filed and held thousands of environmentally desirable patents in fields ranging from solar and wind power to hydrogen and hybrid propulsion. Automotive companies filed and restrained from market

adoption vast patent estates on electric and hybrid vehicles. Public utilities received thousands of patents on grid management and distribution which restricted market use of countless efficiencies. While patent advocates propagate the notion that patents are an incentive to stimulate innovation, the data supports a quite different practice. In point of fact, far more patents are filed to defend legacy market positions against obsolescence than are filed to advance new, innovative solutions.

Another overlooked reality is the fact that environmental technologies – even those patented for the most laudable business or social purposes – have not been filed for protection on an internationally consistent level. As is shown in the figures below, U.K. patents do not, in any of the core climate technology sectors, enjoy worldwide protection. During economic cycles where intellectual property and industrial production were both the exclusive realm of industrialized countries, this asymmetry presented little business consequence. However, in light of the growing industrial and market sophistication in previously marginalized countries, the ability for new actors to create and deploy generic technologies based on patented technologies is at unprecedented levels. In the area of climate change technologies, this necessitates large scale investment and business model innovation as it is highly likely that vital technologies will be provided in open source platforms in markets historically confident of proprietary business models and price controls derived from patent enforcement.

The two dynamics that I've identified above are illustrated with the following Figures which set forth the U.K. patenting activity (including international equivalents filed in or sought by U.K. business interests). For those not familiar with patent law, it is important to note that it is not legal to receive a patent on materials that are anticipated in existing filings. Further, once a year has passed, a patent holder cannot receive coverage on a patent in other countries if an attempt to gain protection has not been made during that year. In other words, as illustrated in the Figures below, many U.K. innovations have little or no proprietary standing in much of the world. This means that technologies produced or sold under patent in the U.K. may be reverse engineered, produced and sold by third parties in much of the world without any risk of infringement as infringement requires a legally enforceable patent at the nexus of commercial activity. The extensive quantity of abandoned expired, and unused patents which are now available in the public domain considerably undermine the past 25 years of price-control business models around which venture capital and economic strategy have emerged.

Figure 1: Fuel cell patents protected in the United Kingdom and their international coverage

This figure shows where U.K. patents enjoy international enforcement potential. Countries in blue indicate areas where there are potential proprietary price controls. Countries in yellow and white indicate those countries where no protection exists for critical patents. In these countries, U.K. innovation can be developed and commercialized for generic domestic consumption and for use in countries without coverage.

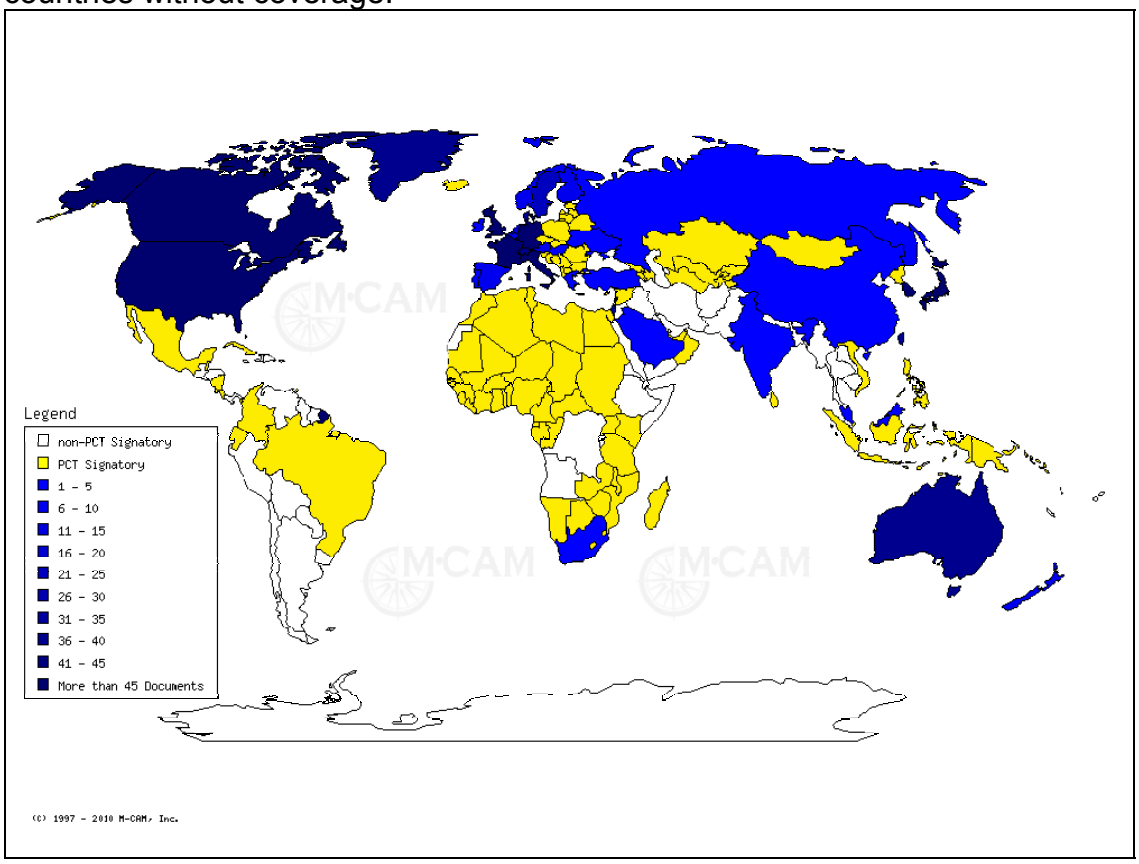
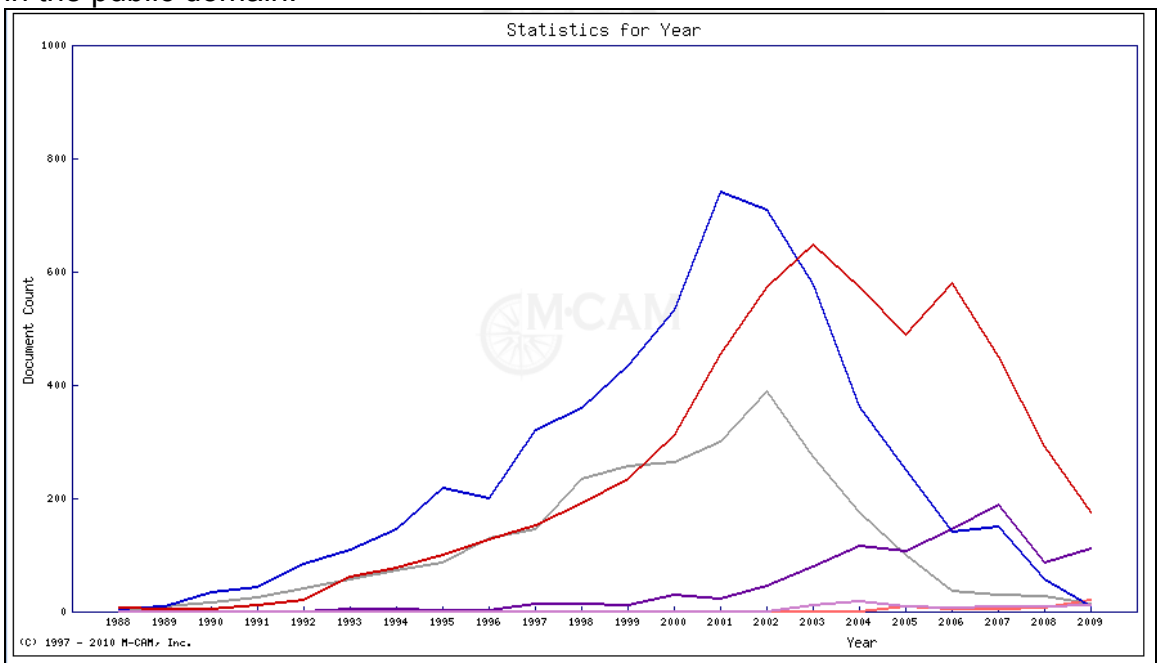


Figure 2: U.K. Fuel Cell Patent Timeline

It is worth noting that patent filing peaked in U.K. fuel cell patenting interests in 2001 meaning that, assuming on-going maintenance of the patents, domestic protections will expire within this decade. Approximately 30% of the U.K. fuel cell patents have been abandoned leaving all innovation disclosed therein accessible in the public domain.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		total
transfer	2	8	15	25	42	57	72	87	130	145	233	257	264	301	389	273	175	99	37	30	27	14	transfer	2682
abandoned	0	0	0	0	1	4	4	3	2	14	14	11	30	23	45	79	116	107	145	189	87	111	abandoned	985
expired	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4	5	6	20	expired	43
file	5	10	34	44	84	110	146	218	200	320	358	433	531	740	710	578	362	249	142	150	86	8	file	5489
issue	6	5	5	11	21	62	77	100	127	153	191	233	311	454	573	648	572	489	580	451	290	176	issue	5535
disallowed	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	11	18	9	7	9	10	12	disallowed	77
total	13	23	54	80	148	233	299	408	459	632	797	934	1136	1518	1717	1589	1243	961	915	834	476	342	total	14811

Figure 3: Geothermal patents protected in the United Kingdom and their international coverage

This figure shows where U.K. patents enjoy international enforcement potential. Countries in blue indicate areas where there are potential proprietary price controls. Countries in yellow and white indicate those countries where no protection exists for critical patents. In these countries, U.K. innovation can be developed and commercialized for generic domestic consumption and for use in countries without coverage. Note the absence of any significant coverage in South America, Eastern Europe and Russia and the Indian subcontinent.

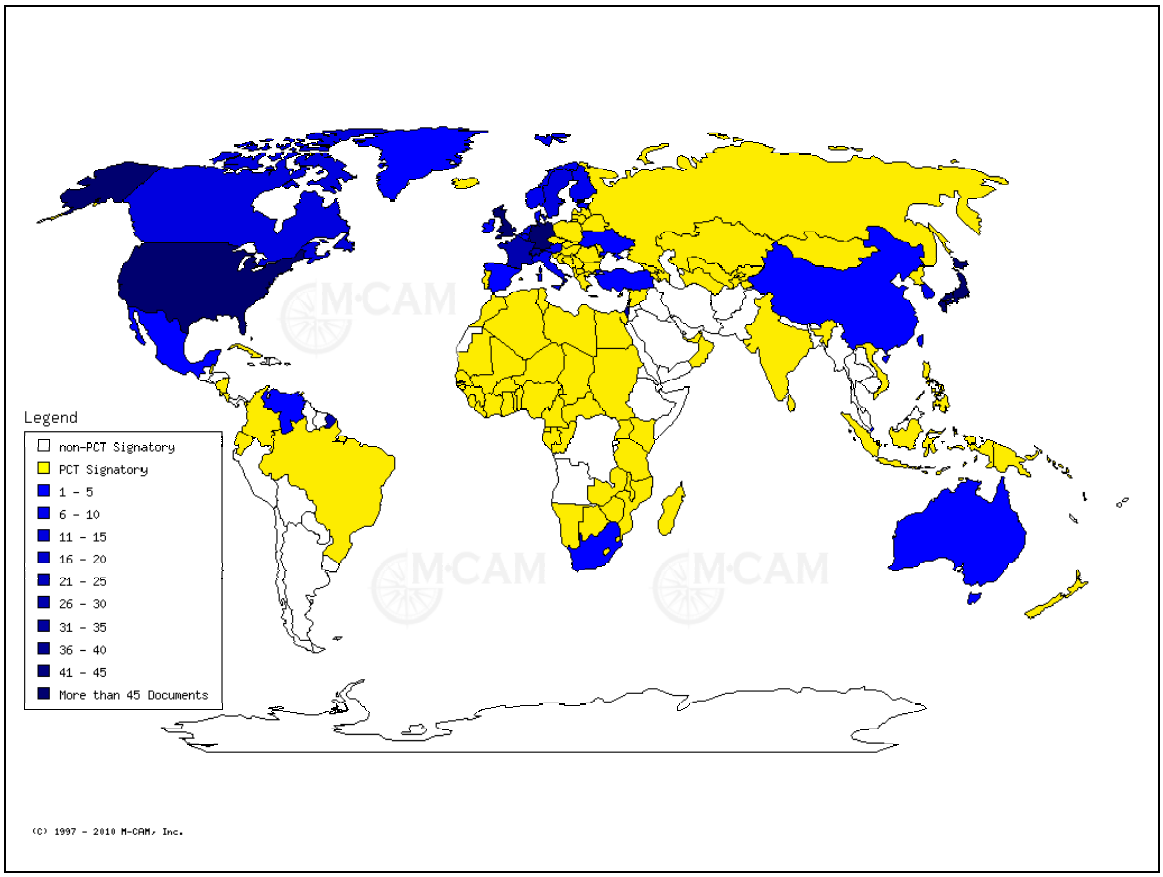
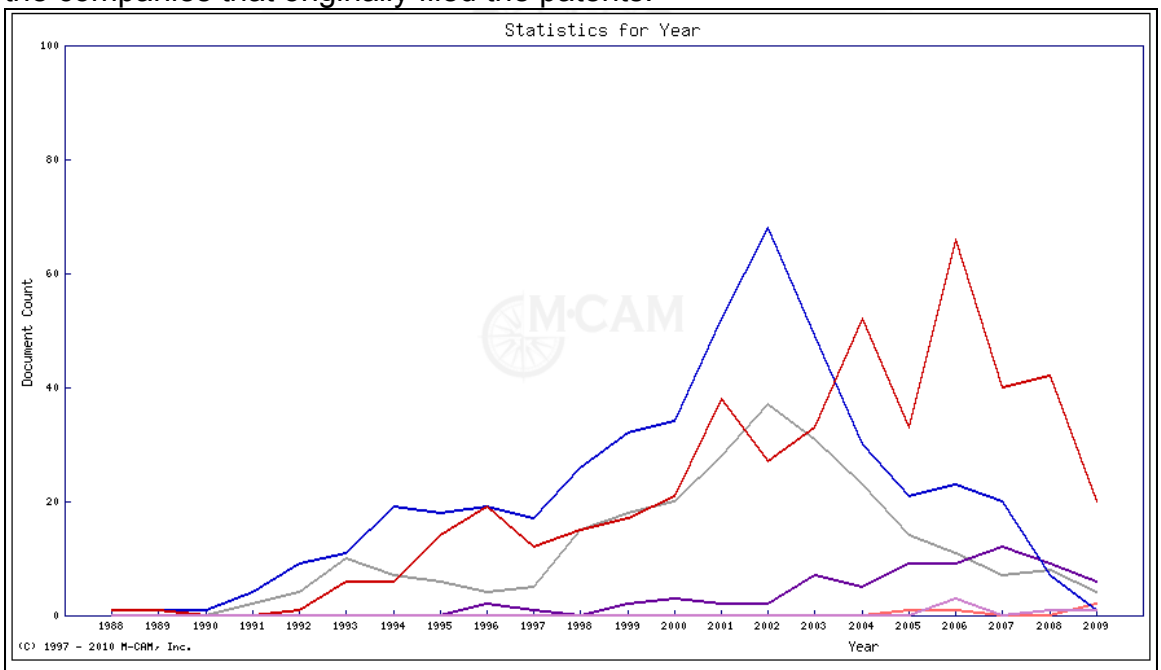


Figure 4: U.K. Geothermal Patent Timeline
Patenting activity peaked in 2001. Expired and abandoned patents represent over 40% of all currently enforceable patents meaning that most proprietary offerings would have open source alternatives available for generic production and distribution. Over 50% of the geothermal patents are no longer owned by the companies that originally filed the patents.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		total
transfer	0	0	0	2	4	10	7	6	4	5	15	18	20	28	37	31	23	14	11	7	8	4	transfer	254
abandoned	0	0	0	0	0	0	0	0	2	1	0	2	3	2	2	7	5	9	9	12	9	6	abandoned	69
expired	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	expired	4
file	1	1	1	4	9	11	19	18	19	17	26	32	34	52	68	49	30	21	23	20	7	1	file	463
issue	1	1	0	0	1	6	6	14	19	12	15	17	21	38	27	33	52	33	56	40	42	20	issue	464
disallowed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1	1	disallowed	5
total	2	2	1	6	14	27	32	38	44	35	56	69	78	120	134	120	110	78	113	79	67	34	total	1259

Figure 5: Hydroelectric patents protected in the United Kingdom and their international coverage

This figure shows where U.K. patents enjoy international enforcement potential. Countries in blue indicate areas where there are potential proprietary price controls. Countries in yellow and white indicate those countries where no protection exists for critical patents. In these countries, U.K. innovation can be developed and commercialized for generic domestic consumption and for use in countries without coverage. It is striking to see that the largest growth markets for this type of technology and some of the largest prospective markets are entirely unprotected.

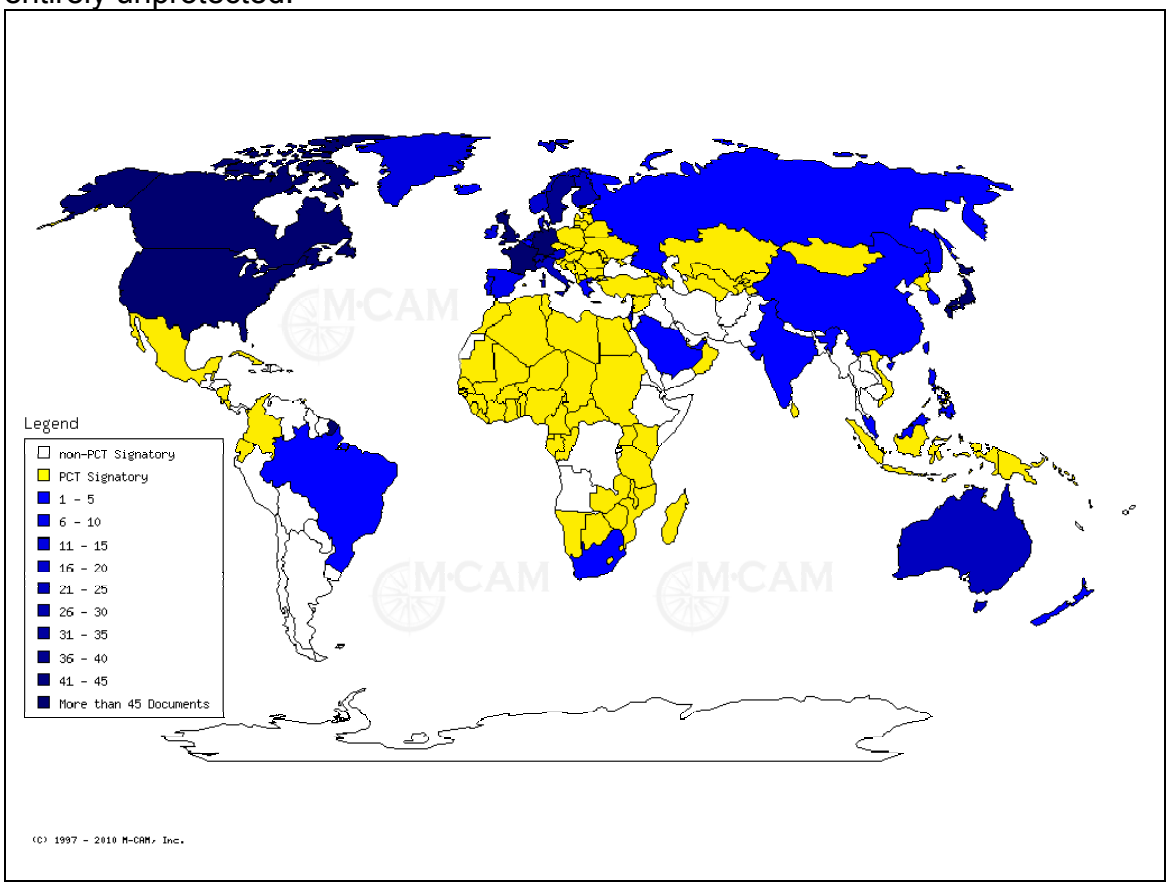
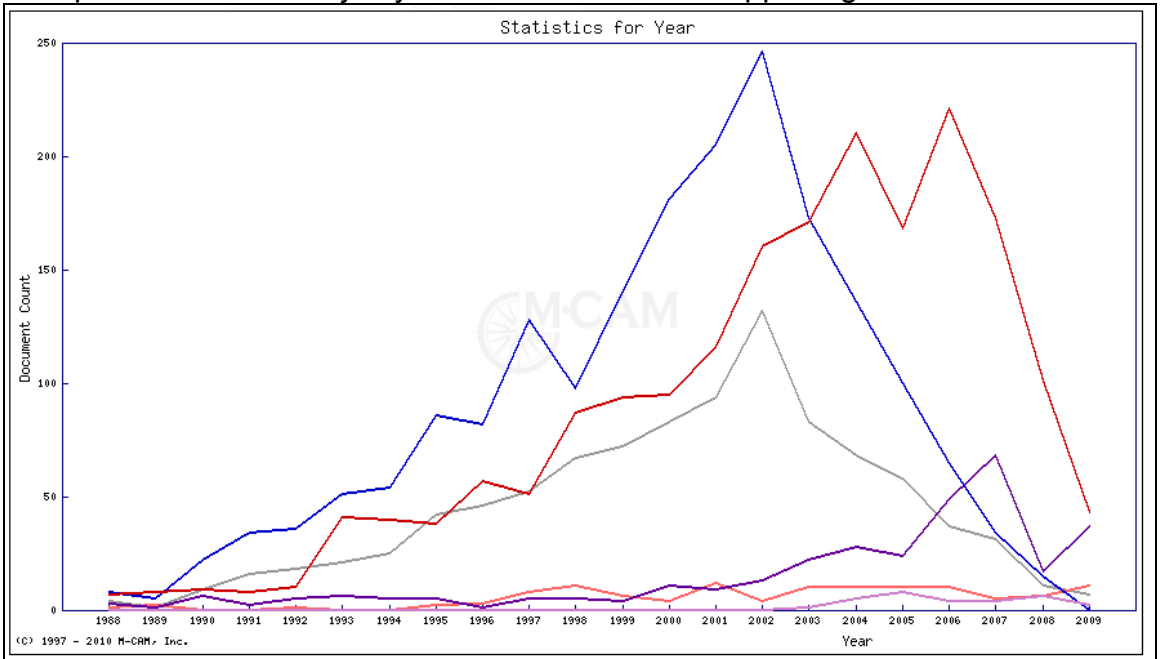


Figure 6: U.K. Hydroelectric Patent Timeline

Patenting activity peaked in 2001 and was overtaken by the rate of abandonment in 2007. Over 50% of the geothermal patents were consolidated and acquired by third parties with the majority of this consolidation happening in 2000 – 2003.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		total
transfer	4	1	9	16	18	21	25	42	46	52	67	72	83	94	132	83	68	58	37	31	11	7	transfer	977
expired	1	2	0	0	1	0	0	2	3	8	11	6	4	12	4	10	10	10	10	5	6	11	expired	116
abandoned	3	1	6	2	5	6	5	5	1	5	5	4	11	9	13	22	28	24	49	68	17	37	abandoned	326
file	8	5	22	34	36	51	54	86	82	128	98	141	181	205	246	173	136	100	55	54	65	0	file	1900
issue	7	8	9	8	10	41	40	38	57	51	87	94	95	116	160	171	210	168	221	173	101	43	issue	1908
disallowed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	5	8	4	4	6	2	disallowed	30
total	23	17	46	60	70	119	124	173	189	244	268	317	374	436	555	460	457	368	386	315	156	100	total	5257

Figure 7: Solar patents protected in the United Kingdom and their international coverage

This figure shows where U.K. patents enjoy international enforcement potential. Countries in blue indicate areas where there are potential proprietary price controls. Countries in yellow and white indicate those countries where no protection exists for critical patents. In these countries, U.K. innovation can be developed and commercialized for generic domestic consumption and for use in countries without coverage. The U.K. has limited international market control over solar power and is not in a position to respond to market activities without relying heavily on open source or third party partnerships. U.K. innovation does not enjoy protection in markets with the fastest growing GDPs.

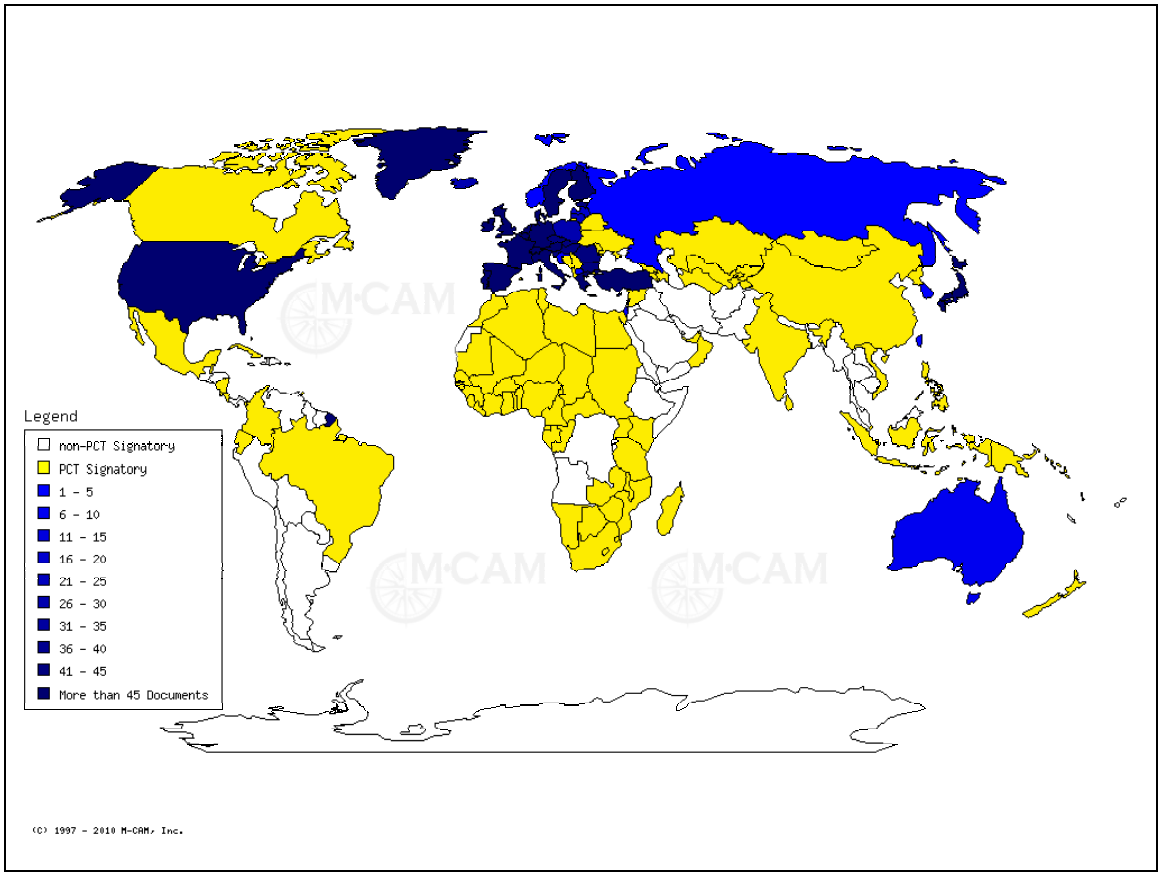
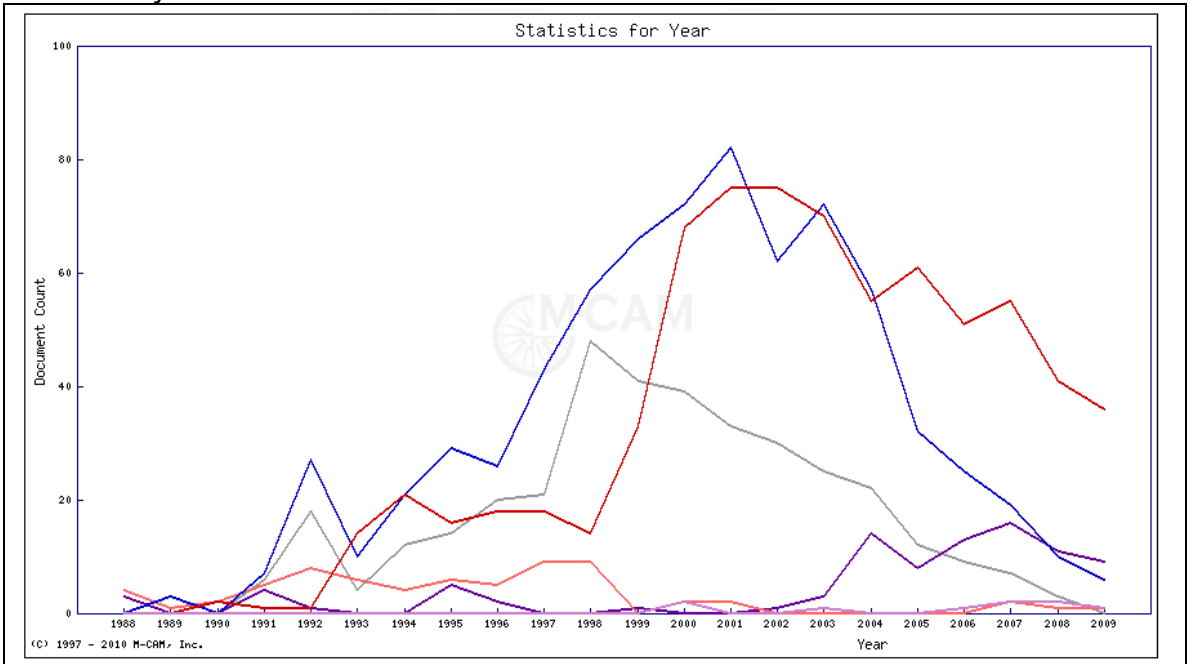


Figure 8: U.K. Solar Patent Timeline

Patenting activity peaked 2001 – 2002. Over 55% of the U.K. positions were abandoned with the most significant abandonments taking place in 2006 and 2007. It is important to note that U.K. patent applications have persisted longer than many countries.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		total
transfer	0	3	0	6	18	4	12	14	20	21	48	41	39	33	30	25	22	12	9	7	3	0	transfer	367
abandoned	3	0	0	4	1	0	0	5	2	0	0	1	0	0	1	3	14	6	13	16	11	9	abandoned	91
expired	4	1	2	5	8	6	4	6	5	9	9	0	2	2	0	0	0	0	0	2	1	1	expired	67
file	0	3	0	7	27	10	21	29	26	43	57	56	72	92	72	72	57	92	65	69	50	35	file	726
issue	0	0	2	1	1	14	21	16	18	18	14	33	68	75	75	70	55	61	51	55	41	36	issue	725
disallowed	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	1	2	2	1	disallowed	9
total	7	7	4	23	55	34	58	70	71	91	128	141	183	192	168	171	148	113	99	101	68	53	total	1985

Figure 9: U.K. Wind Power Patent Timeline
This figure shows where U.K. patents enjoy international enforcement potential. Countries in blue indicate areas where there are potential proprietary price controls. Countries in yellow and white indicate those countries where no protection exists for critical patents. In these countries, U.K. innovation can be developed and commercialized for generic domestic consumption and for use in countries without coverage. It is interesting to note that U.K. wind interests exclude the majority of Eastern Europe but do include countries like Saudi Arabia, the Islamic Republic of Iran, and Turkey.

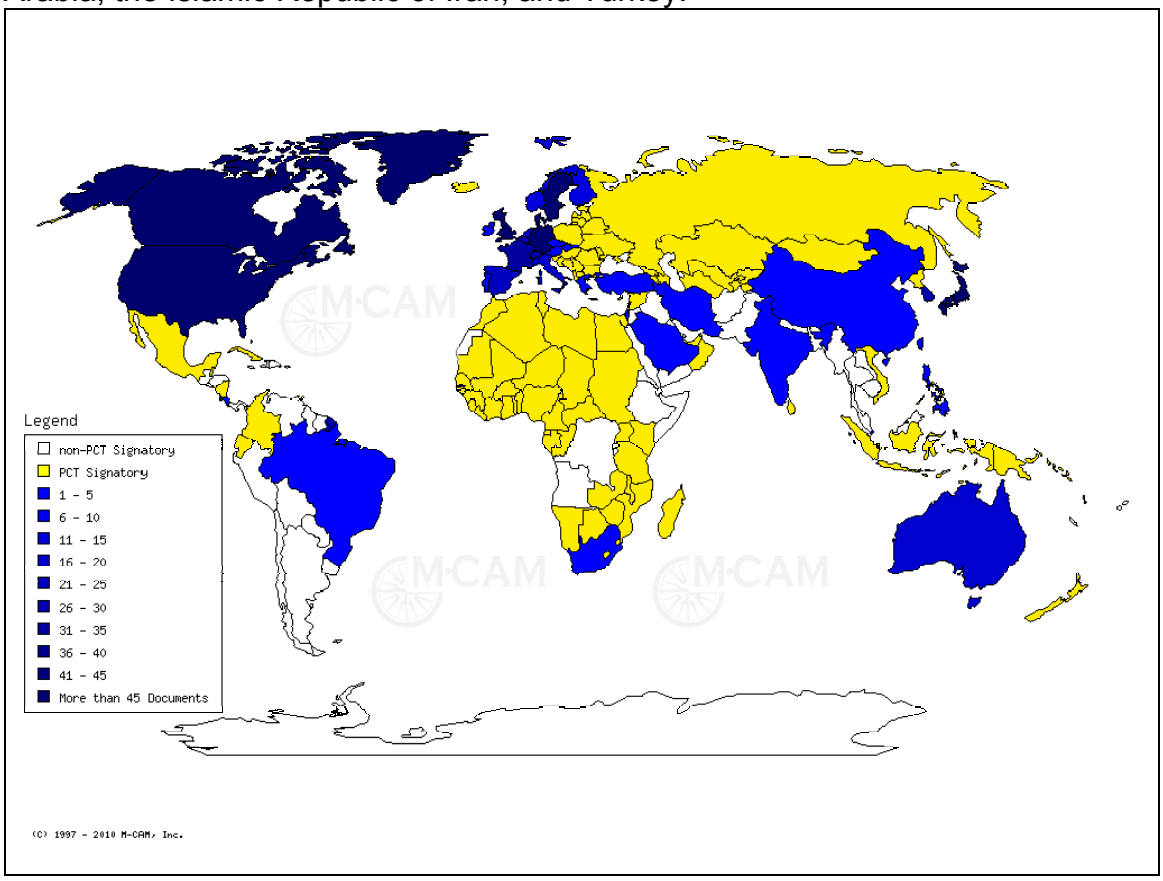
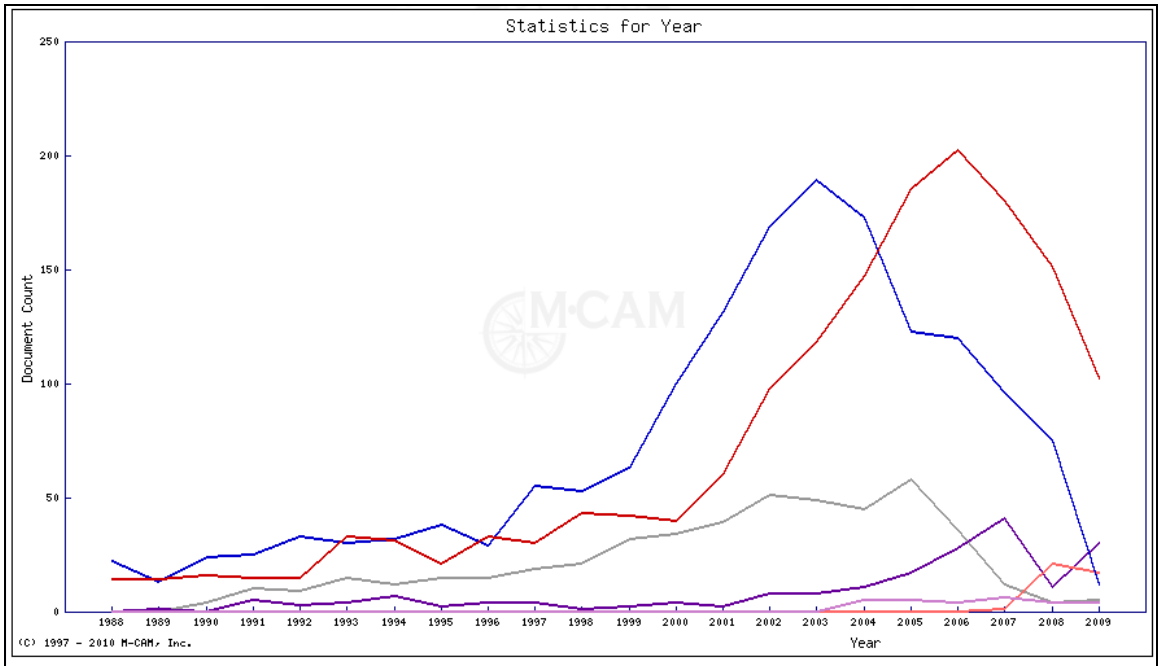


Figure 10: U.K. Wind Patent Timeline
Patenting activity peaked in 2003. Less than 20% of these patents have been abandoned indicating a possible deeper commitment among U.K. interests to wind than to other alternative energy sectors.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009		total
transfer	0	0	4	10	9	15	12	15	15	19	21	32	34	39	51	49	45	58	36	12	4	5	transfer	485
abandoned	0	1	0	5	3	4	7	2	4	4	1	2	4	2	8	8	11	17	28	41	11	30	abandoned	193
expired	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	21	17	expired	39
file	22	13	24	25	33	30	32	38	29	35	43	63	100	131	169	189	173	123	120	96	75	12	file	1605
issue	14	14	16	15	15	33	31	21	33	30	43	42	40	60	98	118	147	185	202	180	151	102	issue	1590
disallowed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	4	6	4	4	disallowed	28
total	36	28	44	55	60	82	82	76	81	108	118	139	178	232	326	364	381	388	390	336	266	170	total	3940

Analysis

As is evidenced in the data presented above, the U.K.'s role in climate change technology is going to require considerable policy and business practice innovation. U.K. commercial, academic and government interests began aggressively pursuing patents on critical technologies in climate change technologies in the early 1990s. This extensive patent filing activity was not related to commercial deployment in the vast majority of cases. This leads to a series of adverse market situations.

First, patents issued on technologies not introduced into the market neither serve the social benefit of patents – namely the public disclosure of information that advances the arts and useful sciences – as such patents do not necessarily evidence viable technologies. However, the existence of filed claims precludes

others from practicing the claimed invention in any commercial form. While no public benefit was served, actual subsequent activities were blockaded.

Second, patents issued on technologies neither introduced into the market nor evidenced by actual reduction to commercial use, preclude others from filing bona fide patents on the same matter if they actually do succeed where prior holders have already filed patent claims without evidencing the invention. As a practical matter, most patent offices have become haphazard about allowing double patenting (allowing more than one patent on the same subject matter), these patents are easily invalidated and rendered commercially unenforceable placing both patent holders and investors at great risk.

Finally, as many of the U.K.'s earliest patent efforts were done by academic or government sponsored programs, it was common practice for the earliest filings to have U.K. and possibly U.S. or European equivalents alone. Most of the foundational invention and innovation did not enjoy global market protection and, as such, exposes the majority of U.K. innovation to generic competition from international interests.

A macroeconomic dynamic is also evidenced in the U.K.'s patenting activity which reflects a market anomaly. Throughout the decade of the 1990s patenting was encouraged by an aggressive venture capital and private equity market. During this decade, a belief was promoted suggesting that patents were part and parcel of any investment-worthy venture. However, with this growing pressure on patenting, no commensurate efforts were taken to insure that the patents represented quality evidence of innovation. Patent offices, devoid of any mandate to review patents for commercial relevance, worked with patent applicants to obtain patents on incremental variations in a "customer service" mandate. This focus on patent applicants as customers rather than the statutory requirement to grant patents when the public interest benefited from disclosure glutted the patent system with significant examination delays and quality failures. Ironically, now at the precise moment the market is awakening to the opportunities in climate change technology, the vast majority of solutions are either off-patent (having expired or been abandoned) or are about to expire.

These dynamics create two issues which require fundamentally new paradigms for incentivizing and deploying climate change technology and financing the same.

Given the legacy of defensive patent filing (filing patents to block others from market entry) and expansive open-source, public domain innovation artifacts, the relevance of patents as market incentives is greatly encumbered. This situation is complicated by the fact that virtually none of the major patent holders in the early 1990s considered protecting their innovations in marginalized nations outside of the G-8. Given that GDP growth is now strongest in the very countries most marginalized and unprotected by the patent regime, no pathway exists to

provide patent-based pricing controls. In short, the ability for international market entrants to significantly alter market dynamics (as happened in the pharmaceutical industry with generics) is not a theoretical risk; rather, it's a certainty.

When market controls such as patents are not in play, business models and their financing, have to rely on alternative capitalization strategies. The aspirational lottery winnings of angel investors and private equity (much promoted and seldom realized) will give way to the same commercial dynamics which funded the technology booms of the 1950s and 1980s. Then as now these are preferential procurement coming from the public sector and from public private partnerships. The focus of investment and returns will necessitate an alignment between enterprise, national procurement, and innovation networks. Not unlike the open-source software impulse which led governments and corporations to require lower-cost, open-source wherever it was competitive with proprietary products, so too will buyers seek to rely on open source innovation (innovation in the public domain) as the preferred purchasing source.

Transformations required by patent carelessness and innovation withholding strategies over the past 25 years will invite a new level of engagement in public sector institutions. The most notable to be effected are the public support of research and development (R&D) and the nature of sovereign procurement.

Given the vast estates of expired and abandoned patent and innovation artifacts, the serious public sector response to climate change technologies will rely on deployment and scaling rather than R&D. Many promising technologies failed to be capable of integration into legacy power, utility and infrastructure grids. New innovation on technology integration will be of greater value than a continued pursuit of something that is not yet here. With thousands of patents – filed in response to serious research and innovation – in the public domain, aggregating partial solutions already developed but not yet integrated at scale will be the most fruitful use of public research funds.

Government procurement has been a notorious victim of cost overruns often justified by improvements to the state-of-the-art. This dynamic must change as countries find themselves increasingly pressured to get more output for their expenditures. As a result, the notion of preferential, open-source supplying of innovation is not merely a socially aligned luxury, it is a necessity.

Private investments in climate altering infrastructure are gaining prominence rapidly. This outcome has been spawned by a confluence of several factors: Although many infrastructure investments were once considered the province of public investment via taxes, bonds, and other sovereign funding, they are rapidly emerging as opportunities for private investment. Public funding capacity for such investments in OECD countries is declining. OECD estimates that government spending on gross fixed capital formation as a share of total general

government outlays fell from 9.5% in 1990 to 7% in 2005. A significant cause of this decrease is rapidly increasing social expenditures which rose on average from 16% to 21% of GDP. Spending on public health and long-term care could increase from its current level of 6.7% of GDP to 12.8% by 2050, with pension costs rising around 4% during the same period, leaving even less room for infrastructure investments in the future.[1]

This decline in public funding capacity is converging with a massive and increasing need for investment in infrastructure development and refresh. Among the 30 OECD countries, in which foundational infrastructure systems are already in place, large expenditures on maintenance and upgrading of existing infrastructure will be required in addition to needed expansions.

Average OECD investments in electricity transmission and distribution are projected to rise from $38B (2005) to $62B in 2015, with average investments in water services climbing from $425B (2005) to $490B in the same period. Average investments in road infrastructure are rising from 2000 levels of $100B to a projected $160B by 2010, and rail investments are projected to rise from $26B to $31B during the same period. Growth in each of these sectors is projected to be significant through 2030.

In emerging-market countries, the requirement for new, open source enabled infrastructure will drive investment volume. For instance, China will increase its investment in water and wastewater treatment to $182B by 2015 and $247B by 2025,[2] and rail passenger and freight volume will grow by 4.8% and 4.5% annually through 2035.[3] OECD concludes that "Traditional sources of public finance will not suffice to meet future infrastructure needs, which are huge and growing."[4]

Private investment in infrastructure therefore represents one of the largest-volume investment targets in the next 20 years. Sustained demand for essential, every day services drive revenue for infrastructure investments. Because of this, they offer consistent demand throughout the economic cycle, predictable, sustainable cash flow, and long-term stable returns. Existing infrastructure companies also have low variable costs and stable operating models. The long-term stability of infrastructure investments led OECD to recommend that

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[1] Organization for Economic Co-operation and Development (OECD), *Infrastructure to 2030: Volume 2 – Mapping Policy for Electricity, Water and Transport Telecom, Land Transport, Water and Electricity*, June 2007, p. 15 [http://www.oecd.org/document/49/0,3343,en_2649_36240452_38429809_1_1_1_1,00.html]

[2] *Ibid.*, 289.

[3] *Ibid.*, 329.

[4] *Ibid.*, 14.

policymakers "encourage the investment of pension funds and other large institutional investors in infrastructures."[5]

These large-scale, stable investments also allow the possibility of capital growth through intelligent infrastructure optimization. Because of the scale of the costs involved in the operation of infrastructure, even incremental improvements in performance can boost profits significantly. Optimizing the functional performance of infrastructure companies, in terms of efficiency, effectiveness, resilience and environmental impact allows untapped potential to be realized within stable investments. Open source innovation deployment and scaling will be the primary driver of successful management of the public private sector dynamics which are now part of the global market paradigm.

Recommendations and Conclusion

Market evolution is not new nor is the reflexive resistance to change. The past 30 years of innovation policy and practice has accelerated the transition from proprietary to preferential procurement as the primary value proposition for innovation. The U.K. is not immune from the excesses of the patent system's abuses and, as a result, for U.K. industry to respond, it can lead by example. In domestic, international and development practices, the U.K. could pioneer open-source procurement preferences. Given the legacy patent estates of companies in continental Europe, the U.S., and Japan, the U.K. has more to gain and far less to lose to take this initiative.

In stark contrast to the practices of the past 20 years of U.S. and European Patent Office promotions, the U.K.'s Allison Brimelow, as out-going Director of the European Patent Office, can build on her critique of the need for patent reform[6]. Her tenure boldly called for significant steps to reform the patent system generally if it was to continue to have relevance in the global warming debate.

Climate change involves more than innovation in technology. It involves a renewed commitment to cross-border cooperation and integrated, open innovation solutions. It requires leadership from public procurement agencies to align expenditures with the reality of the innovation landscape. And, based on years of excess, it will involve a thaw in the freezing of innovation under the out-dated, defensive patent regime.

URN: 11/1028

[5] *Ibid.*, 36-9.

[6] http://www.oecd.org/dataoecd/25/45/40759197.pdf (accessed 16-03-2010)