

I. Preface

The central purpose of this paper is to examine the charge made in certain quarters that corporations acquire patents to restrict technological competition. While this charge is made universally against all corporations, I have restricted my analysis to looking at the major oil companies. Since the oil embargo of 1973, environmentalists have attacked the oil industry for preventing the expansion of renewable energy sources (e.g. solar, wind, geothermal, fuel cells, etc.). To my knowledge, no authoritative study has substantiated this charge, yet it is probably accepted by a sizable percentage of the U.S. population. The question is, how much of this perception is just a general distrust of big oil or based on economic reality.

In this paper, I will attempt to answer the question, “*Is it economically feasible for oil companies to acquire patents for the express purpose of restricting competition from renewable energy sources.*” However before that question can be answered, the fundamental economics regarding the acquisition of patents and the feasibility of alternative energy sources in place of oil, need to be addressed.

II. Pursuing Economic Benefit from a Patent

Before one can determine the economic benefit from acquiring a patent, it is important to understand exactly what a patent is and what rights are actually conferred by the patent. The key words to keep in mind when describing a patent are “right to exclude”. The only right a patent provides is to exclude others from making, using, offering for sale, selling, or importing another person’s invention.¹ In addition, to be awarded a patent does not grant the assignee the right to violate any Federal/State civil law, infringe on the prior patent rights of others, or violate Federal antitrust laws. After the 20-year clock starts on the patent, the assignee must pay maintenance fees on all original patents filed on or after December 12, 1980. These fees must be paid at the 3.5, 7.5, and 11.5 year marks, for the patent to remain in force. At the end of 20 years, anyone may make, use, offer for sale, or import the invention, without the permission of the original assignee. This 20-year term can be extended for certain pharmaceuticals or other particular inventions as provided by law.

As one can see, the process of obtaining and maintaining a patent can be both time consuming and expensive. While a patent does not guarantee success to the inventor, the exclusive right it conveys prevents all competitors from developing

¹ U.S. Patent and Trademark Office, "General Information Concerning Patents", U.S. Government Printing Office, 1997, pp 34-35.

and marketing a similar product. This gives the inventor what amounts to a monopoly. The question then becomes is this "monopoly" necessarily bad. Based on research from The Sources of Economic Growth by Richard R. Nelson, it could be argued that no patent protection for inventors might manifest itself in reduced investments in R&D and fewer inventions being planned.² The benefit to society from these inventions is in providing products consumers want and need. The public then benefits after the patent expires when its specifications become public knowledge.

So what determines the economic significance of a patent? Recent research suggests it depends on its scope.³ The broader the scope of the patent, the larger the number of competing products and processes which will infringe on the patent. In their article for the Harvard Law Review, Merges and Nelson (2001) address the issue of patent scope directly. To Merges and Nelson, most theoretical writing on patents is directed toward issues that are considered largely settled. For example, the authors mention how several economists have explored the question of optimal patent duration. They discuss how this work had a direct impact on the decision to extend patent terms for drug companies to compensate for the regulatory process.

² Richard R. Nelson, "The Sources of Economic Growth", Harvard University Press, 1996, pp 129-131.

³ Robert P. Merges and Richard R. Nelson, "On the Complex Economics of Patent Scope", Harvard Law Review. 2001, pp 1-2.

Still, for all the research into patent duration, the term of most patents remains fixed at 17 years (20 years including the application process). Also, there has been debate over the years on the merits of compulsory licensing of patents under certain circumstances, however the intellectual property community has rejected this idea. As a result, all the scholarly research to date has had little bearing on the day-to-day operations of the patent system.

To Merges and Nelson, the only factor left to consider is the economic effects of patent scope. In this area, the patent office and the courts make patent scope decisions every day. The Patent Office does so when it determines the claims it allows on a specific patent. The courts address patent scope in litigation, where questions of patent infringement are decided. An applicant will always claim as much as he can, leaving it to the Patent Office to decide what claims are allowable. In turn, after a patent has been issued, a patentee will often allege that his invention has been copied by competitors. The courts then have to determine if the accused infringer's product falls within the boundaries of a patentee's invention, as defined in his patent claims, or if any differences between the infringer's invention and the patentee's invention are insignificant. Determining patent scope is no small feat for either the Patent Office or the courts. If the scope is too narrow, the patent is

effectively made useless. If the patent is too broad, then competition in a certain technology can be impaired for the life of the patent.

The bottom line of their article is that a patent with a broad scope (in a marketable technology), provides the patentee tremendous income potential over the life of the patent. While supporting patent protection, Nelson (1996) makes the case for limiting patent scope for cutting edge technologies, precisely because of the market dominance that can result from a broad patent scope.⁴ What Merges & Nelson (2001) and Nelson (1996) don't address is whether the same potential income is available to the patentee, if the patent is only used to block other patents.

To illustrate this point, in the 1990's, patent applications were greater than 50% above the pace in the 1980's. Since 1995, the pace of patent applications received by the Patent Office zoomed to nearly 204,000/year up from 173,000/year earlier in the decade and less than 120,000/year in the 1980's. Research and Development (R&D) outlays by all businesses were up about 10% per year since 1994.⁵ The productivity growth of the 1990's paralleled the increase in patent applications. It's extremely doubtful that patentees were applying for all these patents for defensive purposes only.

⁴ Richard R. Nelson, "The Sources of Economic Growth", Harvard University Press, 1996, pp 142-144.

⁵ Gene Kretz, "Patents Tell an Upbeat Story", Business Week, Dec 1, 1997.

The possibility of a broad patent issued to or acquired by an oil company for a renewable energy technology is what scares Ralph Nader and environmentalist groups. Ralph Nader addressed this fear of renewables being stymied by corporations (e.g. oil companies) in his article The New Energy Crisis: Getting Government's attention on Renewables.⁶ The problem with this charge is that it flies in the face of economic logic whether dealing with a competitive market or a monopoly. Let's assume we are dealing with a pure monopoly, where there is only one seller in the market. The monopolist is still in competition for the consumer's dollar. So unless a monopolist can secure a market for his product(s) his monopoly position is worthless. As Robert H. Frank states in his book Microeconomics and Behavior, monopoly does not guarantee success, it only guarantees that the monopolist can make the most of whatever demand conditions exist.⁷ Also, monopolists would not automatically suppress technological innovation if the potential profits exceeded the profits of their current products. To Frank, the monopolist's rule for maximizing profits is no different than a firm under perfectly competitive conditions. The monopolist will increase output as long as Marginal Revenue exceeds Marginal Cost, and reduce output if the loss in revenue is less

⁶ Ralph Nader, "The New Energy Crisis: Getting Government's Attention for Renewables", In the Public Interest, Oct 6, 1999.

⁷ Robert H. Frank, "Microeconomics and Behavior", Irvin/McGraw-Hill Publishing Inc., 1997, pp 421-423.

than the reduction in costs. The only substantive difference between a monopolist and perfectly competitive firm is that for a monopolist Marginal Revenue is less than price and for a competitive firm Marginal Revenue is equal to price. In deciding whether to acquire patents to suppress technological innovation, the behavior of monopolists and competitive firms is the same. Now applying this reasoning to the question of whether oil companies suppress alternative energy technologies to protect oil profits, economic theory directly challenge this allegation by environmentalists

Monopolists, be they oil companies or not are in the business of maximizing profits than suppressing technological innovation. As an example, an oil company can produce gasoline at a certain total cost per gallon. At the same time, this same company has acquired a patent for a fuel cell that can produce energy at a lower total cost per gallon-equivalent. Figure 1 describes this situation. The cost of producing a fuel cell at \$0.30/"gallon" is only one-fifth the cost of producing a gallon of gasoline. To sell gasoline, the monopolist needs to charge price P1. Conversely, if the monopolist produces fuel cells, he just needs to charge price a price below P1, in this case price P2. Since the monopolist's (oil company) profits from fuel cells

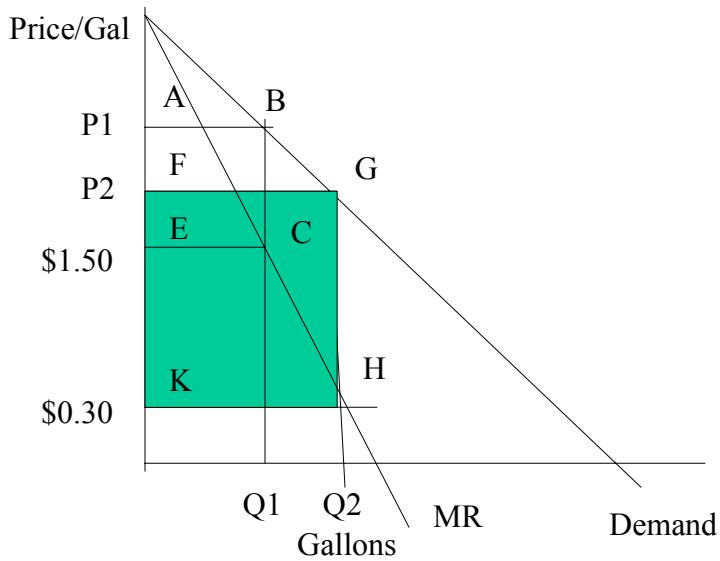


Figure 1. Do Monopolists Suppress Innovation

(Area FGHK) exceeds its current profits from making gasoline (Area ABCE), the monopolist will convert to fuel cells.

Whether dealing with oil companies, electric utilities or auto companies, a corporation's chief functions are to maximize profits and shareholder value. If an oil company can do this producing fuel cells instead of gasoline, they will do it. As Figure 1 shows, firms will not suppress technological innovations if the profit potential exceeds what they're currently producing. The mistake environmentalists make is in assuming oil companies are ideologically attached to producing fossil fuels and hostile to alternative or renewable energy sources. However, as Figure 1

illustrates oil companies will produce fuel cells if the returns are superior to gasoline.

Right now the demand and quality of renewables are not at the point where there is a groundswell of consumer demand. When that point is reached energy companies will have no problem in converting from fossil fuels to renewable energy products. At present, with energy prices at relatively low levels there is no sizable increase in energy R&D spending or in energy patents for either renewables or fossil fuels.

To illustrate, Vergano (2001) in his article references University of California-Berkeley economist Antonia Herzog, who theorizes that innovation in the energy sector declined due to a drop in public/private R&D spending on new energy sources. According to this article, new energy spending dropped from a peak of \$12 billion in 1980 to less than \$4 billion in 2001. Energy patents as an indicator of innovation have declined in “lock step” with the spending decline. In 1994, energy patents bottomed out at a low of 54, from a high of 228 in 1981, as shown in Figure 2 (page 26). Only 0.4% of net energy sales are spent on research, according to the National Science Foundation; figures which compare to 10.2% of

net sales on research in the pharmaceutical sector.⁸ Vergano also cites Herzog when she attributes this spending decline to the return of more stable energy markets following the 1970's oil crisis, and government's reduction in energy spending. She also theorizes that energy deregulation discouraged private research efforts. Or some would say, deregulation made such expenditures unnecessary.

If a case could be made for using patents to restrict competition, it might be made for the pharmaceutical industry. Most non-drug patents last from 17.0-18.5 years. For drug patents it is closer to 11.5 years (due to years spent winning FDA approval). Conservatively, it takes 12-15 years from lab to drug store for a new drug. Also, it takes on average \$500 million to discover/develop one new medicine. For this reason, there is every incentive for a drug company to use a patent proactively to block the development of generic competitors. A drug company will want to maximize revenue from their patented brand name drug to recover R&D and initial marketing costs. With an already shortened patent term, drug companies can ill afford the competition from generics, even if awarded a patent extension from Congress. It should be noted, that even in this situation, drug companies are most likely exercising their patents, not just using them to block generic drugs. So the incentive is still to produce products with one's patent, as the 1990's activity would suggest.

⁸ Dan Vergano, "Energy Research Drop-off: Less Spending, Fewer Advances", USA Today, Oct 15, 2001.

The evidence presented thus far would seem to indicate that even oil companies would not acquire alternate energy patents just to inhibit these technologies. In Section II, I will show that oil companies had opportunities to convert to producing fuel cells and electric batteries since the 1970's, but chose not to do so for purely economic reasons.

III. Economic Feasibility of Fuel Cells and Electric Batteries

In this section, I will assess the current prospects of two alternative energy sources (Fuel Cells, Electric Batteries), and why they have not taken the place of gasoline for powering our automobiles and why oil companies haven't acquired patents for these technologies.

Since the 1960's Americans have had a love-hate relationship about oil. We need it to produce the gasoline we use, but we hate being dependent on it and what its use does to our environment. We demand our energy independence, but do not want to pay the higher gasoline prices that would wean us from foreign dependency. America as a society understands the necessity to conserve oil. However, Americans as consumers still need oil products to power their vehicles and heat their homes.

Over the last twenty years, significant improvements in fuel economy have come from reducing vehicle weight, incorporating more aerodynamic shapes, and using radial tires. Also, improved engine design has reduced the carbon emissions from newer automobiles. Despite this success, significant improvements will still have to be made in order to lessen our dependence on fossil fuels and reduce air pollution. Over the next fifteen years, automobile ownership and use are expected

to rise substantially.⁹ If these projections are correct, all the improvements made in the U.S. regarding fuel economy and air quality over the last 25 years will be overwhelmed. Car manufacturers both in the U.S. and rest of the world are coming to the realization that the internal combustion engine will need to be replaced. Difiglio (1997) in his article estimates this transition will be phased in over the next 10-15 years.¹⁰ It will not be a crash program to protect us from “Global Warming” as former Vice President Al Gore advocated in his book Earth in the Balance, which inspired the failed Partnership for a New Generation Vehicle (PNGV)¹¹ project. Despite the best efforts of the federal government, auto companies, and environmental groups, it will not be easy to break Americans from the gasoline habit. Until they do, the major oil companies have no economic incentive to invest in alternative energy sources. Two such technologies that have been touted as replacements for the gasoline-powered vehicle are Electric Batteries and Fuel Cells. Following is an examination of both.

1. Electric Battery Vehicles

The technology of Electric Vehicles (EVs) has been around longer than gasoline-powered vehicles but consumers turned away from the EV due to its

⁹ Joyce Dargay & Dermot Gately, “Vehicle ownership to 2015: Implications for energy use and emissions”, *Energy Policy* 25, no 14-15 (December 1997): 1121-1127.

¹⁰ Carmen Difiglio, "Using advanced technologies to reduce motor vehicle greenhouse gas emissions", *Energy Policy* 25, no. 14-15 (December 1997): 1173-1178.

¹¹ ibid.

limited range and speed. Their comeback is motivated by the promise of clean air and freedom from oil imports. Enthusiasm for EVs is mostly from bureaucrats and environmentalists.¹² The chemistry of batteries has been basically the same for the last 100 years. However, there are few battery breakthroughs on the horizon. Considering the lead times it takes to engineer and market a new car, the coming EVs will still be limited in both size and performance. Currently, EVs suffer from a max of 65 mph for only 90 minutes. This time period is even shorter if the air conditioner, heater or headlights are also running. In some cases, owners will have to recharge the batteries for up to eight hours. Including the cost of batteries, electric motor, and other components as well as the small scale production, EVs will have a price premium on a typical \$16,600 car of anywhere from \$1,350 to \$20,000.¹³ Considering the challenges to be overcome, no U.S. auto company wanted to absorb the development costs of EVs alone. In order to underwrite the cost of battery research, the Big Three (Ford, GM, Daimler-Chrysler) formed the U.S. Advanced Battery Consortium. The aim of the consortium is to develop vehicle batteries that will last five years and cost \$6,000. The technology may improve, but the challenge will be finding customers willing to pay a premium for

¹² Jim Motavalli, "Forward Drive: The Race to build Clean Cars for the Future", Sierra Club Books, 2000, pp 214-220.

¹³ Alex Taylor III, "Why Electric Cars Make No Sense", Fortune, July 26, 1993: 126-127

an EV. As mentioned earlier, the chief cheerleaders for EVs are bureaucrats and environmentalists. During a guest lecture at Virginia Tech, Dr. Stephen DeCanio of the University of California, Santa Barbara provided an update on the state of California's mandate that the Big Three automakers convert 2% of their yearly sales in the state to zero emission vehicles (ZEVs) by 1998, 5% by 2001, and 10% by 2003. From 1998-2000, less than 0.1% of vehicles sold in California were EVs or any other type of ZEV.¹⁴ Despite the meager results in California, eleven other states, mostly in the Northeast, including Illinois and Texas also considered similar mandates.¹⁵ With demand for EVs in this country low, only heavy subsidies, by automakers or governments have kept their price competitive with conventional vehicles. Another blow to the panacea of EVs is that they are not pollution free. While the vehicles themselves do not produce pollution, the utilities that produce the electricity for charging the batteries do. Bottom line, electric battery technology has not jumped by leaps and bounds and their performance to date has been marginal. Still, with their support from government policymakers, investment in EV technology will continue, but consumer demand may not.

¹⁴ Dr. Stephen DeCanio, Univ of California, Santa Barbara, guest lecturer to Va Tech STS Class; 10/16/00

¹⁵ Alex Taylor III, "Why Electric Cars Make No Sense", Fortune, July 26, 1993: 126-127

2. Fuel Cell Vehicles (FCVs)

The second technology to be addressed is Fuel Cell Technology. While Electric and Vehicle technology dates back to the early 20th Century, fuel cells were developed in the 1960's for the U.S. Space Program. Basically, FCVs operate in the reverse of the electrolysis of water, where electricity is used to split water into gaseous hydrogen and oxygen. Fuel Cells combine hydrogen and oxygen into water and in the process a flow of electrons from an anode to the cathode is established, producing the electricity that powers the vehicle. For automotive vehicles, oxygen will be extracted from air and hydrogen would be extracted from a variety of hydrocarbon fuels, or carried onboard in gaseous or liquid form. With hydrogen as the source, fuel cells can convert fuel into electric energy at an efficiency of about 50-60% or 2 1/2 times more efficiently than an internal combustion engine.¹⁶ Other sources besides hydrogen are alkaline, methanol, ethanol, and natural gas. If another source besides hydrogen is used, a reformer must be employed to extract hydrogen from the fuel before it can be used in the reactive process. Also, if any fuel other than hydrogen is used, efficiency is reduced. The advantage of an FCV is that the engine has few or no moving parts to wear out, makes no noise and has increased range and performance over battery-powered electric vehicles. More importantly it saves fossil fuels and emits only water vapor as the byproduct.

The disadvantage of fuel cells is that they typically contain expensive metal catalysts to pull electrons off hydrogen, and in the process can be clogged up by contaminants. In addition, fuel cells, especially using alkaline, suffer from slow start-up, low specific power, and slow response to changes in load. Another disadvantage is that existing fuel cells can work only with a few fuels, such as hydrogen and methane, both of which are difficult to store and dangerous to handle.¹⁷ Still, the technology is promising enough to automakers that improvements in this technology are pressing ahead. A number of car manufacturers already have prototypes. Ford recently unveiled their prototype hydrogen-powered fuel cell car.¹⁸ The Ford Focus FCV is Ford's demonstration project to prove the technical capability of fuel cells. Ford plans to offer FCVs to consumers by 2004. Other automakers (e.g. Mercedes) are also testing FCVs, so the race is on to bring FCVs to the marketplace. Still, even fuel cell boosters will admit FCVs are still years way from competing with conventional gasoline-powered vehicles in both total performance and customer satisfaction.

Against this backdrop, it is not surprising that oil companies have not been enthusiastic acquiring alternative energy patents . From a strictly economic standpoint, this section would seem to answer the question of whether major oil companies would acquire alternative energy patents to restrict competition from these technologies. The answer

¹⁶ Robert Q. Riley, "Alternative Cars in the 21st Century", Society of Automotive Engineers, Inc., 1994, pp 244-245.

¹⁷ Jeffrey Winters, "Tomorrow's Engine", Discover Magazine, February 1998. pp 26-28.

is no. However, in order to confirm this assessment, the following section will examine actual data from the U.S. Patent Office describing whether oil companies have actually acquired alternative energy (e.g. electric battery, fuel cell) patents.

¹⁸ Mark York, “Bloomberg News Article of FCVs”, Washington Times, Nov 3, 2000.

IV. Have Major Oil Companies actually acquired Alternative Energy Patents

Considering the expense incurred by a firm in acquiring a patent and the unfulfilled prospects for certain alternate energy sources, it would not seem to make economic sense for oil companies to obtain alternative energy patents. Still, the perception exists that corporations (e.g. oil companies) have acquired rights to patents for alternate energy technologies in order to restrict their development.

This perception has been strong since the oil shortages of the late 1970s. As mentioned earlier, the purveyors of this “conspiracy theory” have been primarily the environmentalist movement, inspired by Ralph Nader and his Public Interest Research Groups (PIRGs).¹⁹ Environmentalists in particular have been vociferous in their criticism of oil companies. As far as the environmental movement is concerned, all alternative energy technologies have been targets for oil companies using their profits to acquire all the renewable technologies they can obtain, to preserve their petroleum-based businesses.²⁰ While this perception is widely held by certain sectors of society, no comprehensive study has been done to substantiate this charge.

¹⁹ Ralph Nader, "The New Energy Crisis: Getting Government's Attention for Renewables", In the Public Interest, October 6, 1999.

²⁰ Ralph Nader, "Dick Cheney and Conservation", In the Public Interest, 5/1/2001.

While there have been many studies on alleged and actual monopolistic practices among the oil companies, no specific studies have been conducted looking at the acquisition of patents by these same oil companies. In setting out to determine the accuracy of this allegation, let us assume that oil companies do acquire patents to restrict alternative energy technologies.

In order to confirm if oil companies acquired alternate energy patents for fuel cells and electric batteries, I developed a test, whereby I examined the patents issued by the U.S. Patent Office from 1983 to 2001, for Fuel Cells and Electric Batteries against those issued from 1976-1980. The first period was a time of relatively stable oil prices, while in the second period energy prices were quite volatile. If oil companies were going to acquire renewable energy patents it would be during the period of energy price volatility, because rising energy prices would make research in renewables competitive to fossil fuels. Reviewing Patent Office data for the period, 1983-2001, 222 Fuel Cell patents and 65 Electric Battery patents were issued. Using Lexis/Nexis references, I was able to identify the ownership for almost all companies examined. Their associated Standard Industrial Classification (SIC) codes are listed in Appendix A and Appendix B respectively.

Table 1. Fuel Cell Patents by Sector 1983-2001

Manufacturing	A	42
Electronics	B	28
Energy	C	27
Academia	D	20
Research	E	20
Chemicals	F	17
Elec Power	G	15
Unknown	H	15
Automobile	I	11
Personal	J	9
Government	K	9
Fuel Cell Dev	L	8
Env Eng	M	1
Total		222

Table 1 lists the fuel cell patents in descending order, by industrial sector. For 15 patents, I was unable to identify the sector. This was due to the firm being an obscure foreign company and not listed in any of the reference material used. The top fuel cell sector was Manufacturing of which none were oil companies. Other sectors in the top five were: Electronics, Energy, Academia, and Research. As with Manufacturing, there were no oil companies listed as ultimate owners of the patents. The Energy sector in particular was composed almost entirely of foreign firms, such as British Nuclear Fuels and Tokyo Gas Company Ltd. As shown in Figure 3 (page 26), Manufacturing has a strong, but not overwhelming lead.

Looking at the Electric Battery patents issued since 1983, there have been far fewer patents than fuel cells. In contrast to fuel cells, only one company involved with electric batteries could not be identified with a sector. Table 2 lists the electric battery patents in descending order, by industrial sector.

Table 2. Electric Battery patents by Sector 1983-2001

Personal	A	19
Manufacturing	B	13
Power Supply	C	12
Automobiles	D	8
Electronics	E	6
Energy	F	3
Aerospace	G	2
Computers	H	1
Unknown	I	1
Total		65

The leading sector for electric batteries was personal. The Patent Office website did not list any licensing agreements these individuals might have entered into. Following Personal patents were Manufacturing, Electric Power Supplies, Automobiles, and Electronics. Figure 4 (page 27) provides a breakdown of the electric battery patents. Again, exactly like fuel cells, no major oil companies were among those firms within the electric battery sectors.

Since the period 1983-2001 was a period of relatively stable energy prices for fossil fuels and minimal R&D dollars invested in energy research, it is not surprising there were no alternative energy patents acquired by major U.S. oil companies. In contrast, the 1970's were a period of unstable energy markets where consumers were willing to consider alternatives to fossil fuels. The 1970's would seem an ideal opportunity for the oil companies to acquire alternative energy patents as a defensive strategy. However, a review of the actual Patent Office data does not support this strategy. First looking at Fuel Cells from 1976-1980, Table 3 lists the patents by sector. Figure 5 (page 27) provides a breakdown of fuel cell patents.

Table 3. Fuel Cell Patents by Sector 1976-1980

Automobiles	A	5
Government	B	4
Manufacturing	C	3
Energy	D	3
Oil Companies	E	2
Electronics	F	1
Recreation	G	1
Unknown	H	1
Total		20

Of the 20 patents issued during this period, only one was issued to an oil company, the Exxon Corporation/Research and Engineering Company. Of 24 Electric Battery patents, two patents were issued to Exxon Corporation. Table 4 lists the Electric

Battery patents by sector. Figure 6 (page 28) provides a breakdown of electric battery patents.

Table 4. Electric Battery Patents by Sector 1976-1980

Electric Power	A	13
Personal	B	5
Unknown	C	3
Government	D	1
Oil Companies	E	1
Recreation	F	1
Total		24

As shown, the Exxon Corporation acquired a patents for both a fuel cell design and an electric battery design in the 1970's. Carefully examining the history of each patent, neither design heralded a major breakthrough in its respective technology, so Exxon was not positioned to use their patents to suppress these technologies. From all the evidence examined from the Patent Office and available literature, Exxon investigated the feasibility of these technologies and was not impressed with their profit potential. So despite the energy problems of 1970's, there was no glut of fuel cell and electric battery patents acquired by oil companies, because these two technologies still weren't economically competitive.

V. Conclusion

When the founders gave Congress the authority in Article 1 of the Constitution to grant patents, they understood their importance in encouraging technological innovation and entrepreneurship. Many environmentalists today believe there is significant promise in alternative energy patents. For both fuel cells and electric batteries, no major oil companies were assigned patents for these technologies for the last 20 years. There are other alternate energy sources that should be examined (e.g. solar, wind, geothermal, etc.) for patent ownership by oil companies, but for fuel cells and electric batteries, examination of the patents issued that are still in force does not support the assertion that oil companies purposely acquire these patents. If oil companies ever begin to acquire such patents, only by watching what they do with them can we know what the true purpose of such acquisition might be. At present, the allegation that oil companies acquired alternative energy patents to suppress technological competition, is not supported by the actual patent data or economic theory.

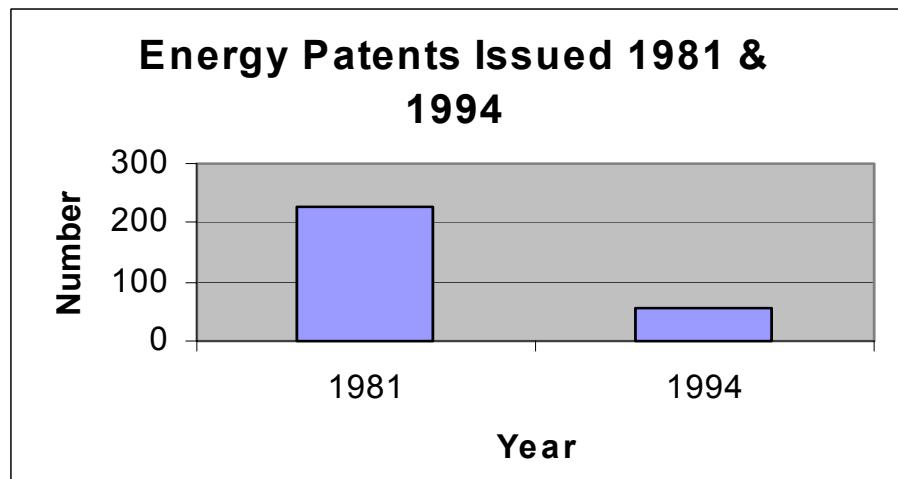


Figure 2 - Energy-related Patents in 1981 & 1994

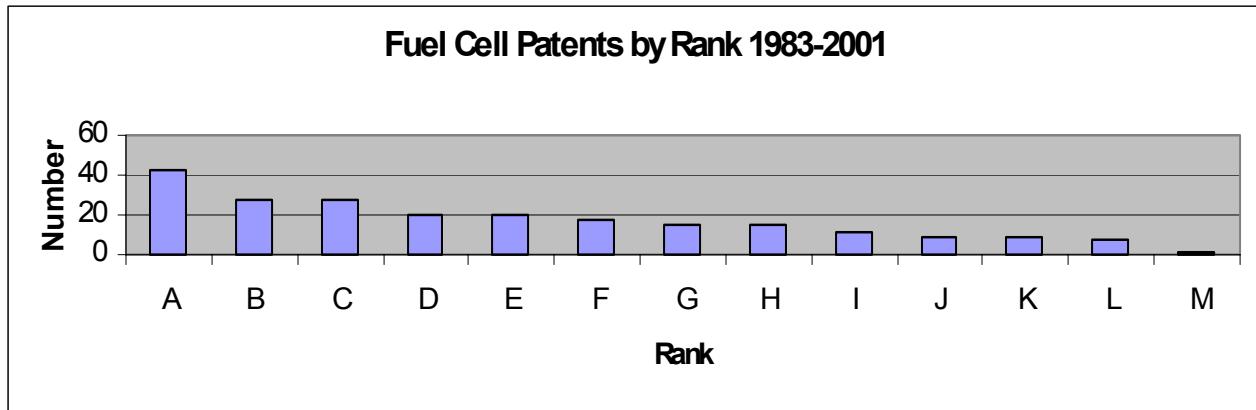


Figure 3 – Fuel Cell Patents by Rank 1983-2001

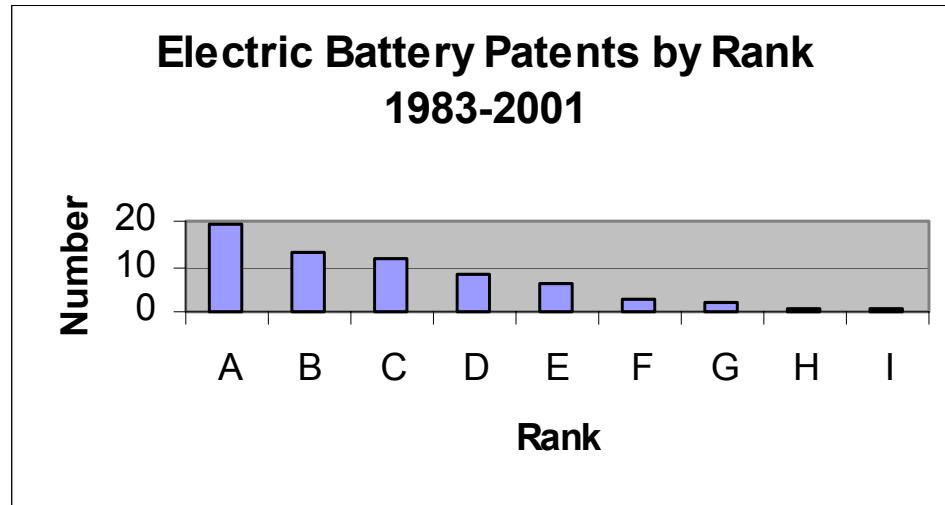


Figure 4 - Electric Battery Patents by Rank 1983-2001

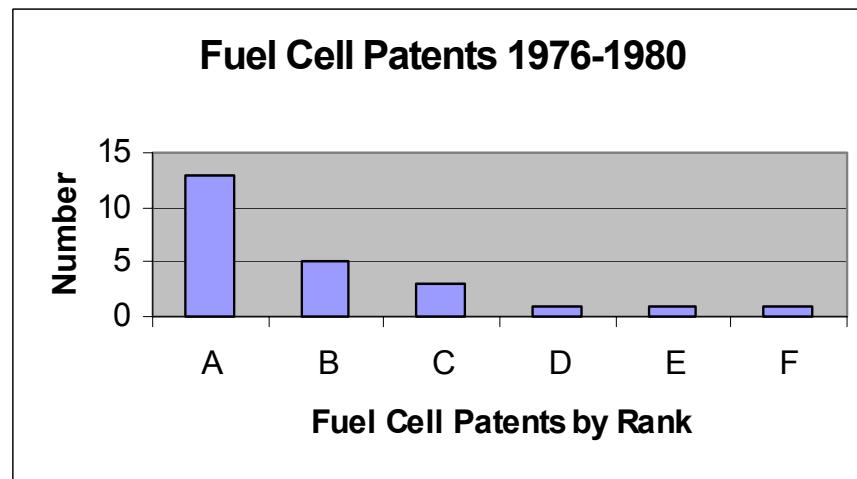


Figure 5 - Fuel Cell Patents by Rank 1976-1980

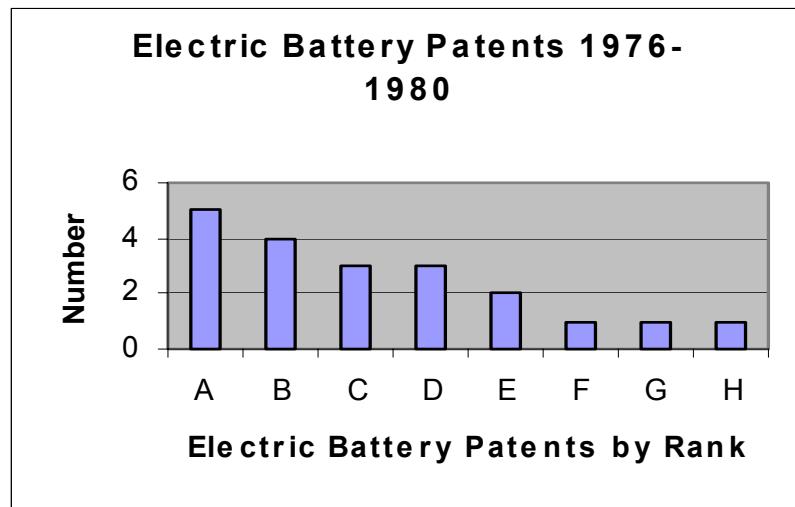


Figure 6 - Electric Battery Patents by Rank 1976-1980