Timeline

A Chronology of Public Opinion on Nuclear Power in the United States and United Kingdom

Stephanie Dalquist
29 April 2004

The China Syndrome, *a film eerily prophetic of the Harrisburg accident, has drawn huge crowds—and protesters, as seen here in Philadelphia.*

Table of Contents

Abstract
At 3:25 Central Standard Time on February 12, 1942 beneath the University of Chicago, physicists first captured the power of the atom. A team led by Enrico Fermi initiated a self-sustaining nuclear chain reaction which would introduce the most destructive weapon ever known into the Second World War and the most advanced power source to homes worldwide. Ten years later, the first usable electricity was pulled from the atom in 1951. The military origins of and applications for nuclear power set the trends in American public opinion and an anti-nuclear movement which would shape the industry until the end of the twentieth century.

Only forty years ago, nuclear power was hailed as the miracle technology which would change the way we live forever. But the last US nuclear power plant went online in the late nineteen seventies, bringing the total number of operating power generators to 111. Since then, more than 120 orders have been canceled in the middle of construction or indefinitely postponed. The root cause is the change in public opinion over the decades, and its associated effects on economic and logistic viability of nuclear power. Nuclear disasters and the ineffective government and corporate responses fed the anti-nuclear movement and shaped today's opinions. The movement was at its strongest in the early seventies, matched in strength by protests of the Vietnam War, from which the anti-nuclear movement drew many of its tactics and participants.

The United Kingdom was also an early leader in nuclear technology, but the British public was slower to form an opinion on nuclear technology. An early incident at Windscale was a significant setback to the newborn nuclear industry. Despite significant construction in the sixties and seventies, the British have consistently been less supportive of nuclear power than Americans. The UK was also in the direct path of fallout from Chernobyl, and were again made aware of the risks accepted for nearly unlimited energy.

1 Introduction: Growing up together

This year, 111 nuclear power generators will provide approximately 20% of the nation's total electricity[1]. Commercial nuclear generators are distributed unevenly throughout the country. There are more in the densely populated and industrialized East (Figure 1). On the other side of the Mississippi, sparse population and manufacturing results in lower electricity demands which are met with easily-accessible coal. That coal may become even more important if, as the EIA predicts[2], nearly 40% of US nuclear capacity shuts down within the next twenty years.

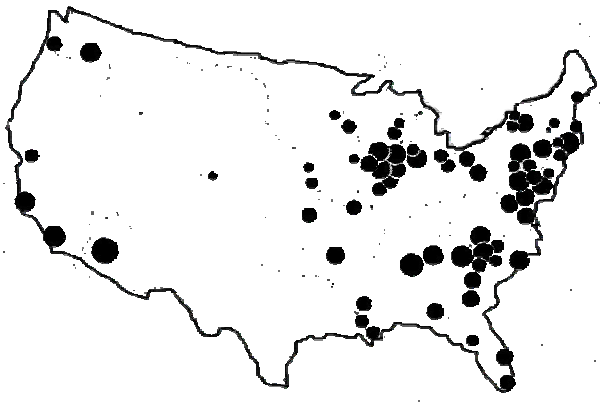

Figure 1. Location and relative size of US nuclear plants in operation, 1987.
Source: Mounfield, P.R. 1991.

It is unlikely that new nuclear plants will replace the decommissioned ones unless public opinion towards nuclear power changes. People most fear risks[3,4]

- That are imposed, rather than self-selected
- Where the source of danger cannot be easily identified by the senses
- Where possible harm may be manifest only after a long period, and
- That arise from a novel activity.

All of these are characteristics of nuclear power. In addition, organizational problems and risk availability increase the general trend of fear.

Opposition of nuclear power first developed because of its military connections. The technology originally came from military submarines, and the first commercial plant in the US was even owned by the US Navy[5]. Secrecy was a fundamental component of the military project which carried over to the nascent civilian projects. Elements of the old

culture resurfaced during accidents or following reports on adverse health effects and were detrimental to public support[5]. But when the risks were presented, and the most unlikely scenarios considered, people's attention focused on the severe but highly unlikely possibilities. Far less concern was given to the consequences of day-to-day operations[5]. Calming public fears and settling lawsuits led to frequent cost overrruns and poor economic performance. Nuclear power plants had unprecedented capital costs and utility costs far from "too cheap to meter." Other problems which concerned the public were High Level Waste (HLW) disposal, and the effectiveness and independence of regulators.

Many of the concerns plaguing nuclear power development were exacerbated by poor administrative planning for large scale use and insufficient consideration of the psychological effects on the public. As the application was scaled up, the point at which nuclear programs began to offer practical benefits also marked the era which saw the rapid growth of opposition to nuclear power[3]. Because much of the increased cost of siting and licensing a plant were caused by negative public opinion, the government and utilities responded by trying to improve the image of nuclear power. This began with an organizational divorce from the military, and eventually, industry assumed an increasing share of expenses previously paid by the government[5]. The new role led to investigations on improving economic performance in the interests of the public and private industry. Most studies found[3] that the best way to decrease costs was to increase support. This led to a wide range of programs designed to improve communications, including

- Visitor centers
- Local and national conferences and debates
- Educational materials for schools
- Increased independence and visibility of nuclear safety authorities, including their activities and the performance of facilities[5].
- An International Nuclear Event Scale from the International Atomic Energy Agency (IAEA) to give consistent ratings of the different levels of operation and incident[7]

The United Kingdom, another early leader in nuclear power technology, encountered similar trends as the need for new power and nuclear facilities grew. The UK had to contend with a national nuclear crisis during the Windscale incident in 1957. Today, old plants soon in need of relicensing or decommissioning can be found in both countries, along with a political desire to meet electricity demands and carbon emissions goals, and a public that sees no urgent need to expand the energy supply or build new nuclear plants, but believes nuclear will be a part of the future.

2 The nuclear age in America

Had some of these communication-based principles been considered in the beginning, the nuclear industry may not have ended up in the uncertain position it is in today. The need to maintain secrecy in the first years of development was evident. At the time Enrico Fermi initiated the first self-sustaining nuclear reaction in 1942 Chicago, the world was embroiled in World War II. The Germans were known to be working on their own nuclear weapon[1]. The next years were spent on plutonium research and military applications, but soon after the war ended, President Truman signed the Atomic Energy Act, forming the Atomic Energy Commission (AEC) to "develop the nation's nuclear energy capabilities and explore peaceful uses of atomic energy." Thus began the Swords into Plowshares campaign on August 1, 1946.

2.1 History of the atom in the United States

Nuclear power quickly made its way into the imagination of popular culture. Dick Tracy carried an "atom-powered two-way wrist radio" from 1946 on[7], and futurists predicted that every home would have its own generator. Civilian nuclear power entered AEC policy in 1948, with the eventual goal of producing commercially competitive electricity. The public was interested, but hesitant at first. Visitors to the AEC visitor center left feeling more hope and less fear about the atomic future[7]. By the end of the year, the AEC knew that public relations would be a key component of growth. There were still PR gaffes, as in 1950, when Scientific American was forced to pull an article on nuclear power and burn 3000 copies of the issue[7]. Less than a year later, the Argonne National Laboratory produced the first usable electricity from nuclear power[1]. By 1953 one of

every 300 articles in *Reader's Digest* was about nuclear energy, a sharp rise from the late 1930s (one of every 3000)[1]. The press was overwhelmingly positive.

2.2 1950s: The atom goes commercial

The military/civilian dance continued throughout the fifties. The AEC tested bombs in Nevada, claiming there was no hazard presented by the fallout, which was simply[7] an "inconvenience," and denying connections to area health problems. Eisenhower gave his 1953 "Atoms for Peace" speech to the United Nations, proclaiming that all countries should work together to promote peaceful uses of atomic energy and to share information and materials. 1954 brought the declassification of military research, leading to privatization throughout the US, and another bomb detonation – this time on the Bikini Atoll, obliterating the island and spreading fallout across the ocean and several island nations. The "harmless" fallout sickened people on other islands and the crew of a nearby Japanese fishing boat[8]. By then, the AEC knew the cause of the illnesses, and the trust of the public suffered from the AEC's continued denials. The same year, the AEC revoked the security clearance of Robert Oppenheimer, scientific director of the Manhattan Project[7]. Not only had the AEC alienated the public, they were losing the scientists, too.

Although more people lost confidence in nuclear power after major nuclear incidents, it would be untrue to say that operational problems did anything more than fuel anti-nuclear sentiment. The real difficulty was that nuclear energy was introduced to the public during World War II as a weapon of undreamed-of destructiveness. At the time, however, national imagination and publicity focused on nuclear power as a magical source of unlimited energy, where a bit of fuel the size of a pea could take a ship to the moon and back[9]. As the promotion films in the late forties said[7], "when you get deeper and deeper into the secrets of life, you find them so fascinating you sometimes forget that the atom can kill." Even some of the utility companies were opposed to nuclear energy at the beginning, declaring it expensive and unnecessary, but they were still able to do research and venture into nuclear power with large government subsidies. This was how Shippingport and subsequent early stations came into being – they were symbolic of what

could be done with weapons technology, and represented a national technological accomplishment. The Shippingport (Pennsylvania) Nuclear Power Station opened in December 1957, adding 60 MW_e to the national power grid. Shippingport was owned by the US Navy and the design was taken straight from the Nautilus, a nuclear submarine[1]. This accomplishment was hailed in a full 1% of 1958 *Reader's Digest* and *New York Times* articles[7].

Local opposition was always a reality – even Shippingport had its opponents. In the US, as in other countries, unions opposed nuclear power because it would put coal miners and others in the supply chain[1]. The environmentalists, a strange partner for the unions, were already concerned about the effects on public and environmental health. Together, they organized the first major public protest occurred at the opening of Shippingport. The opposition was mostly local, and would remain so for two decades, from one site to the next. Local groups protested the siting of plants in California (in a nature preserve and on a geologic fault!) and in New York City, just a mile from Central Park[10].

2.3 1960s: Everything will be all right

Nuclear power represented a new risk which people could not easily understand. Bizarre fears turned up that nuclear damage could strike anytime, anywhere in the world. Radiation turned up in movies disguised as monsters or named by a faceless scientist as the source of mutant monsters destroying the city[7]. Dick Tracy still wore an atom-powered watch, but now Superman could be weakened by the glowing kryptonite from planet Krypton. In response, the Atomic Energy Commission produced and distributed more than twice as many films between 1963 and 1967 as they had in the previous decades[7]. Instead of promising the utopian future of nuclear power, the message focused on practical reassurances. By the end of the decade, the nuclear industry was making and distributing more education and public relations materials (by quantity and cost) than any other industry in the nation[9]. If anything, the intensity of efforts to reduce and downplay risk without explicit communication about achievements may have increased perceived risk and even intensified fears[11]. Supporters were busy portraying nuclear energy as environmentally friendly and cleaner than other power sources, hoping to increase the

number of supporters[12]. The claims may have been true, but opponents were not only worried about the environment. Even though the US did not and never would use breeder reactors for reasons of national security, and as a result, had more radioactive waste and lower energy production efficiency, international events forced the public to be concerned about the proliferation of nuclear weapons and their connection to nuclear power. In 1965, 200 pounds of uranium disappeared from a disposal site in Pennsylvania. The AEC told Congress that there was "no evidence that would lead us to believe or suspect that the material had been diverted," but when it turned out that the uranium may have been sent to Israel, head of the CIA Richard Helms was said[13] to have told President Lyndon Johnson "Don't tell anyone. Don't tell McNamara, Don't tell Rusk," referring to the Secretary of Defense Robert McNamara and Secretary of State Dean Rusk.

While publicly denying the risks associated with nuclear power and the consequences of failure, the government was also studying the possible effects of a core meltdown and release of radioactive gas. The study found that such an incident could affect an area "equal to that of the state of Pennsylvania," but the report was buried[14]. The government knew that releasing the report would sap public support and increase the already significant cost and hassles of siting new plants. Until and even after it was uncovered by a 1974 filing under the Freedom of Information Act, the sponsors claimed that the study had never been finished, and therefore, never released[14].

The feelings in the power industry had changed as more plants came online – originally concerned about the expense and frivolity of the new technology, utility companies came to believe that nuclear would be the only way to provide power in the future. Industrialized and urban areas were passing increasingly strict ordinances on emission, labor costs were rising, and the price of coal had been kept artificially high because the cost of nuclear power was, at the time, still higher[1]. Slowly, the change in attitude allowed nuclear power to penetrate into coal country. As the number of plants grew and the technology matured, more plants lowered prices, ultimately hurting the coal industry.

Overall, energy costs had been rising throughout the decade, and people began to pay more attention to their consumption patterns. The conservation and use of fossil fuels received increased attention, and policymakers looked instead at "soft" alternative energies such as hydropower. After all, there was no point of developing a nuclear program if the nation could get unlimited energy from nature.

2.4 1970s: A time of crisis, a change of heart

As the sixties progressed into the seventies, the successes of nuclear power mounted. The nuclear power plant at Shippingport, Pennsylvania opened at the end of 1957 after only four years of construction[1]. Ten years later, there were 38 plants, and in 1975, there were 45. Increasing attention was paid to the licensing and regulation of nuclear power plants, leading President Gerald Ford to reshape nuclear administration, splitting the AEC into the Energy Research and Development Administration and the Nuclear Regulatory Commission (NRC), which promptly codified safety and licensing[5]. None of these moves stemmed the growing discontent of the public.

The beginning of the decade was marked by the 1973 energy crisis following the Arab Oil Embargo. Oil prices quadrupled, and prices of other fuels and electricity also rose. Interest in renewable, particularly solar and wind, energy rose[15]. The push did not extend to nuclear power, however. A strong economic downturn gripped the United States for years afterwards, caused by the energy crisis and increasing efficiency of foreign manufacturers.

The recession caused electricity demand to stabilize and actually decreased in 1982 for the first time since World War II. Inflation rose dramatically, making all large-scale construction impractical. With high costs and low demand, all types of planned power plants were cancelled. Nuclear was hit hardest, though, because capital costs were 30% to 100% higher than for coal-fired plants[11]. The effect of lower than forecasted load growth and constraints on construction financing can be seen in the number of plants ordered: a peak number of plants, 42, were ordered in 1973. 24 were ordered in 1974, but 0 in the years following that[3]. The last new power plant to go online was connected

to the grid in 1974. No plants have been opened since then, and many have been left in advanced stages of construction. Shoreham, at Long Island, New York, was completed but will probably never be used[1]. Increased concern over environmental quality, emissions and thermal effects regulations gave anti-nuclear groups many good ways to stall construction indefinitely. Confidence was further shaken by the other side of the world as India performed test explosions of its first nuclear weapons[3].

The turning point for anti-nuclear organizations came in 1976. It was the national bicentennial, an election year, and for protesters, the year of "direct action," or confrontation. Nuclear protest went national when Ralph Nader founded the Critical Mass Energy Project[1]. Nader provided the loosely affiliated local groups with data and experts to fight the proposed utilities through legal channels. Along with legal challenge, civil disobedience became a crucial tactic. Thousands of people turned up for occupations, and the distance traveled by protesters to support other groups grew. Since the heart of the protest was still local, though, most of these groups failed to attract sustained support and faded out of existence when they became locally obsolete.

Anti-nuclear groups had historically had a local user base fighting the approval of specific plants because the problem seemed local in nature to the public[16]. A significant majority of Americans (between 70% and 80%, throughout the seventies, Figure 2) believed that nuclear power should play a somewhat or very important role in the national energy strategy for the future. Between 61% and 63% of those surveyed supported building nuclear power plants in general. But when asked if they would favor or oppose the building of nuclear power plants in their local area, 23% said they were flat out opposed to the idea, and 59% said they would have to reserve judgment. Many people, it seemed, found too much risk in the idea of living near a nuclear power plant (Figure 3).

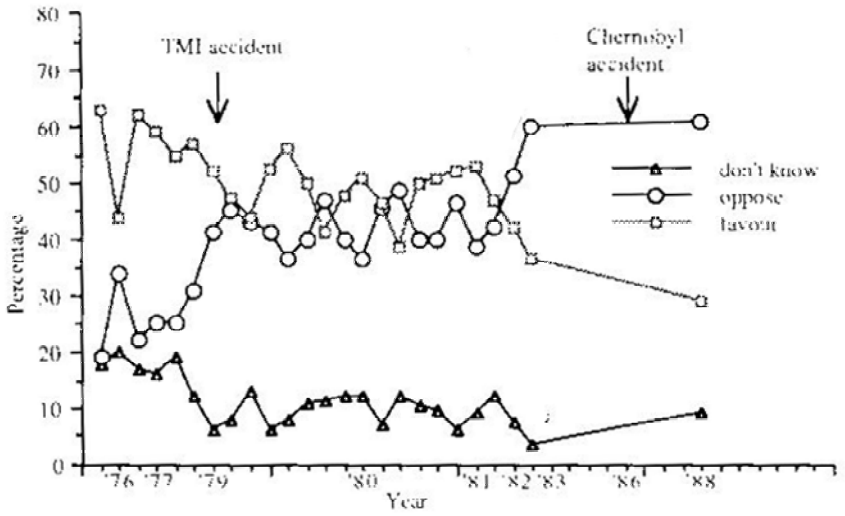

Figure 2. Public opinion on the construction of new nuclear plants from the 1970s and 1980s. Source: Eiser, et al. 1995.

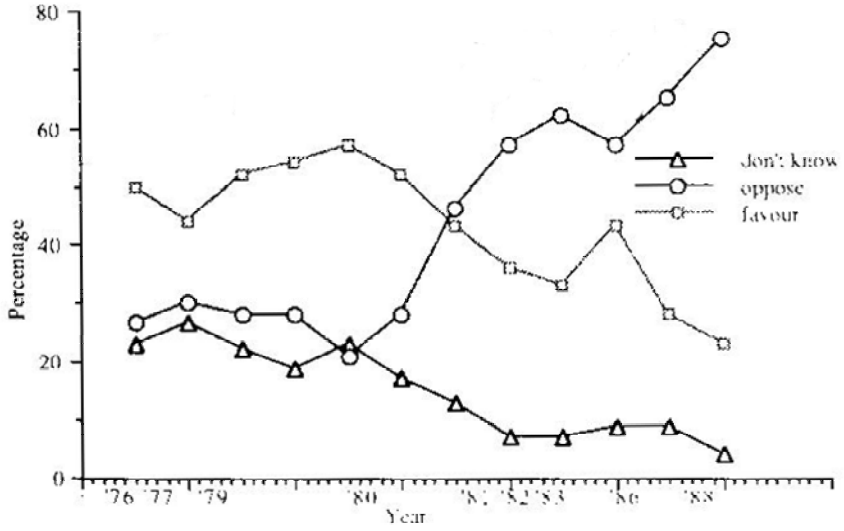

Figure 3. Public opinion on the construction of new nuclear plants in the respondents' local area from the 1970s and 1980s. Source: Eiser, et al. 1995.

2.5 1979: Three Mile Island

The increasingly anti-nuclear public and American nuclear power industry met their first national crisis on an early morning in late March, 1979, when one of two reactors at Pennsylvania's Three Mile Island (TMI) melted, releasing radioactive gas[17]. A series of mechanical and judgmental errors caused the loss of a substantial part of the protective blanket of water in the reactor, and as a result, as much as two-thirds of the nuclear core was uncovered and part of the core melted. In addition, an undetermined amount of

radioactive gas was released into the atmosphere. The accident and its aftermath slashed support of nuclear power nationwide. An almost impossible event had happened, and no one had been prepared for it.

The least prepared for such an accident wasn't even the public – it was the utility company and government. The panic and loss in confidence after TMI was largely due to inconsistency between experts that people had to turn to for information[17]. With a major image crisis on its hands, Metropolitan Edison downplayed the extent of radiation release and evaded facts. In one press conference, Met Ed Vice President Jack Herbein, said that there could be a "spontaneous energetic disassembly" at the facility. A reporter asked him to stop the technical jargon and explain the difference between that and an explosion, at which point he lost his temper, leaving the press and the public unanswered[18]. This was one instance among many where the staff gave contradictory or inaccurate information – originally, the public was told that no radiation had been released, then they that the amount was unknown, and later that it was only a minor release[19]. At the same time, the governor of Pennsylvania suggested on television that pregnant women and children be evacuated from the area, causing statewide panic.

Coincidentally, a movie released just two weeks earlier may have contributed to the panic at TMI. *The China Syndrome*, with ominous similarity, featured the cover-up of a significant accident caused by serious safety problems and profit-minded corporations. The media is best at reinforcing public opinion, not changing it[20], and people responded to the movie with questions and fear. The catchphrase "Pennsylvania is everywhere," taken directly from the government report released in 1974, was taken up in the film and became truth weeks later when the public could verify Individual attitudes firsthand.

In fact, there had been a worse accident than TMI near Detroit in 1966, but it was overwhelmed by the pro-nuclear fervor at the time, and has since been lost to popular history. Numerous national public opinion polls by Harris showed a decline in support for construction of nuclear power plants before the TMI crisis, as discussed above. TMI did serve to polarize people's opinions. In 1978, 47% of Americans supported new

construction, and 43% said they were opposed, leaving 10% undecided[11]. By 1981, majority support had been lost: 60% of Americans opposed building new nuclear power plants, and 37% said they were in favor[17]. The "inoculation effect"made supporters immune to bad experiences, reassured anti-nuclear groups in their beliefs, and gave the neutrals a chance to choose a side[21]. In the Three Mile Island area, people still favored the use of nuclear power and even that specific plant – from March 1979 to March 1980 support had dropped[18] only 4 percentage points from 57% to 53%. The small change can be attributed to the greater support among people living near plants than those living far away. Locals also saw the possible disadvantages of nuclear, but placed more value on the economic advantages of continued operation. After TMI, opposition to plants in communities where they were planned or being built had increased to the point where a majority opposed construction[17].

As time passed after the accident, the negative attitudes formed during the TMI crisis diminished. Public support nationwide returned almost to the same levels as they had been before 1979. Support never returned to the levels it had been at in the early seventies, before the national energy crisis. Another international incident in the 1980s diminished hope that the public would ever accept nuclear power again.

2.6 1980s: Lost Hope, Chernobyl

By the beginning of the decade, Congress had spent $18 billion on research, and all aspects of the US fuel cycle except enrichment and disposal were handled privately. The government had stepped back, becoming ambivalent to funding the industry as siting and disposal became more politically motivated. Despite repeated requests from the industry, the government refused to streamline application and licensing procedure "divorced from the actual technology." Both the Office of Technology Assessment and the Nuclear Regulatory Commission blamed bad management and shoddy workmanship for delays and overruns. It looked like Nader may have been right[22] in 1982 when he said that "if its accidents do not end nuclear power, its economics will." Indeed, the construction cost per kilowatt capacity had risen from a low, early value of $200 to $750 in 1980. By the end of the decade, the cost would reach $3500 per kilowatt due to

increased political and regulatory costs[1]. For example, the Citizens to Save Cayuga Lake, in 1968 and 1969, used legal hearings and lawsuits to delay construction. The extra cost was used to pressure the New York State Electric and Gas Corporation (NYSE&G) to give up on Cayuga Lake. At the end of the affair, the cost of the CSCL tactics were estimated at $100,000 per each day lost to licensing[23].

While America worried about the cost of nuclear power, errors in operation and design shocked the rest of the world. On April 28, 1986, at Chernobyl, Ukraine, a combination of human error and design weaknesses led to the worst nuclear accident ever. In a test to see how long a spinning turbine could provide electric power to plant systems in case of emergency shut down, the operator gradually reduced power as planned. At one point, he made an error and powered down to 1% of capacity, upon which the core filled with water. He manually raised power to 7%, causing fluctuations in flow and temperature. The control rods were withdrawn, causing the power to rise slowly at first, but reducing the flow as voltage dropped. The water in the core began to boil, the power rose, and the operator ordered manual shutdown, at which point the power rose beyond control[24].

Even during the Cold War, the Soviets recognized the importance of the media and used the international event to showcase the nation's expertise and cooperation. Gorbachev opened the USSR to foreigners for the investigation, eagerly cooperating with the International Atomic Energy Agency. The stakes were high. The USSR could face open hostilities from not cooperating, but hoped for improved power generation from Western scientists[24].

Chernobyl caused only a modest decrease in support for nuclear power in the States. The US was far from the Ukraine, and would not be affected by fallout carried by wind. Opposition to nuclear power was about 49% after Chernobyl, in 1986, but was much higher after TMI and even before TMI, during the economic downturn following the energy crisis[18]. By 1989, opposition had returned almost to pre-Chernobyl levels[16] and the underlying roots of opposition had driven the cost of establishing nuclear power to all-time highs.

2.7 1990s: Ambivalence

Opinion has tempered since the Chernobyl incident in the mid eighties. Over the last decade, media and political focus on nuclear power has abated. Those whose attitudes were turned against nuclear power during economic and safety difficulties had begun to reweigh their interest. During that time, the polls began to look more favorable. One poll showed at the end of the decade that 51% of survey respondents supported the building of new nuclear plants[25]. Even more respondents (68%) agreed that nuclear energy should play an important role in meeting future energy needs. Such responses suggest that although the anti-nuclear contingent is still very vocal and not small enough to be ignored, the majority of the public is supportive or at worst indifferent to nuclear power.

3 The nuclear power opponent

In learning to respond to protesters, it became clear that a particular type of person dominated the set of opponents to nuclear power. It was not only risk perception and irrational fears causing opposition to nuclear power – opponents and proponents of nuclear power had different reasons for holding particular attitudes. Opponents were repeatedly shown to share similar societal values, and the person's attitude was shown to be a function of the person's societal values[4].

In general, individuals with pro-nuclear positions weighted economic considerations more heavily than environmental and societal health. Those with anti-nuclear beliefs placed much greater emphasis on environmental and societal health values (Table 1). This concordance has been studied in different parts of the United States[4,16] with consistent results. Higher values on economics were also linked[26] to economic optimism and more conservative political views.

	Pro-nuclear	Anti-nuclear
Decreased emphasis on materialistic values	36	100
Reduction in scale of industrial, commercial, and governmental units	22	86
Industrial modernization	68	6
Security of employment	77	40
Improved social welfare	31	80
Conservation of the natural environment	77	100
Advances in science and technology	82	13

Table 1. The importance of general values as a function of attitude. The columns show the percent of respondents identifying each value as one of the top five factors which would contribute to an improved "quality of life." People who identified themselves as pro-nuclear placed higher value on economic factors. Source: van der Pligt, J. 1995.

Some correlation was made between demographic and attitudes toward nuclear power. Those least likely to support the use of nuclear power were women, people with a college education, and younger people[10]. The same groups were also more likely to be undecided[14], and consequently were the people targeted for public relations campaigns. Those who participated in major demonstrations against nuclear power tended to be young, well-educated, politically liberal, and evenly split between men and women. No more than 4% were registered Republicans, over 80% were younger than 35, over half held college degrees, and half of those had advanced degrees[27].

Even within geographical regions, significant variation could be found in more local areas. City residents were more likely to oppose nuclear power – perhaps owing to an increased concentration of college students and graduates[10]. Also, people living near nuclear power plants were more optimistic about the economic effects of new plants and less concerned about environmental and health effects[16], though they did acknowledge the risks. This is not a surprising conclusion considering that people living near existing power plants are more likely to approve of nuclear power[4] and that supporters of nuclear power tend to value economic arguments over others.

4 The Nuclear/War Connection

The anti-nuclear activist will sound familiar to any American who lived through the Vietnam War era that marked the late-middle twentieth century. The connection between protesters of the Vietnam War and nuclear power can be made anecdotally and

statistically. The link goes deeper than a shared dissatisfaction with the present social and economic structure and for most anti-nuclear groups, there is the suggestion that energy should be used as a means for societal changes not directly connected with energy. Much like the Vietnam veterans who came back to the States and protested the war, nuclear experts and victims turned to nuclear protests[28].

The theme of nuclear accidents and weapons from stolen material resonated strongly with those who had fought against the war in Vietnam. Besides the usual concerns of health and safety hazards throughout the power cycle and environmental destruction, protesters saw the growth of nuclear power feeding the bureaucratization and centralization of power production as just another way to institutionalize the practice of allowing the elite to make decisions for the public[10].

People living in New England still remember the protest surrounding the plans to build a nuclear power plant in New Hampshire to serve the growing electric needs of the greater Boston area. Protesters came from several states away, much further than in earlier protests, and the locals wanted nothing to do with them. They came to symbolize and be a part of that movement of "vegetarians in leather jackets" who drove "their imported cars to Seabrook listening to the Grateful Dead on their Japanese tape decks amid a marijuana haze," wrote economist George Gilder in *Forbes* magazine[29].

Many of those "vegetarians in leather jackets" were members of the Clamshell Alliance, a diffuse organization of local protest groups. The Clams were "committed to observe democratic principles and to oppose economic power and centralized control over energy distribution and the lives of individuals." They saw[29] their attacks as fighting the establishment's use of nuclear power as a tool for dominating ordinary citizens, and[29]

> "displayed the style and idealism popularly associated with the Woodstock generation. They wore jeans and headbands and carried guitars and backpacks; their songs often seemed more articulate than their speech, their actions more eloquent than song. Clams espoused tactics more than ideology; they reacted rather than proposed. They displayed the outward manifestations of earlier social movements against racial discrimination and war, and they had a similar internal certainty. They had the energy

> of zealots and a dedication to their cause that may have substituted for children or jobs or property that many of them had not yet acquired. They were easily and frequently derided as young and inexperienced and outside most behavioral and political norms...."

Because they worked outside local norms, the protests against Seabrook had to be brought mainstream by another organization. The Seacoast Anti-Pollution League, formed in 1969 in response to the Public Service Company of New Hampshire's (PSCNH) announcement to build a plant in Seabrook, turned to legislative support to fight the construction of the power plant. Meanwhile, the Clams operated the way they had learned in Vietnam protests, focusing on leafleting and occupation. As many as 1,400 arrests occurred in one day of occupying the PSCNH property in Seabrook[30]. The Clams got national attention, but true to the root cause of the protests, the Clams focused the media attention on civil liberties and institutional change, not nuclear power. Even when offered a public spot and amenities to exercise their first amendment rights, the protesters continued occupation of the utility property because they were hesitant to any negotiation with the state or PSCNH[29]. Those who were most resistant to negotiation acted on their own sometimes, committing acts of sabotage and obstruction which were neither condoned nor condemned by the Clamshell Alliance.

The Clams were often speaking from their own experience, Vietnam veterans who played a vital role in educating the American public to the difference between the realties of US policies and the claims of the government[28]. Studies in the Boston area in the seventies showed that members of Boston anti-nuclear groups were not first-time activists. About one-third made a start in protesting the Vietnam War, and a majority of active members in Boston anti-nuclear groups also protested the war[27]. Although some of the groups studied in Boston were taking positions against the use of nuclear weapons, about one half of the members of those groups also participated in protests against the use of nuclear energy[27]. Other studies[26] have also found that attitudes towards military use of nuclear energy are very predictable of attitudes towards civilian use. Further, those who were active in nuclear issues were found to use a "vigilant" cognitive strategy to deal

with the conflicts in belief which come from additional information. A "vigilant" strategy involves weighing the costs and benefits of changing one's beliefs, and is in contrast to other methods like "rationalization" "procrastination, and "defensive avoidance." The same strategies were found in Vietnam protesters[26]. Though three decades have passed now since the end of the Vietnam War, the protesters and the strategies are still familiar, and continue even today.

5 Nuclear future of the United States

In the United States more than perhaps anywhere else additional construction will require winning the public's acceptance. Since Three Mile Island in 1979, more plants have been cancelled (120) then ever completed (112) in the country[1]. The escalated costs from inflation and increasing litigation put future nuclear construction in an unfavorable light from which it has not yet recovered. Additionally, the pressure to find a permanent geologic repository for radioactive waste has raised concern over further dependence on nuclear energy. Despite predictions of increased electricity prices and a desire to increase national security through a diverse energy supply and reduced imports from the Middle East, there are no new nuclear plants in the foreseeable future. Additionally, Americans throughout the nineties showed no concern about the electricity supply and saw no urgency in changing the supply or adding capacity[31].

The future of US policy will instead focus on relicensing older plants and continuing the policy of expanding existing sites. These are both more economically efficient and less likely to meet public resistance. Capital costs are reduced significantly, of course, but since people living near nuclear facilities are less likely to oppose the continued use of nuclear power, the facility will encounter less legislative and civil action against its continued or expanded use. Even of those opposed to building new plants, few are in favor of closing plants, and many favor nuclear construction "if it is needed," which may open the possibility of future construction in circumstances more favorable than the energy crisis in 1973. In this case, the public may have to come to embrace nuclear power once again.

In anticipation of a future where nuclear power will again become a visible part of the US energy strategy, the National Research Council recommends[31] working foremost on improving public opinion of new power plants, in an effort to increase support and decrease the costs of planning and building a nuclear plant. Their recommendations include:

- Creating a recognized need for larger electrical supply met by large plants (indeed, the United States Energy Association[32] finds that people believe new plants will be needed if nuclear is part of the future, but only support building them if there is need)
- Implementing economic sanctions to reduce fossil fuel use, making nuclear power more economically competitive
- Improving communications on risk, focused on the difference in estimation of risk between experts and the public
- Resolving the issue of high level waste disposal
- Assuring the public that nuclear power does not contribute to the proliferation of nuclear weapons
- Making meaningful contributions to the public in the arenas of economic and public development, dispelling the image, true or not, of nuclear facilities held by anti-nuclear groups

Additionally, and perhaps most importantly, the government must support[33] the power industry in the choices made for the country's future – financially, politically, and legislatively – without failing to serve the public's needs.

6 Across the Pond

The relationship of any given technology to the society around it is not the same the world around. The United Kingdom was another leader of the early nuclear age. Many of the same underlying effects were comparable to those in the United States. Early public opinion on nuclear power was shaped significantly by the military connections. Nuclear incidents were introduced to the public opinion early on, with a fire at the Windscale generator. Windscale[34] "conditioned public opinion to expect accidents and hazards in nuclear industry," forming a heritage of "fear and suspicion." What sets the UK apart from the US is its decision not to participate in the Vietnam War and

appropriate administrative response to risks and international nuclear disasters. Nevertheless, the UK public has had consistently lower support for nuclear power over the years.

Figure 4. Location and relative size of US nuclear plants in operation, 1987.
Source: Mounfield, P.R. 1991.

6.1 History of the atom in the United Kingdom

Britain's first atomic generating station at Calder Hall went online in 1956. A dozen more Magnox gas-graphite reactors were quickly scheduled[11]. As in the United States, the proliferation of nuclear power threatened jobs across the country. In coal-rich Britain, it was estimated[1] that opening a dozen new generators would force the closure of 175 coal plants, costing 8,000 jobs. Public interest (and protest) was slower to develop in the UK, and was considered, at the time, to be a "natural progression" from the opening of Calder Hall[3].

The first major nuclear power incident jump-started public interest. In 1957, a physicist at Windscale made an error in a routine operation[35], starting a fire in a plutonium pile. While performing a Wigner release – raising and lowering the temperature of the reactor core to coax distorted graphite blocks back into proper shape – his reading of the instruments said the effect was not complete, and would require more heat. He withdrew additional boron control rods, and at least one fuel rod ignited, starting a fire that burned for almost a week. Windscale was the worst radioactivity release incident in the world until the 1986 Chernobyl disaster.

Expert public relations minimized fear. When radioactive isotopes were found in the wild, for example, authorities gathered all the milk in a 500 km^2 area and dumped it into the sea[35]. The gesture was largely symbolic, as the released isotope ^{131}I has a half-life of only a few days. In the interest of the public's opinion, no better move could have been made. Even after Windscale public support of nuclear energy dropped by only a few percentage points.

By the early seventies, it became clear that Britain's choice of Magnox and advanced gas-reactor (AGR) technology was less economically efficient than designs chosen by other countries. Capital costs were higher, construction took longer (up to eighteen years!), and the end result was unreliable and relatively inefficient in fuel consumption. The UK began to consider new types of reactors, specifically, importing pressurized water reactor (PWR) technology from the United States[3]. The inferior generators that had been built in the meantime directly led to growing opposition. Besides costing numerous jobs in the coal-rich country, the newer plants had larger reactors. The larger reactors operated with hotter cores and higher pressure. Under these operating parameters, the reactors in Calder Hall developed cracks and unexpected byproducts[1]. Another policy decision arose in 1976, with the proposal of a new thermal oxide reprocessing plant (THORP). British THORP plants had been processing spent nuclear fuel into uranium and plutonium products since the country began its nuclear program. For the first time, the government was considering building a new THORP – specifically to begin processing for the first international customer, Japan[5]. The battle was largely fought on environmental grounds, but eventually approved because of economic concerns and the lack of long-term plans for HLW disposal. The result of the extended debate on PWRs and a new THORP was a polarization of public opinion (Figure 5). At the beginning of the decade, there were a large number of people reporting no opinion on the construction of new nucelar power plants. Additional information and prolonged

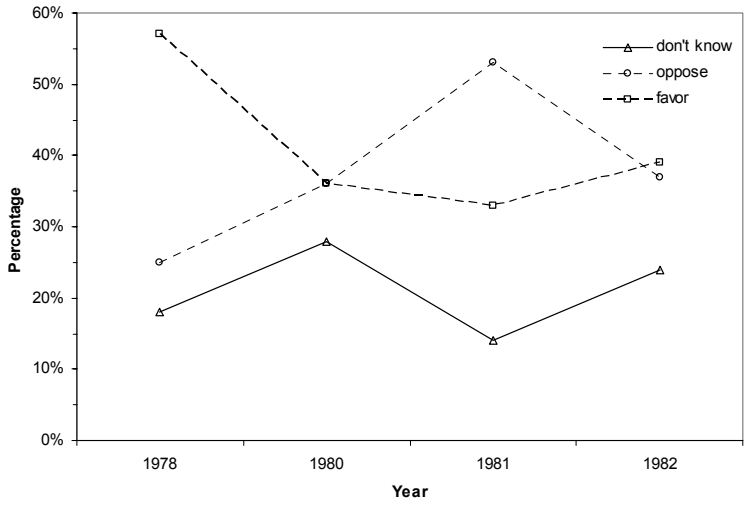

Figure 5. Public opinion on the construction of new nuclear plants in the United Kindgom from the 1970s and 1980s. Sources: van der Pligt, 1995 and Nelkin and Pollak, 1981.

discussion about the risks of nuclear power polarized public opinions nationally. Many of those people decided[36] that further investment in nuclear power was not worthwhile.

While the release at Three Mile Island (TMI) woke up the American public, it received less consideration from the British. Not only had the incident at Windscale been more serious than TMI, but the British were still using the AGR. TMI also fell right before the election, where its biggest effect was on the debate of importing the same PWR technology used in TMI. Weeks earlier, in response to the prophetic *China Syndrome*, the Central Electricity Generating Board (CEGB) had had to admit that it was also possible for an AGR core to catch fire and melt. So even though Labor Party Minister of Energy Anthony Benns said "no government anywhere in the world can now widely approve of nuclear systems of that type," the fact that a British plant could do the same thing allowed decision-makers to focus again on economic performance. Thatcher won the election and subsequently promised to double the number of nuclear plants in country the by using American PWR technology. Such a bold move revived the antinuclear movement[36] in the public and the media. They even adopted a slogan from *The China Syndrome*: "Pennsylvania is everywhere," referring to the area that could be made uninhabitable by a core meltdown[36]. Not only was the public afraid of failures, but as in the US, many people found the need for additional plants to be unproven[35]. The benefits

of nuclear plants were expressed solely in economic terms, a language many people were unfamiliar with, especially at the scale considered with an electric utility.

As the next decade dawned, there were hints that the effects of the Windscale fire were non-negligible[35]. Researchers for a 1983 Yorkshire TV program, *Windscale: the Nuclear Lauundry*, turned up childhood leukemia rates twelve times the national average in Seascale, the coastal town built for and owned by Sellafield employees[37]. The reporters, and later the viewing public, demanded a full investigation. What they got in return was increased "outreach" to the communities. Image consultants were brought in to reshape the image of nuclear power. Comprehensive national surveys allowed them to pick out the demographics with insufficient support. Three separate campaigns were designed – one for educated professional audiences, which turned up in publications like *New Scientist*, one for women and university students, and a third for schools, where elementary-age students would first be introduced to the wonders of nuclear power. Clusters of cancer victims were likewise found near Dounreay, the first operating fast breeder reactor (opened in 1959), in the late eighties[1].

Apprehension about the Sellafield-leukemia linkage and nuclear energy in general increased after the Chernobyl incident in 1986. However, British confidence in nuclear power decreased less than in other European countries because the CEGB rapidly pointed out the differences in construction and safety standards between the United Kingdom and the USSR[20]. The changes in support were similar to those found in the US – while, unlike the US, the UK was affected by the fallout carried over from the Ukraine, the British placed more trust in the regulatory authorities. Unlike in the US, Britain did not have recurrent issues which provoked mistrust of their nuclear agencies. The statements from the CEGB and the open admissions during the *China Syndrome* scare are counted among the ways the nuclear agencies have been considered trustworthy in Britain. The focus instead turned to the hazards of fallout from the USSR, rather than problems of UK nuclear power. The summary dismissal of a policy proposal by the University of Cambridge and the coal industry to formally phase out nuclear power[38] was a sure sign

that what support existed for the continued use of nuclear power, if not the construction of new facilities, could withstand international disaster and uncertainties.

Studies[39] showed that the main reason for continued support despite Windscale, Chernobyl, and lagging public approval was the belief that nuclear power increased British energy independence. Support may have been higher had more people realized that nuclear power was relatively clean – one out of five Britons surveyed believed that nuclear power generation contributed to acid rain, the hole in the ozone layer, *and* the greenhouse effect[39]. Most people believed that nuclear power contributed to at least one of the three. Although this supports the theory that people should be given more information, reports as far back as the Windscale inquiry indicated that too much extra information leads to scientific controversy and doubt, therefore increasing rejection of nuclear power and creating more irrational fears[35]. Despite decades of experience, the Brits, like the Americans, were still trying to find the balance between too much information and too little, which was a common complaint in testimony since the Windscale inquiry[35].

By 1992, there were 19 generating stations in 15 locations, producing 12,800 MW_e of electricity. Nuclear power accounted for 20% of the electricity produced in the UK and up to 50% of Scotland's electricity[1]. As in the United States, nuclear power was quietly present, enabling the growing consumption of an industrialized nation.

Parliament had just allocated £1 billion to finish a generator at Sizewell, despite the fact that 1990 fell in the middle of the moratorium on nuclear power and a simultaneous proposal to phase out nuclear power altogether[5], when Prime Minister Margaret Thatcher proposed the privatization of nuclear utilities. The position was seen as a way of abandoning nuclear power – by finishing Sizewell, the government's move was interpreted as a closure to its commitment to nuclear power. Privatized firms, it was believed, would not want to build new facilities, and would cancel the proposed "families" of small reactors across the country once Sizewell had been completed[5], focusing instead on renewal of older plants. Despite Thatcher's personal support,

privatization could not be accomplished because of the high costs and long time frame required to decommission facilities, the responsibility for which would fall to private corporations. Instead of privatizing nuclear power, the government instituted the Non-Fossil Fuel Obligation (NFFO). When all other electric utilities went private, the NFFO set five successive "orders" on delivered net capacity of electricity. The NFFO was initially written to stimulate the nuclear industry, but it has stimulated research and installation of other renewable facilities.

6.2 Nuclear future of the United Kingdom

The NFFO did make the industry responsive to market pressures, and has stalled development of gas-graphite and other reactor projects that aren't economically viable[1]. But even under the NFFO, the government could no longer take the position that nuclear power would be cheaper than coal. When the issue of nuclear privatization rose again in 1994, the main issues were diversity and security of supply. By calling on the nation's security, the industry was successfully privatized[40] by the close of 1996.

True to predictions, no new nuclear plants have been proposed, and the relicensing of plants reaching the end of their intended lifecycle has become a larger issue. In general, the public has supported the relicensing of older plants more than the construction of new generators. The results are logical, considering[16] that many Britons are in favor of the use of nuclear power, in general but are opposed to building new plants in their community, unless they live in an area already near a reactor. Given the need for public support in new plant sites, it seems that the siting of currently operating plants will dictate the location of any future plants.

According to the 2001 Department of Trade and Industry whitepaper on the country's goals for the future, which reviewed the UK energy situation, those new plants may never be needed. The emphasis[41] is on low-cost, low-carbon energy sources and transportation and on an increase in renewable capacity to meet the NFFO. Neither a significant increase in nuclear activity nor complete shutdown of operational plants seems to be under serious consideration. Rather, nuclear will continue to play a large role in the

national electricity supply without additional infrastructure. Public opinion in other countries, including Germany, Sweden, and the Netherlands, has hastened legislative decisions to formally phase-out nuclear power, closing each facility as it reaches the end of its licensure and forbidding the construction of new plants[33]. Although this remains a possibility, it is unlikely that the government will decide to close down the industry in light of its goals on carbon emission and targets as part of the ratification of the Kyoto Protocol[41]. Under these pressures, the UK will need to continue nuclear power production well into the twenty-first century. Barring exceptional nuclear accidents or security threats, public opinion of nuclear power should remain steady. Public interest in meeting goals set by the Kyoto Protocol may actually increase interest and approval of nuclear production.

Increased public support will be needed for any future construction. Even though the British have been found to have consistently more negative attitudes towards nuclear power than the Americans[4], a significant number of respondents indicated that they were undecided on the construction of new plants. The uncommitted were found to be closer to the pro-nuclear position in the knowledge-belief-action space which maps values to issue positions and responses (Figure 6). The space shown reflects the findings in the United States that opponents are more concerned with public health and environmental factors. Supporters of nuclear power were found to be more "rational," including in their belief structure more anti-nuclear values. Those with an anti-nuclear stance were unlikely to mention any benefits of nuclear power. Attaining increased public support will require the decisive polarization of the public, as occurred during the THORP proposal of the 1970s. This would have to come from an event at the expense of another fuel source: increased taxes on petroleum, a major oil leak off the coast, or increased hostilities with(in) the Middle East, for example. Some of these are options not to be planned, but increased taxes are a reality, especially in a country whose goals in carbon emissions reduction are quite ambitious.

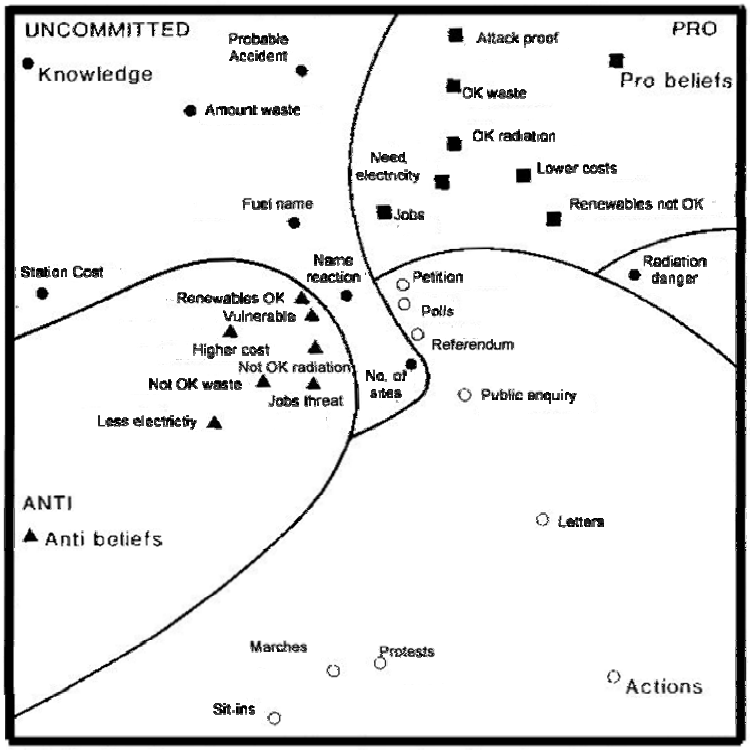

Figure 6. Space analysis of knowledge, beliefs, action disposition and attitudes towards nuclear power. Source: Mounfield, P.R. 1991.

7 Conclusions

The last fifty years of commercial nuclear power have demonstrated, on both sides of the world, the importance of valuing the public's opinion. Nuclear power has continued to be a quiet player in the international energy supply, while public interest in nuclear power has waned. The trend cannot continue much longer though – interest should be[33] renewed around 2010. By then, older plants will increasingly need to be relicensed or shut down, and demand, if it matches load predictions, will grow too high to be met by remaining power plants. Today, the public trusts neither the industry nor the government. Public support can be regained, but the first prerequisite is the demonstration of demand for new nuclear plants and increasing generation capacity. Making the public understand the need for more energy and different sources will require reaching out to the media in a way the nuclear industry has not done since

At this point, the needs of the US and the UK are not dissimilar. The US and UK, like other countries in the OECD, are recommended by the International Energy Association[5] to

- Strive to be open in all policy decisions
- Eliminate whatever remains of the "culture of secrecy"
- Be upfront about government funding and support
- Ensure a fully democratic process, rather than relying on administrative decisions without public debate, especially with regards to HLW disposal
- Develop government-sponsored communications programs which inform of but do not overemphasize the risks of nuclear power
- Publicly discuss safety among other values like the environment and job-creating opportunities – people are still not aware that nuclear power is relatively clean, add reminding them of this can improve acceptance[32] of nuclear power
- Avoid representing nuclear power as perfectly safe

As a representative of the Commission of European Communities phrased it[20], "entering into communication with someone creates the expectations of a social relationship, and it is this expectation which allows information to become communication." The public wants people, and human arguments, not technical data. To be understandable is not enough – the public must be given a basis for belief and trust[42] which has been missing, particularly in the US, for many years. Even as far back as Cayuga Lake in 1968-69, anti-nuclear groups were flexible, fast-moving, and easily reshaped. Companies like the NYSE&G were characterized in polls near Cayuga Lake as slow to release info, inaccessible to the press, and "cautious if not defensive" with the public[23]. NYSE&G "sought to reassure the public without refuting specific criticisms" and failed largely because the they saw their "credibility" as being based on prior history with customers who didn't trust them, especially with a new and powerful technology. This suggests the need for organizational responses on the part of the nuclear industry, to complement the ever changing face of public opinion.

Beyond the public opinion, the numbers surrounding nuclear power will have to change for future success. Reduced costs are critical to future resurgence in the nuclear industry. Increased public participation is one way to achieve this – increased support for nuclear power will make siting a plant less difficult and reduce the amount of and cost of litigation. As it stands, there is a significant risk of not recovering the high costs of investment when blocked at any stage by legal actions. The problems surrounding disposal of radioactive waste will also have to be solved. Even if the world can reach this point in the coming years, the public, industry, and governments must realize[1] that "the price of a near-inexhaustible energy source is eternal vigilance."

References

1. Dresser, P.D. 1993. *Nuclear Power Plants Worldwide*. Gale Research, Inc., Detroit, Michigan.
2. Wolfe, B. 1999. *Energy Problems of the Future, Can we Solve them*. International Energy Forum 1999.
3. NEA Secretariat. 1984. *Nuclear Power and Public Opinion*. OECD, Paris.
4. van der Pligt, J. 1995. Public Attitudes to Nuclear Energy: Salience and Anxiety. *Readings in Environmental Psychology: Perceiving Environmental Risk*. Academic Press, London. p.91-101.
5. International Energy Agency. 2001. *Nuclear Power in the OECD*. OECD, Paris.
6. International Atomic Energy Association. 1998. *The International Nuclear Event Scale for Prompt Communication of Safety Significance.* http://www.iaea.org/Publications/Factsheets/English/ines-e.pdf
7. Weart, S.R. 1988. *Nuclear Fear: A history of images*. Harvard University Press, Cambridge, Massachusetts.
8. British Broadcasting Corporation. *Bikini Atoll bomb test remembered.* 1 March 2004. http://news.bbc.co.uk/2/hi/asia-pacific/3522243.stm
9. Stauber, J. and Rampton, S. 1995. *Toxic sludge is good for you! Lies, damn lies, and the public relations industry*. Common Courage Press, Monroe, Maine.
10. Price, J. 1990. *The Antinuclear Movement*. 2nd edition. Twayne Publishers, Boston, Massachusetts.
11. Mounfield, P.R. 1991. *World Nuclear Power*. Routledge, London.
12. Peterson, S. 1999. *Public and Political Support for Nuclear Energy*. International Energy Forum 1999.
13. Burnham, D. 1981. *The Press and Nuclear Energy*. The Three Mile Island Nuclear Accident: Lessons and Implications, April 24, 1981, New York.
14. Nealey, S.M., Melber, B.D., and Rankin, W.L. 1983. *Public Opinion and Nuclear Energy*. Lexington Books, Lexington, Massachusetts.
15. Manoharan, S. 1974. *The Oil Crisis: The End of an Era*. S. Chand & Company (Pvt) LTD. New Dehli, India.
16. Eiser, J.R., van der Pligt, J., and Spears, R. 1995. *Nuclear Neighbourhoods*. University of Exeter Press, Exeter, Devon
17. Houts, P.S., Cleary, P.D., and Wu, T.-H. 1988. *The Three Mile Island Crisis: Psychological, social, and economic impacts on the surrounding population*. Pennsylvania State University Press, University Park, Pennsylvania.
18. Walsh, E.J. 1988. *Democracy in the Shadows: Citizen mobilization in the wake of the accident at Three Mile Island*. Greenwood Press, Westport, Connecticut.
19. Rubin, D.M. 1981. *What the President's Commission Learned about the Media*. The Three Mile Island Nuclear Accident: Lessons and Implications, April 24, 1981, New York.
20. Otway, H. 1990. *How the Public Perceives Technologies*. NEA Workshop Proceedings on Public Information on Nuclear Energy, 7-9 March 1990, Paris.
21. Renn, O. 1995. Public Responses to the Chernobyl Accident. *Readings in Environmental Psychology: Perceiving Environmental Risk*. Academic Press, London. p.113-129.
22. Velocci, Jr. T. 1982. On the Road to Recovery. *Nuclear Power: Both sides*. W.W. Norton & Co., New York. P. 148-155.
23. Nelkin, D. 1971. *Nuclear Power and its Critics: The Cayuga Lake controversy*. Cornell University Press, Ithaca, New York.
24. Marples, D.R. 1988. *The Social Impact of the Chernobyl Disaster*. Macmillan Academic and Professional, Ltd., Houndmills, Basingstoke, Hampshire.
25. Bisconti Research, Inc. 2001. US Public Opinion on Nuclear Energy January 2001. Washington, D.C.

26. Eiser, J.R., et al. 1995. Nuclear Attitudes After Chernobyl: A Cross-National Study. *Readings in Environmental Psychology: Perceiving Environmental Risk*. Academic Press, London. p.103-112.
27. Miller, B.A. 2000. *Geography and Social Movements : Comparing Antinuclear Activism in the Boston Area.* University of Minnesota Press, Minneapolis, Minnesota.
28. Dellinger, D. 1982. The Antinuclear Movement. *Nuclear Power: Both sides*. W.W. Norton & Co., New York. P. 233-238.
29. Bedford, H.F. 1990. *Seabrook Station: Citizen politics and nuclear power*. University of Massachusetts Press, Amherst, Massachusetts.
30. Life Magazine. In the World of Nuclear Power, Crisis. *Life Magazine.* May 1979, p.22-30.
31. Kursunoglu, B., Mintz, S., and Perlmutter, A., eds. 1999. *The Challenges to Nuclear Power in the Twenty-First Century.* Kluwer Academic/Plenum Publishers, New York, NY.
32. Bisconti, A. 1990. *How to be better understood: The role of language in communicating concepts*. NEA Workshop Proceedings on Public Information on Nuclear Energy, 7-9 March 1990, Paris.
33. National Research Council. 1992. *Nuclear Power: Technical and institutional options for the future*. National Academy Press, Washington, D.C.
34. McGinty, L. 1990. The Evolving Perception of Nuclear Energy by the Media. NEA Workshop Proceedings on Public Information on Nuclear Energy, 7-9 March 1990, Paris.
35. Stott, M. and Taylor, P. 1980. *The Nuclear Controversy: A guide to the issues of the Windscale Inquiry*. Town and Country Planning Association in association with the Political Ecology Research Group. London.
36. Nelkin, D. and Pollak, M. 1981. *A Pregnant Pause: The European response to the Three Mile Island accident*. The Three Mile Island Nuclear Accident: Lessons and Implications, April 24, 1981, New York.
37. Macgill, S.M. 1995. Public Perceptions of Science: What Seascale Said About the Black Report. *Readings in Environmental Psychology: Perceiving Environmental Risk*. Academic Press, London.
p.53-75.
38. Fothergill, S. 1986. *Phasing out Britain's Nuclear Power Stations*. University of Cambridge, Cambridge, England.
39. Taylor, D. 1990. *Survey of Public Opinion in the Countries of the European Communities*. NEA Workshop Proceedings on Public Information on Nuclear Energy, 7-9 March 1990, Paris.
40. Department of Trade and Industry. *Nuclear power generation development and the UK industry*. 16 July 2003. http://www.dti.gov.uk/energy/nuclear/technology/history.shtml
41. Department of Trade and Industry. *Energy White Paper: Our Energy, Our Future – Starting a Low-Carbon Economy.* February 2003. http://www.dti.gov.uk/energy/whitepaper/index.shtml.
42. Brodsky, A. 1982. Protecting the Public. *Nuclear Power: Both sides*. W.W. Norton & Co., New York. p. 46-56

Cover and leaf picture from Life Magazine. In the World of Nuclear Power, Crisis. *Life Magazine.* May 1979, p.22-30.

Captions:
"The China Syndrome, a film eerily prophetic of the Harrisburg accident, ahs drawn huge crowds - and protesters, as seen here in Philadelphia."

"In Seabrook, N.H., last March members of the Clamshell Alliance, an anti-nuclear coalition, chained themselves together in an attempt to block delivery of a reactor vessel to a power plant site."