

WP2

Sweden

Short Country Report

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Executive summary

This report belongs to a collection of 20 short country reports on the History of Nuclear Energy and Society (HoNESt, project Ref.662268). The reports tackle the complex sociotechnical system around nuclear energy. Nuclear developments, notably nuclear energy, are closely intertwined with social, economic, environmental, political and cultural spheres. Nuclear energy is also a globalized system involving transnational transfers of knowledge, materials, technologies, people and products including electrical power, medical elements, toxic wastes and other environmental hazards, materials, capacities and knowledge that must be carefully safeguarded. Nuclear energy is a complex social and technological phenomenon that influences societies but is also shaped by societies.

The short country reports are designed to assemble information and research results on the history of the relations between nuclear energy and society about all the different country cases in an accessible manner, and to document the findings with references.

The purpose of the country reports is threefold, addressing three different audiences:

1. to provide basic elements of narrative and analysis for further historical research by HoNESt researchers;
2. to provide information, context and background for further analysis for HoNESt's social science researchers;
3. to provide accessible information on nuclear-societal relations in the various countries for the purposes of outreach and communication with stakeholders (civil society, industry, associations, policy makers, journalists).

This report focuses on the history of the relations between nuclear energy and society in Sweden. The first chapter gives an historical overview of Sweden's nuclear history. An ambitious research program on nuclear energy began after WWII with both civilian and military goals. In the mid-1950s this led to a decision to build a domestic nuclear fuel cycle based on Heavy Water Reactors (HWRs), partly to enable the construction of nuclear weapons, which became a contested issue. Ten years later private power companies started ordering a number of Light Water Reactors (LWRs), because they thought these reactors would be more

economical, and the plans for a domestic fuel cycle were abandoned. In the early 1970s a strong nuclear-industrial complex had arisen.

At this time an anti-nuclear movement emerged which quickly grew in size. Two of the five parties in Parliament took an anti-nuclear stance, and after the elections in 1975 the leader of one of these became the new Prime Minister. In the following years nuclear issues were very high on the political agenda. In 1980, partly in response to the accident at Three Mile Island (TMI), an advisory referendum on nuclear power was organized. The referendum campaign engaged hundreds of thousands of activists. The outcome was a defeat for the anti-nuclear side. Parliament decided to continue nuclear expansion in the short run, but to phase out all nuclear power by the year 2010. In the 1980s Sweden became the country with most nuclear power per capita in the world, and it still is. A full phase out did not occur. However, in 1999 and 2005 the reactors in Barsebäck, very close to Copenhagen, were phased out (see Danish Country Report), in 2015 one reactor was phased out in Oskarshamn, and three more reactors (one in Oskarshamn and two in Ringhals) will be phased out by 2020.

The issue of waste disposal has been much disputed since the 1970s. In the early 1980s a number of attempts to drill in order to find a place for a repository were strongly opposed by local environmental groups. In the 1990s, SKB, the organization responsible for the nuclear waste, changed strategy, seeking cooperation with local municipalities. Two municipalities that already had nuclear plants were identified as suitable locations for a repository and a competition emerged between them for hosting it.

The second and third chapters analyse a number of events when nuclear issues were intensively debated and contested in order to illustrate the relations between the nuclear industry and civil society in Sweden. The events are

- The nuclear weapons controversy
- Public inquiries on energy futures in the 1970s
- The referendum on nuclear power in 1980
- Local protests against a repository
- Chernobyl and its political effects in Sweden
- A competition for getting a repository

For each event, the actors involved, the arguments and behaviours used, and the kind of public engagement are discussed.

1. Historical context

1.1. Introduction to the historical context

During almost three decades after WWII, Sweden experienced fast economic growth. Sweden had managed to keep its neutrality during the war and its industry was intact. The Social Democratic Party governed the country until 1976 and strived for fast economic growth in order to build a welfare society. A fast urbanization took place. In 1949 Sweden decided to remain neutral and not join NATO as its close neighbours Norway and Denmark did. This decision was combined with an ambitious strengthening of the Armed Forces.

Energy was an important issue. Sweden has very limited fossil resources, and the country's dependency on energy imports had become very salient during the war when Sweden had had to import coal from Nazi Germany in exchange for iron ore. After the war there was a strong will to develop domestic energy sources. The hydro power resources in northern Sweden were exploited and was transmitted to southern Sweden through new high voltage lines built by the ASEA company, which became a world leader in high voltage technology in the 1950s. Sweden had large uranium resources and the option of developing nuclear energy became a very attractive future possibility. This would also enable the development of nuclear weapons and there were strong advocates for such weapons, but also critics. There was a broad political support in the post-war decades for a very ambitious nuclear program, financed by the government. This program led to the building of several research and experimental reactors in the 1950s and commercial reactors in the 1960s and onwards.

In the mid-1970s the fast economic growth came to an end partly due to the Oil Crisis and the international economic recession following it. Moreover, the long Social Democratic hegemony came to an end in 1975, when a right-centre coalition won the elections and formed a government. Energy became a vital political question anew. The Oil Crisis had demonstrated Sweden's huge dependency on oil; imported oil provided no less than 75% of total energy supply. An environmental opposition had emerged and questioned the further exploitation of hydropower in Northern Sweden and highlighted the impact of the acidification of the environment caused by large scale use of fossil fuels. Moreover, the safety of nuclear power

plants that were becoming operational was being questioned by some scientists and environmentalists. In fact, ever since the mid-1970s, nuclear power has been a central controversy in Swedish politics; it has been decisive for the outcomes of Parliamentary elections, it has toppled governments and it has been the issue of a referendum. This report focuses on the debates and conflicts around nuclear power. First a general narrative is presented in the following section, followed by a presentation of the main actors. In the following chapters a number of illustrative events will be analysed.

1.2. Contextual narrative

Coordinated Military-Civilian Nuclear Research, 1945-1955

The atomic bombs over Hiroshima and Nagasaki were the starting point of Swedish activities in the field of nuclear energy. The military and some scientists (primarily physicists and chemists) were the first to act: for the military, it was naturally of vital importance to get information about this new, extremely powerful weapon and its implications for future warfare. For the scientists, there was an element of scientific inquisitiveness and a prospect for future funding (Lindström 1991, Larsson 1987). Both groups lobbied for action, and in November 1945 the Government appointed an Atomic Commission, with the task of investigating the need for research. The commission consisted of very prestigious scientists, two who were Nobel laureates (Manne Siegbahn and The Svedberg) and two future laureates (Arne Tiselius and Hannes Alfvén), as well as high ranking public officials. In its report the commission recommended, firstly, to strengthen basic research in relevant fields of physics and chemistry at universities and research institutes, and, secondly, to establish a special organisation, the Atomic Energy Company (AE), with the task of developing reactor technology (Lindström, 1991).

These recommendations were readily adopted by the Social Democratic government; which could be seen as a bold effort, orchestrated by the state, to use the results of science for the well-being of society and which therefore suited their ideological beliefs very well. In particular, Tage Erlander, Prime Minister from 1946 to 1968, had a strong interest based on personal contacts with leading physicists, including Niels Bohr. An Atomic Energy Company, was set up in 1948 and its first major task was to build a small research reactor called R1, a 100 kW heavy-water reactor (HWR) fuelled with natural uranium. The choice of location of R1 may seem rather remarkable today; it was on the

campus of the Royal Institute of Technology, only a few kilometres from the centre of Stockholm. However, the reactor was built in an excavated cave in the rock 20 meters below the ground. On July 13, 1954, the reactor was completed and heavy water was pumped into the reactor tank. When the reactor went critical, Sweden had definitively entered the nuclear age (Lindström 1991, Larsson 1981).

The nuclear research also had a military dimension. After WWII, Sweden started to build up a strong military defence. This effort was intensified when Sweden in 1949 decided not to join NATO but to remain non-aligned. A large domestic arms industry was developed and in particular the aircraft industry had a pivotal role; in fact Sweden's Air Force became the fourth largest in the world in the 1950s. The National Defence Research Institute (FOA) established in 1945 was given a crucial role for research and technological development in the military field. One of the new institute's first actions was to secretly set up a research group on nuclear weapons led by the young nuclear physicist Sigvard Eklund (Agrell 2002, Jonter 2016).

In 1950 Eklund was recruited to AE as research director and was given the responsibility for building the R1 reactor. He was also – more secretly – responsible for coordinating the civilian and military nuclear research. He proposed that the future “civilian” reactors should be heavy water reactors fuelled by domestically mined natural uranium. Moreover they should be constructed in such a way that weapons-grade plutonium could be produced. Finally, reprocessing plants should be built to separate this plutonium from the spent fuel. In 1953 Eklund wrote a report in which he outlined a plan for the construction of ten bombs of Nagasaki-strength within ten years (Agrell 2002).

Up to the mid-1950s there was almost unanimous political support for the nuclear research program. However, the commercialization of nuclear energy still seemed uncertain and far away, and therefore the power companies and the electrical equipment industries were rather passive.

The “Swedish Path” and the atomic weapons controversy, 1955-1965

US President Dwight Eisenhower's launching of the "Atoms for Peace" policy in late 1953, and in particular the First Geneva Conference on Atomic Energy in August 1955, raised expectations for nuclear energy in a dramatic way. The new international policy implied a change from utmost

secrecy to a considerable openness in nuclear matters. Both the Swedish general public and the power industry were filled with optimism about a coming commercialization of the new technology. In late 1955 the government appointed a new Atomic Commission to formulate a long-term policy in the nuclear field. This commission outlined a very ambitious program, which came to be known as the "Swedish Path." It was adopted by Parliament the following year (SOU 1956:11).

The long-term goal of this program was the development of a domestic nuclear fuel cycle, encompassing the extraction of the vast (but low-grade) Swedish uranium resources, the construction of heavy water reactors for producing heat and electricity and the reprocessing of the spent fuel. This goal has to be seen in its historical context. Sweden has hardly any fossil resources, and during both World Wars, imports of coal and oil had been drastically reduced, causing severe problems for both industry and households. Swedish dependence on foreign energy supplies increased after World War II owing to a rapid rise in oil consumption. The resulting vulnerability was underlined during the disturbances in the global fuel markets caused by the Korean War. Increased self-sufficiency of energy supply was thus seen as a vital goal and in this context the domestic uranium deposits were seen as a crucial resource, even though the uranium percentage in these deposits was known to be low. The "Swedish Path" also had a less overt military aspect. A domestic nuclear fuel cycle was not only a way of diminishing dependence on foreign energy supplies, but also a way of enabling the production of material necessary for the construction of nuclear weapons (Lindström 1991, Agrell 2002).

The parliamentary decision in 1956 about the "Swedish Path" meant that huge resources were channelled to the nuclear domain in general and the Atomic Energy Company in particular. The staff of the Company increased rapidly from 260 employees in 1956, to 1000 in 1959, and more than 1500 in 1964. In the second half of the 1950s AE built a research facility in Studsvik with two research reactors. Moreover, it built two heavy water reactors for energy production, first a combined heat and power producing reactor and later on a larger power-producing reactor. The first reactor was built in Ågesta, just south of Stockholm. It took three years longer and cost five times more to build this plant than was originally estimated, but in 1964 the plant was completed and put into operation and produced 55 MW heat for district heating and 10 MW electricity. The second reactor was to be built in Marviken, near the city of Norrköping. The further history of this

reactor is a story of time- and cost-overruns, of growing criticism both from technical experts and from politicians, and of refusal to relinquish the project because of prestige. Finally, even the management of AE had to admit that the plant did not fulfil the necessary safety requirements and the project was brought to an end in May 1970 (Schagerholm 1993, Glete 1983, Brynielsson 1989).

AE also worked with the other links of the nuclear cycle. In the early 1960s, facilities for uranium mining were built in Ranstad, east of Gothenburg. In 1965 the production capacity was tested but only on a small scale; at this time uranium could be imported for a price that was 40% lower than the production costs in Ranstad. Research was also conducted in the reprocessing field, but it was concluded that a reprocessing plant would be too costly.

In the late 1950s a strong controversy arose concerning nuclear weapons both within the governing Social Democratic Party and outside it. Growing factions within the governing party, not least its Women's Association, wanted to put a halt to the development of nuclear weapons. Also the government itself was divided on the issue with the Defence Minister supporting nuclear weapons while the Foreign Minister opposed them. The controversy threatened to cause a major disruption in the party and Prime Minister Tage Erlander set up a "study group" to investigate the matter and try to find a compromise. After more than a year of discussions, the study group presented a report recommending FOA to stop the construction of weapons but to pursue what they called "extended protective research." (Agrell 2002)

In 1958 twenty leading intellectuals including the Arch Bishop and some well-known authors and academics established Aktionsgruppen mot Svensk Atombomb (the Action group against Swedish Atomic Weapons), AMSA. AMSA had a program with two points: opposing the idea that nuclear weapons were introduced to Swedish defence program and requesting that the financial resources saved were used for development aid instead. The members of AMSA were very active and influential; they wrote articles in newspapers, participated in radio and TV debates, talked at public meetings etc. In April 1960 they made a plea for a referendum on nuclear weapons, and started to gather signatures for their plea, although they were not able to muster the necessary number of signatures. When this campaign failed, AMSA more or less dissolved. (Agrell 2002)

The following year a new organization called Kampanjen mot Atomvapen (Campaign against Atomic Weapons), was established inspired by the British organization Campaign for Nuclear Disarmament and the Danish Kampagnen mod Atomvåpen. Like these organizations it strived for different kinds of members and other types of activities than AMSA had done. KMA attracted young people, not least students, and focused on organizing marches and protests. The first major event was a 2-day long protest march from central Stockholm to FOA's research facility in September 1961 with 800 participants. The following years similar protest marches were arranged with several thousand participants. (Agrell 1999) However, the issue of constructing Swedish nuclear weapons lost its political urgency in the early 1960s, when leading militaries changed their views on the benefit of nuclear weapons. Sweden gradually changed its foreign policy and took an active part in the international negotiations concerning the Non-Proliferation Treaty. In 1968 Sweden formally decided not to develop atomic weapons and to sign the Non-Proliferation Treaty.

The debate on nuclear weapons is analyzed in event 1 in chapter 3.

Building the first LWR plants without public debate, 1965-1972

In the mid-1960s the prospects for the Swedish Path had changed due to the decreased importance of the military aspects of the program, and the choice of reactor type was discussed at length among Swedish energy experts in particular among utilities and the leading electric manufacturer, ASEA. The Swedish power industry was made up of the State Power Board, called Vattenfall which produced about 40 % of all power and a dozen private power companies (many owned by municipalities and/or energy-intensive industries). For the power industry the national independence aspect of nuclear reactors was subordinate to their competitiveness and reliability. In the late 1950s many power companies started to question the HWR - which was an integral part of the "Swedish Path" - from a commercial point of view. They were influenced by the fact that the major US electric equipment producers were developing LWRs of two kinds; General Electric was building Boiling Water Reactors (BWR) and Westinghouse Pressurised Water Reactors (PWR). By then it was possible to buy enriched uranium from the United States, which made such LWRs a possible alternative.

When, in December 1963, General Electric signed a turn-key contract for a 520 MW reactor to be built in Oyster Creek for the sensationally low price of 68 million US dollars (equivalent to 350

million Swedish crowns), this was seen as definite proof of the economic superiority of LWRs. In retrospect it is clear that General Electric sold this plant far below the actual costs, assuming that rapidly falling costs would compensate for the sale of one or more "loss leaders". The optimism and enthusiasm resulting from the Oyster Creek plant were decisive in the establishment of a consortium of private power producers called Atomkraftkonsortiet, AKK, later renamed Oskarshamns Kraftgrupp AB, OKG, which in 1964 started negotiations with ASEA for the construction of a large BWR at Oskarshamn. In July 1965 a contract for this plant was signed. The total investment cost for this 440 MW plant was 500 million crowns (Jasper 1990).

ASEA was the leading Swedish supplier of electric technology. In 1952 it had built the world's first 400kV high voltage line in close cooperation with the State Power Board, Vattenfall. As early as 1954 ASEA formulated a long-term strategy for its nuclear energy activities. Its goal was to become an internationally competitive producer of nuclear reactors. ASEA saw itself as the leading Swedish force in the development of commercial reactors. However, the launching of the "Swedish Path" in 1956 made it clear that the government wanted AE to play the leading role in the development of a domestic nuclear construction capacity, with ASEA being one of several suppliers. ASEA vigorously opposed this division of responsibility. It argued that AE lacked the competence necessary for the design of commercial nuclear plants. Yet, in the late 1950s and early 1960s, it was AE that had the financial power through its generous government funding. ASEA could not afford to finance the necessary development on its own, and thus became dependent upon orders from AE. ASEA built most of the Ågesta plant and the Marviken plant, and even though these reactors were not LWRs, the building of them made it possible for ASEA gradually to build up more and more competence in the nuclear field. By 1960 ASEA's nuclear division had grown to 350 people (Glete 1983).

At this time ASEA became more pessimistic about the future for nuclear energy. The economic prospects seemed gloomier with decreasing oil prices and increasing construction costs for nuclear plants (specifically the Ågesta reactor). The company also started to question whether the HWR was the best choice of reactor, and it studied several other reactors including a graphite-moderated gas-cooled reactor of the British type and a light-water boiling reactor developed in the United States. In 1964, after the spectacular Oyster Creek contract, the AKK (later OKG) started negotiations with ASEA about a large BWR of about 300-400 MW in Oskarshamn. For ASEA this

would mean a big step; the Ågesta reactor was much smaller and of a different type, and ASEA did not even have experience with conventional thermal plants of this size. ASEA thus started negotiations with General Electric about a license-agreement. But ASEA found the conditions imposed by General Electric too restrictive and chose to develop its own reactor. This was a bold move; all other European companies chose to buy US licenses. But ASEA was confident of its own ability, and the fact that AE proved to be very willing to cooperate with ASEA was of considerable importance (Glete 1983).

The contract signed with the Oskarshamn-consortium in July 1965 was thus a decisive, but risky, step for ASEA. Soon after this contract Vattenfall and the largest private power company, Sydkraft, showed interest in additional reactors. However, ASEA met competition from a consortium of Swedish industries and Westinghouse. Vattenfall too was convinced of the superiority of LWRs after Oyster Creek. But it was uncertain whether BWRs or PWRs were the best solution. Furthermore, in the middle of the 1960s Vattenfall was somewhat doubtful about ASEA's capacity to design and build commercial reactors. ASEA had little previous experience with large thermal plants, and Vattenfall was not fully satisfied with an oil-fired plant that ASEA was building for it at this time. For ASEA Vattenfall was a customer of the utmost importance. In 1968 the Swedish government used this situation to almost extort ASEA into a merger with AE; it was clearly indicated that ASEA would not get Vattenfall's order if it did not comply. And soon after the merger the new company, ASEA-Atom, got a contract for one of the two reactors that Vattenfall ordered for the Ringhals plant the other was a PWR from Westinghouse.

In the following five years, ASEA-Atom got seven new reactor orders, two from the Forsmark-consortium with Vattenfall as the dominant party, three from the private Swedish power industry and two from the Finnish power consortium, TVO. ASEA's 1954 long-term goal of becoming an internationally competitive producer of nuclear power plants now seemed to have been achieved, even though it had been forced to merge with its rival, AE. It was a remarkable technological achievement for ASEA; all the other companies that managed to become independent producers of reactor plants - Westinghouse, General Electric, and Siemens (KWU) - were much larger firms, devoting more personnel and financial resources to nuclear development (Jasper 1990).

On May 18, 1972 the nuclear power plant in Oskarshamn was inaugurated by the King of Sweden, Gustav VI Adolf with the following words:

Nuclear power is a proof of man's ability to develop his surroundings. In an ever-increasing pace it has come to stand out as the rescue out of a feared energy crisis. In a time when the epoch of hydropower development is coming to a close and difficulties are being discerned regarding the supplies of fossil fuels nuclear power has been realized. Sweden's first commercial power plant thus marks the beginning of a new epoch in our country's energy supply. The completion of this nuclear power plant is a milestone in our country's industrial development. Swedish industry has with foresight and skillfulness independently developed a technology of which we today can see the application. The Oskarshamn power plant represents a technical achievement which well matches the great innovations in Swedish industry. (Citation in Gimstedt 1990)

The inauguration was a moment of great pride for all participants and the future for nuclear power looked very bright indeed. The participants made up what could be called a "nuclear-industrial complex" encompassing ASEA-Atom, Vattenfall and the private power companies, government and government agencies and technical universities. This complex planned to build 24 plants in the coming decades and the prospects for exporting nuclear technology were also promising. Neither the King, nor any of the prominent guests could anticipate that nuclear power would very soon be strongly contested in Sweden.

Nuclear power contested 1973-1978

Nuclear energy had long been considered a clean, environmentally benign source of energy. In the 1950s and 1960s, the largest and oldest environmental organization, Svenska Naturskyddsföreningen, SNF, had even demanded a faster introduction of nuclear power to save the remaining wild rivers from being developed into sources of hydroelectric power (Lindström 1991). Thus, very little questioning of nuclear power occurred in Sweden until the early 1970s, but from 1972 and onwards a dramatic shift took place and nuclear power became heavily criticized by many different kinds of actors. Three of these were particularly important: scientists, politicians and environmental activists.

The single person that most strongly contributed to this shift was a scientist, Hannes Alfvén. He had been awarded the Nobel Prize in physics in 1970 and thus was held in high regard as researcher. He had also been deeply involved in the nuclear research program as board member of the Atomic Energy Company. In the late 1960s he did much of his research in California and came in contact with the growing number of American scientists and engineers who began to question the safety of nuclear power plants, the difficulties of taking care of the radioactive waste from reactors, and the risk of proliferation of nuclear weapons materials. Alfvén became increasingly critical of nuclear power and started writing articles in newspapers and contacting politicians. He even wanted to give a speech at the first UN conference on the Environment organized in Stockholm in June 1972 but was not given the opportunity. Alfvén soon became a very influential nuclear critic as his knowledge and insight could not easily be questioned. Also a number of other Swedish scientists and nuclear experts were influenced by the critique formulated by Alfvén and colleagues abroad, but as many of them worked (directly or indirectly) for the Swedish nuclear industry they were hesitant to formulate their critique publicly (Anshelm 2000, Jasper 1990).

Secondly, a number of parliamentarians began to question nuclear power, some from the Centre Party, which was at the time the second largest party after the Social Democrats and some from the Communist Party. In the spring of 1973 they succeeded to get approval in parliament for a proposal that investigations about the risks of nuclear power had to be made before any decisions about new nuclear power plants were made. One of the parliamentarians also arranged a meeting between Hannes Alfvén and the party leader of the Centre Party, Torbjörn Fälldin. Fälldin was deeply impressed by Alfvén and became a dedicated opponent of nuclear power, and soon the entire party took an antinuclear stance, which fitted well with the party's new environmental ideology. The party had traditionally been the political representative of the farmers, but with a fast decreasing population in the countryside, the party tried to attract urban voters with a "Green" policy of environmentalism and decentralism (Anshelm 2000, Lindqvist 1997).

A third category of nuclear critics were young environmental activists. In the late 1960s a new kind of environmental movement emerged, consisting of small and often local activist groups inspired by similar movements abroad. They protested against polluting industries, car traffic, acid rain and other issues. In the early 1970s they found out that their sister organizations in the United States

were increasingly questioning nuclear power and realizing the huge scale of the Swedish nuclear program they started to learn about the criticism against nuclear power and disseminated it. However, this environmental movement was rather scattered in many small organizations and was as yet unable to organize a broad protest movement against nuclear power (Anshelm 2000, Daleus and Kågeson, interviews).

However, the growing criticism of nuclear power among scientists, politicians and environmental activists led to an intensive public debate. Many critical articles were published in large daily newspapers, the first critical books were published (Kågeson 1973) and environmental groups distributed many pamphlets and posters. The growing antinuclear sentiments, together with the oil crisis in 1973-1974, put energy policy at the center of the political arena. Several government commissions were appointed to study different aspects of energy such as nuclear waste treatment, research and development needs in the energy sector, and long-term prospects for the energy sector. In 1975 an Energy Bill was passed, which initiated an ambitious research and development program, ranging from nuclear research to renewable energy sources and energy efficiency (Prop. 1975:30). Furthermore, this Bill foresaw a reduction in the future growth rate of energy demand and thus a smaller expansion of nuclear energy than previously expected. A total of 13 nuclear reactors were envisaged by 1990, compared to 24 reactors a few years earlier.

In 1976, for the first time in 40 years, the non-socialist parties won over the Social Democrats in the parliamentary elections, and Fälldin became Prime Minister in a coalition government. At the end of the election campaign, Fälldin had made very clear antinuclear statements on ethical grounds, and this was probably decisive for the victory, which was very close (Holmberg et al 1977). However, the other two non-socialist parties in the government coalition had a very different, much more positive, view of nuclear energy, and the nuclear issue caused much conflict. One way to handle this was to set up a government commission with representatives from the different parties and organizations involved for trying to find compromises. This commission made a very detailed investigation and outlined four scenarios for the future but could not unite in a joint vision (SOU 1978:17).

The role of all the government commissions in the second half of the 1970s will be analyzed in event 2 in chapter 3 below.

Nuclear waste was an issue that attracted particular attention in the public debate, and in the spring of 1977 the government proposed a Nuclear Stipulation Act which was passed by Parliament. This Act stipulated that reactor owners had to demonstrate that they would be able to handle the spent fuel from their reactors in a “totally safe” way to get permission to commission new reactors. This Act spurred the Swedish power companies to jointly pursue an intensive research project about a methodology for final storage of spent fuel; alternatively of the high level waste produced if the fuel was reprocessed. However, despite this effort to find a common ground, the government split in 1978, after a confrontation about how to interpret the Nuclear Stipulation Act, and a minority government led by the Liberal Party was formed with Carl Tham as Energy Minister (Vedung 1979).

TMI and the referendum on nuclear power

The environmental movement in Sweden grew in strength during the 1970s and it increasingly focused on nuclear power. In 1978 a broad umbrella organization called Folkkampanjen mot Atomkraft, the People’s Campaign against Atomic Power, was established. There was a lively debate within the People’s Campaign about possible strategies. How would it be possible to fight the powerful nuclear industrial complex that moreover was supported by three political parties with an overwhelming majority in Parliament? A referendum emerged as the best option. However, when the People’s Campaign demanded a referendum, the nuclear friendly parties opposed it arguing that the nuclear issue was too complex for a referendum (Eriksson 1981, Interviews Daleus, Odell, Kågeson, Falk).

So the People’s Campaign started a petition for a referendum in the beginning of March 1979, and activists began to collect signatures. In the midst of this campaign, the Three Mile Island accident occurred on March 28. Swedish mass media reported extensively about it, and the accident gave the anti-nuclear movement an enormous boost (Holmberg&Asp 1984). A week later, Olof Palme announced that the Social Democrats had changed stance and now supported a referendum, and the Conservatives and Liberals soon followed suit.

The approval of the referendum was a huge success for the People’s Campaign. But the framing of the referendum, which was decided by Parliament, became a disappointment. The anti-nuclear

side had foreseen a straight forward referendum with two alternatives, one for a phase-out and one for a continued expansion of nuclear power. It came as a shock to them when the pro-nuclear parties split into two alternatives instead of one, for tactical reasons (Eriksson 1981, Interviews Daleus, Odell, Kågeson, Falk). Thus Line 1 was supported by the Conservatives, Line 2 by the Social Democrats and the Liberals and Line 3 by the Centre Party, the Communists and, of course, the People's Campaign.

Line 3 was a straight forward phasing out alternative and meant that the six operating nuclear reactors should be phased out within ten years. Line 1 and Line 2 were almost identical, and they too were framed as phase out alternatives, albeit in a far future. The crucial formulation in both was as follows: *Nuclear power will be phased out at a pace that is possible with consideration to the need for electricity for employment and welfare.* Concretely the two lines proposed that besides the six reactors already in operation, six more reactors already completed or under construction should be brought into use in the coming years. The only difference between the two alternatives was that Line 2 in addition demanded public ownership of all nuclear power plants. Line 2 was intended to appear as a "middle way" alternative and their slogan was "phasing out, but with reason" (Holmberg&Asp 1984).

The referendum campaign dominated political life and the mass media for several months. The Line 3 campaign became a mass movement of grassroots activists all over Sweden. They organized demonstrations, public meetings, distributed campaign newspapers, and knocked on doors to talk with ordinary people. The campaigns of the other two lines were more like ordinary election campaigns, dominated by party officials and professional lobbyists and were heavily supported by Swedish industry economically. They had the resources to finance huge ads in the major newspapers (Holmberg&Asp 1984).

The outcome of the referendum was that Line 2 received 39.1% of the votes, Line 3 received 38.7% and Line 1 received 18.9%. Based on the referendum, Parliament set up the goal that all nuclear power plants should be phased out by the year 2010. But in the short term it meant a return to "business as usual". In the following five years six additional reactors, much bigger than the previous ones, were taken into operation. The outcome was of course a huge disappointment for all the members of the People's Campaign that had campaigned so intensively in the previous

months. Not surprisingly an overwhelming majority of the activists became disillusioned and quit the People's Campaign. A few joined political parties instead, not least the new Green Party that was founded in 1981 (Eriksson 1981, Interviews Daleus, Odell, Kågeson, Falk).

The referendum on nuclear power represents the peak of nuclear debate in Sweden when hundreds of thousands of Swedes were actively engaged, and it will be analyzed further in the next chapter as a showcase of interaction between nuclear industry, political parties and civil society in Sweden.

Nuclear expansion and nuclear waste

A few weeks after the referendum, the government approved fuel loading for the four reactors that were completed but not yet operating. Later on, the companies received about 4 billion crowns from the state as compensation for the delay of commissioning owing to the referendum. Furthermore, the construction of two additional, even bigger reactors was accelerated. These were completed and taken into commercial operation in 1985. Consequently, nuclear power production increased threefold from the time of the referendum to 1985, and Sweden now generated more nuclear power per capita than any other country.

Electricity consumption did not develop according to earlier forecasts in the 1980s and in order to find a market for all this additional power, Vattenfall reduced its electricity prices considerably in 1983, and the other power producers followed suit. About half of the new electricity was used for the heating of houses, and this was criticised by the nuclear opponents as a wasteful way of using electricity. For ASEA-Atom the completion of the 11th and 12th reactors in Sweden marked the end of an epoch. Since then the company has built no more reactors. Not only the Swedish market but also the international market for nuclear reactors almost vanished in the late 1970s, and the company did not get any new reactor orders after 1976. However, the nuclear fuel manufacturing division, now owned by Westinghouse, is very competitive in the international market.

Nuclear waste was another issue that had to be dealt with by power companies and government. In 1979 the power companies had presented a methodology for final storage of spent fuel in accordance with the Stipulation Act. This method, called KBS, was approved by the regulating agency SKI, and this was a condition for the commissioning of the new reactors. As a

next step the power companies owning nuclear reactors had to try to find possible locations for a repository.

In April 1980, just a month after the referendum, PRAV, an organization with the task to find a place with good geological conditions for a repository, tried to set up a testing site for proof drillings at Kynnefjäll, 100 km north of Gothenburg. However, the drilling team was met by intense local protests and had to withdraw. The protesters guarded the intended site for no less than 20 years. Also in the other places that PRAV had identified as promising for a repository they met strong local protests, which could however not prevent the drillings. But these local protest groups were able to gain strong support from the local population and also from local politicians. All these local groups soon formed a national network called the Waste Chain which engaged university geologists as counter experts which strongly questioned the intended design of the repository. The local protests thus had more than a NIMBY character.

In parallel with these local controversies Swedish Parliament decided in 1981 about the financing of the future costs for handling nuclear wastes. Every reactor owner had to pay a certain amount for every produced kWh to a state Nuclear Waste Fund that would guarantee the financing of the future repository and other facilities. By the mid-1980s the power companies responsible for the final storage of spent fuel had established a new jointly owned organization, SKB, with the task to develop and build facilities for final storage. SKB reached the conclusion that it would be impossible to establish a repository at a site where the local population was strongly against it. Thus, the local opposition groups had won the first round in the controversy about final storage (Anshelm 2006a and b).

The local opposition to test drillings will be analyzed in event 3 in chapter 3 below.

The Chernobyl disaster and its effects in Sweden

The debate on nuclear power decreased after the referendum but was suddenly revived again in the spring of 1986 after Chernobyl. This disaster was in fact disclosed by Swedish nuclear experts. 30 hours after the incident increased radiation levels were detected at the Forsmark nuclear power plant in Sweden. A Crisis team was set up by the Swedish Radiation Protection Agency and after analysis of the fallout and of the meteorological conditions it identified the Chernobyl nuclear station

as the probable source for the fallout over Sweden. The Swedish findings forced the Soviet government to inform the world about the disaster (Dsl 1986:11).

Parts of northern and eastern Sweden were severely affected by the disaster and Swedish mass-media reported intensively about the increased radiation levels, and this caused much anxiety. The anti-nuclear movement experienced a revival as a result of Chernobyl. Demonstrations were arranged in many places all over Sweden demanding an immediate start of the nuclear power. But this revival was short-lived and soon ebbed out. The Minister of Energy phasing out of, Birgitta Dahl, had played an active role in the disclosing of the disaster and was deeply shaken by it. She rapidly commissioned an investigation of the disaster. This commission concluded that Chernobyl did not change the earlier assessments of nuclear risks in Sweden, and it further argued that an immediate phasing out of nuclear power would have severe economic consequences.

Based on this report and further investigations Birgitta Dahl presented a proposal to start the phase out in the mid-90s, with a first reactor in 1994 and a second two years later. After Parliament approved this proposal, Dahl emphasized that the decision to start the phase out was “irreversible”. This new policy was forcefully contested by industry and trade unions, representing a strong faction within the Social Democratic Party. They argued that a “premature phase out” – as they called it - would threaten jobs in industry. In the following year the Social Democratic Party experienced a strong internal conflict between an economic growth oriented faction, and an environmentally oriented faction. The former won and as a result the energy portfolio was transferred from Birgitta Dahl to the trade union leader, Rune Molin in 1990.

Molin immediately started negotiations about a revision of the energy policy with the Centre Party and the Liberal Party, and the three parties reached an agreement in 1991 in which the “premature phase out” of nuclear power in the mid-1990s was postponed to an undefined future. The agreement also contained a new element: It underlined the importance of the deregulation and internationalisation of the energy sector in general and the electricity system in particular. Thus five years Chernobyl, Parliament made a decision to continue the Swedish nuclear program unchanged. The “irreversible decision” to start the phase out in the mid-90s had in fact been reversed after a strong reaction from the pro-nuclear side, while the anti-nuclear movement was too weak to influence the process.

Chernobyl and its implications on Swedish energy policy are analysed in event 4 in chapter 3.

Municipalities competing for a repository

After the failed attempts to find a suitable location for a repository in the 1980s, SKB initiated a new strategy in the early 1990s. It adopted a much more open and cooperative attitude towards municipalities, emphasizing that a decision about a repository only would be made if a local municipality was in favour of it. Based on more developed safety analyses, SKB argued that the rock itself was not the single most important barrier but that the other components in a repository, the copper canister surrounded by bentonite clay, were also crucial parts. This meant that it was no longer necessary to search for the best possible geological location in the whole country, but that the geology in large parts of the country was sufficiently good. After a stepwise screening of potential sites all over Sweden, SKB turned to municipalities in southern Sweden that already had nuclear facilities. Preliminary studies indicated that two of these, Östhammar (where Forsmark is located) and Oskarshamn, had the best conditions with inhabitants that were not averse to nuclear facilities and suitable transport infrastructure (Anshelm 2006a, Lidskog 1998).

In 2002 more thorough studies of these two municipalities commenced including test drillings. The ensuing process was very different from previous attempts. Instead of having to deal with very reluctant local populations, SKB now had two positive local populations. After a long evaluation process SKB reached the decision in 2009 that Östhammar would be the best place for the future repository on geological grounds. To lessen the disappointment in Oskarshamn they simultaneously decided that the future plant for constructing copper canisters for the spent fuel would be located next to the existing interim storage facility in Oskarshamn.

The municipal “competition” for a repository is analysed in event 5 in Chapter 3.

Nuclear phase out or expansion?

The tripartite agreement in 1991 spurred what would become an institutional revolution in the Swedish electricity sector. New legal frameworks were introduced in 1996 in order to promote competition, and the ownership patterns changed dramatically; in particular a number of foreign power companies bought large shares of previously domestic energy companies, while Vattenfall expanded abroad, particularly in Germany where it bought power companies owning nuclear reactors and large coal mines (Högseius&Kaijser 2007). However, the nuclear issue did not

disappear from the political agenda altogether. In 1997 a new tripartite energy agreement was made, this time between the governing Social Democrats, the Left party (former Communist party) and the Green party, and this agreement included a decision to start a phase out of nuclear power in the near future. As a result the two reactors at Barsebäck were closed down in 1999 and 2005 respectively. That these two reactors were chosen had to do with their location only 20 km from Copenhagen. For decades the Barsebäck plant had been a nuisance in the relations between the Swedish and the Danish governments. (See Danish Country Report)

In 2010, the time frame for phase out decided by Parliament after the referendum in 1980, ten reactors were still operating. These reactors had been upgraded and could generate more electricity than the twelve reactors did in 1985, and Sweden was still the country with most nuclear power per capita. In 2010, Parliament made a new decision on nuclear power in, which allowed the construction of new reactors, but only at existing power plants and for replacing old reactors. For a number of years electricity prices in Sweden had been low, and due to increasing safety demands on reactors, particularly after Fukushima in 2011, the reactor owners were forced to make large investments in safety improvements as well as in replacements of components that had reached the end of their technical life. In May 2015 the owners of the Ringhals nuclear power plant made a decision to close down the two oldest of their four reactors by 2020 for economic reasons, and in October the same year the owners of the Oskarshamn nuclear power plant also decided that the two oldest of their three reactors will be closed by 2020. At present it thus seems as if economic rather than political conditions will dictate the future of nuclear power in Sweden, bearing in mind that political decisions regarding taxes and subsidies in the energy sector may have substantial economic impact.

1.3. Presentation of main actors

The first two organizations of importance for nuclear energy were *the Atomic Energy Company, AE*, and *the National Defence Research Institute, FOA (now FOI)*. AE was established in 1947 as a limited company in which 4/7th of the shares were owned by the state and the rest by private industry, but the government had a dominant influence and provided most of the funding for AE. The main task of AE was to develop and design nuclear reactors, uranium mines, and reprocessing plants. FOA was established in 1945 by merging a number of separate military

research institutes and became responsible for research on military applications of nuclear technology. FOA cooperated closely but discreetly with AE. Both AE and FOA had a dominance of nuclear scientists in leading positions. Public universities and in particular the technical universities, KTH and Chalmers, also played an important role early on, both for fundamental nuclear research and for educating nuclear scientists and engineers.

In the mid-1950s ASEA, Sweden's leading manufacturer of electrical equipment also became involved in nuclear development. By this time, ASEA had developed the world's first 400 kV-line in close collaboration with *the State Power Board, Vattenfall*. ASEA formulated a goal to become one of the world's leaders in heavy electrical equipment, and it saw nuclear power as an area of vital importance for the future. ASEA had a dominance of electrical engineers in leading positions and had a long tradition of developing and manufacturing electrical plants.

The main power producers in Sweden were the state owned Vattenfall and about ten private power companies. They were ambivalent towards nuclear power in the mid-1950s. They feared that the nuclear enthusiasm might threaten the exploitation of hydropower in the still untouched rivers in northern Sweden, which was their first priority. They were also hesitant about the future costs of nuclear power. But in the 1960s they changed stance and jointly purchased nuclear reactors. Most of the Swedish nuclear power plants have been co-owned by several power producers. Until the mid-1990s these companies were fully Swedish owned, but with the liberalization of the Swedish electricity market foreign companies, i.e. the German company E.ON (now UNIPER) and the Finnish company Fortum have also become major owners.

From 1956 there was a division of labor dictated by government in which AE developed and designed nuclear reactors (HWRs), ASEA built them and Vattenfall operated them – and the government funded it all. Both ASEA and Vattenfall challenged AEs role as main developer. They had collaborated closely in the development of high-voltage technology in the 1940s and 50s, and wanted to continue a similar cooperation in the nuclear field, but had to accept AEs leading role. However, in the mid-60s private Swedish power companies decided to purchase light water reactors, LWRs, from ASEA, and the latter managed to develop and build such reactors on its own without licenses from General Electric or Westinghouse, which was unique in Western Europe. In 1969 the reactor development part of AE merged with ASEA to form ASEA-Atom, and this new

company came to harbour most of the country's nuclear reactor expertise. Research and materials testing activities at Studsvik remained in a reduced AE, now Studsvik AB, a private company.

Also the government and government agencies supported nuclear energy. Most of the research and development work up till the mid-1960s was government financed from the Ministry of Trade and the Ministry of Defence. From 1968 the new Ministry of Industry took over responsibility for energy matters from the Ministry of Trade. There has been an energy unit at these Ministries responsible for preparing Energy Bills, setting up committees and new agencies and much more. The public servants in this unit, mostly engineers and economists, had a considerable de facto influence.

In 1956, Parliament passed an Atomic Energy Law, which led to the establishment of agencies for regulating fissile material and nuclear plants and their activities. At first, three temporary agencies were created, one for inspecting safety of reactors and security of fissile materials, one responsible for the siting of reactors, and one for radiation protection. In 1965 the third of these was formalized as *the State Radiation Protection Institute, SSI*. In 1974, the first two were merged and became *the Swedish Nuclear Power Inspectorate, SKI*. Finally, in 2008 SKI and SSI were merged and became *the Swedish Radiation Safety Authority, SSM*.

In 1972 a new company was established on government initiative for coordinating the purchase of nuclear fuel, *SKBF*. It was owned jointly by the reactor owning companies. In the late 1970s this company was given an additional task, to develop a method for final storage of spent nuclear fuel and it changed its name to *SKB*.

In a fairly small country the organizations supporting the development of nuclear energy have been rather few, and the leading persons in these organizations have all known each other and formed a rather tight network, even though there have also at times been conflicts within the network. Around 1970 a very powerful "nuclear-industrial complex" had emerged, and there was a broad political support for nuclear power in Sweden from all political parties and from civil society as well, including influential organizations like the Federation of Swedish Industry and the Swedish central labour union, LO.

There was very little criticism of nuclear power before 1972. In the late 1950s there had been an opposition against nuclear *weapons*, and these critics had also questioned that the early reactors were designed to enable weapons materials. But they had not questioned nuclear energy as such.

In the early-1970s an anti-nuclear movement emerged. It started among some scientists and engineers, which were influenced by the critique launched by American colleagues. Some environmental organizations also became critical of nuclear power due to close contacts with sister organizations abroad. In the 1970s the anti-nuclear movement gradually gained momentum also beyond the environmental organizations, in particular among young "counter-culture" people with experience from the student revolt in the late 1960s and the Vietnam and Chile solidarity movements, but also among peace organizations, women's organizations, and religious groups. In 1973 also two of the five parties in Parliament took an anti-nuclear stance, *the Centre Party*, with its base in the country side, and *the Communist Party*.

The anti-nuclear movement was heterogeneous and organizationally scattered and to overcome this, an umbrella organization called *the People's Campaign against Atomic Power, FMA*, was established in 1978. FMA decided to demand a referendum on the future of nuclear power, which was first rejected by a Parliamentary majority but later approved due to the strong sentiments caused by the TMI accident. The referendum campaign led to an enormous increase of the FMA membership and hundreds of thousands were engaged. However, the outcome of the referendum was a huge disappointment and an overwhelming majority of the activists became disillusioned and quit FMA, or FMK as it had been renamed.

FMK thus lost much of its strength as a national actor, but in some places that were chosen as sites for test drillings for possible nuclear fuel repositories, active *local protest groups* emerged in the 1980s. Moreover, other environmental organizations gained strength, for example *the Swedish Society for Nature Conservation, SNF*, and *Greenpeace Sweden*, which partly changed character and became professional lobby organizations rather than grassroots based activist organizations. In 1981 *the Green Party* was established in Sweden and it won its first seats in Parliament after the election in 1988. This Party absorbed some of the activists from FMK and became a strong anti-nuclear voice in Parliament.

Mass media have also played an important role in the history of nuclear energy in Sweden. In the early decades media gave positive and uncritical accounts of nuclear technology, but in the 1970s newspapers and TV and radio became important arenas for debate about the pros and cons of nuclear energy. Media played particularly important roles in relation to the incidents at TMI, Chernobyl and Fukushima and during the referendum on nuclear power (Holmberg&Asp 1984).

2. Showcase. The referendum on nuclear power in 1980

Case history

The referendum on nuclear power that took place on March 23, 1980 represents the most intensive engagement with the nuclear power issue ever in Sweden. Hundreds of thousands of Swedes were actively engaged during the months preceding the referendum. Many leading politicians were also engaged as were representatives from industry, trade unions and lobby organizations. Mass media were filled with articles and programs about the pros and cons of nuclear power and also with advertisements from the competing sides. Thus, the referendum is a fairly obvious choice as a showcase.

Referendu in Sweden are unusual. Before 1980, there had been only three earlier referendums: one concerning a ban on alcohol in 1922, one about introducing right hand car traffic in 1955, and one about a change in the pension system in 1957. In all these three cases opinions did not follow traditional party lines and a referendum was seen as a way to overcome this. It is Parliament that decides to arrange a referendum, and it is only advisory; it is the task of Parliament to interpret the result afterwards.

A proposal to organize a referendum on nuclear power was first proposed by the Communist Party in 1975 but was rejected by the other parties (Anshelm 2000). In the autumn of 1978, the proposal to hold a referendum came up again, this time within the *Folkkampanjen mot Atomkraft* (the People's Campaign against Atomic Power), FMA. The FMA had been established in March 1978 as an effort to create a national umbrella organization for the rather heterogeneous anti-nuclear movement. It encompassed a dozen organizations, some of which were non-political environmental or peace organizations, while others were political organizations, including the Centre Party and Communist Party, and also many parties not represented in Parliament, primarily from the left but also including the Christian Democrats.

The nuclear friendly parties in Parliament - the Social Democrats, the Conservatives and the Liberals – were still negative about a referendum and argued that the nuclear issue was too technically complicated for a referendum. To put political pressure behind the demand for a referendum the FMA in the beginning of March 1979 launched a nationwide campaign to collect

signatures on a petition for a referendum. On March 28, in the midst of this campaign, the Three Mile Island accident occurred, and all Swedish mass media reported extensively about it. The accident had a major impact on the public opinion, and a week later, Olof Palme, the party leader of the Social Democrats announced that he and his party had changed stance and now supported a referendum. The Conservatives and Liberals soon followed suit. For these parties a referendum was a way to separate the nuclear issue from partisan politics, thus preventing the TMI accident from becoming a big issue in the upcoming elections in September 1979. The decision to organize a referendum was complemented by a decision to postpone the fuel loading of four new reactors until after the referendum (Fjaestad 2008).

The details of the referendum were decided after the general elections, which brought a new non-socialist coalition into office, with Fälldin as Prime Minister. After negotiations among the five parties in Parliament, an agreement was reached in mid-December 1979. When demanding a referendum, the FMA had foreseen a straight forward referendum with two alternatives, one for a phase-out and one for a continued expansion of nuclear power. However, the pro-nuclear parties split into two alternatives instead of one, for tactical reasons. The Social Democrats did not want to support the same alternative as the Conservatives. There were thus going to be three alternatives in the referendum that was to take place on March 23, 1980. Line 1 was supported by the Conservative Party, Line 2 by the Social Democrats and the Liberals and Line 3 by the Center Party and the Communists (and the FMA). Each of the three lines was given 18 Million Swedish Krona to finance its campaign.

The ballots of Line 1 and Line 2 were largely identical. They proposed that besides the six reactors already in operation, six more reactors that were already completed or under construction should be brought into use. Beyond this no further expansion of nuclear power would be allowed. Line 2 had some additional points concerning, inter alia, public ownership of nuclear power plants and a ban on electric heating of dwellings. Line 3 proposed that the six operating nuclear reactors should be phased out within ten years and that no new reactors should be put in operation.

The ballots of Line 1 and 2 both began with the following sentence: *Nuclear power will be phased out at a pace that is possible with consideration to the need for electricity for employment and welfare.* They thus presented themselves as phase-out alternatives too, but in a far future. In the

short term their proposals implied a threefold increase of nuclear production. In particular Line 2 had the aim to look like a "middle way" alternative and their slogan was "phasing out, but sensibly". The anti-nuclear movement was very upset both about the arrangement with three alternatives instead of two and about the other lines' efforts to look as phase-out alternatives, but it could not do anything about it (Kågeson&Kjellström 1984, Eriksson 1981, Interviews Daleus, Odell, Kågeson, Falk)).

The referendum campaign started in mid-January and dominated political life and the mass media for two months with a peak in the weeks preceding the referendum. The three lines had very different organizational set ups and modes of campaigning and arguing (Holmberg&Asp 1984, Anshelm 2000).

Line 1 was closely linked to the Conservative Party and to industry. The campaign general was a 32 old year parliamentarian, Per Unckel, who was fairly unknown to the general public. The board of Line 1 also encompassed leading industrialists and scientists. The Swedish Federation of Industry established a lobby organization called Industries Energy Information to support Line 1.

Line 2 was linked to the Social Democratic Party, the Liberal Party and the main trade union, LO. The Social Democrats were in majority as they were a much bigger party. The trade union leader Rune Molin was appointed as the main spokesman of Line 2, while the liberal diplomat and former Foreign Minister Hans Blix was his second. Also the Social Democratic parliamentarian Birgitta Dahl had a leading role and represented Line 2 in many debates. Line 2 strived to mobilize the trade unions to campaign at work places all over the country.

Line 3 was the most heterogeneous line with more than 30 supporting organizations including, the Centre Party, the Communist Party, the Christian Democrats, parties far to the left and environmental and peace organizations. Its campaign general was Lennart Daleus, an unknown 33 year old environmentalist representing Friends of the Earth. Line 3 also included social democrats, liberals and trade unionists that were anti-nuclear. The most prominent of these "turncoats" was Ulla Lindström, a former Minister and a grand old lady in the Social Democratic Party. The Line 3 quickly developed into a mass movement with several hundred thousand people organized in local committees all over Sweden. Many activists took part in study circles to learn more about, energy

issues, often based on the book “Vote No” (Kjellström&Kågeson1979) of which 170,000 copies were. These activists organized meetings, distributed campaign newspapers, and knocked on doors to talk with ordinary people (Eriksson 1981, Interviews Daleus, Odell, Kågeson, Falk).

In addition to the spokesmen and other representatives directly linked to the three lines the ordinary party leaders also played an active role in the campaign and did their best to try to convince their traditional voters to support “their” line.

A good illustration of the differing characters of the three campaigns is the way they arranged their major activity before the election (Holmberg&Asp 1984, 100ff). Line 1 organized its final meeting in a sober concert hall in Stockholm with speeches by a handful of the campaign leaders. The main point on the program was a presentation making use of sophisticated audio visual aids of a possible future “crisis scenario”, describing a conflict in the Middle East leading to rationing of petrol (as had actually happened in 1956 and 1973), and with the underlying argument that Sweden would be much better off if it expands nuclear power.

Line 2 had its final meeting in the labour movement’s bastion “The People’s House” in Stockholm. The theme of the day was “Don’t make the 80’s more difficult”, and very prominent politicians and trade union leaders all argued that Line 3’s proposal to phase out nuclear power in 10 years would create huge economic difficulties. “It’s not only about the stereo and the car, it is about our jobs and social security” as the leader of LO put it.

Line 3 arranged demonstrations in a hundred towns all over Sweden one week before the referendum. In Stockholm 25 000 demonstrators marched to the main sports arena, where a number of musicians and actors participated and Lennart Daleus was the main speaker focusing on the safety problems with nuclear power. The slogan of the demonstration was “Say yes to life – say no to nuclear power”

These three events also illustrate the kind of argumentation that the three lines pursued. Line 1 emphasized that nuclear power was crucial for further economic growth and for decreasing the dependency on imported oil. It also argued that nuclear power was safe and that Swedish nuclear plants were more reliable than the one atTMI. Even if its ballot stated that nuclear power would be phased out “at a pace that is possible with consideration to the need for electricity for employment

and welfare” the representatives of Line 1 talked very little about this future phase out, but much more about the nuclear expansion in the immediate future.

Line 2 had a similar argumentation as Line 1 and strongly emphasized that nuclear expansion was necessary for economic growth and social welfare. It also emphasized the need to develop alternative energy sources like wind and solar power but argued that it would take a long time before these sources could replace nuclear power. In the long run, sometimes the year 2010 was mentioned, a nuclear phase out should thus be feasible.

Line 3 emphasized the dangers of nuclear power; the risk of disasters in power plants, the challenge to store spent fuel for hundred thousand years, and the risk for nuclear proliferation. It argued that it would be possible to replace the six reactors in operation in the coming ten years through an ambitious program for building wind power and combined heat and power plants and through measures for increased energy efficiency, and that such a program would create many new jobs (Holmberg&Asp 1984, Anshelm 2002)).

The outcome of the referendum was that line 2 received 39.1% of the votes, line 3 received 38.7% and line 1 received 18.9%. As referendums in Sweden are only advisory it was the task of the Parliament to transform the referendum result into a political decision. In June 1980 Parliament set up four long-term goals for the energy sector:

- all nuclear power plants should be phased out by the year 2010;
- the country's dependence on oil should be reduced;
- energy efficiency should be increased;
- a transition should be made to "an energy system based as far as possible on sustainable, preferably renewable and indigenous, energy sources with least possible environmental impact".

It should be noted that the year 2010 was not in the ballot text of lines 2 or 1 but was added by Parliament. It was based on an expected (economical) lifetime for nuclear reactors of 25 years and assumed that the last two reactors would be commissioned in 1985. Parliament thus formulated goals for the energy sector implying a major redirection sometime in the distant future and it did not specify a time table for the phase out. In the short term, this decision meant a return to "business as

usual," after a period of intense politicization of energy matters. A few weeks after the referendum, the government approved fuel loading of four reactors that were completed but not yet operating. Furthermore, the construction of two additional, even bigger reactors was accelerated. These were completed and taken into commercial operation in 1985.

The outcome of the referendum was a huge disappointment for all the Line 3 activists that had campaigned so intensively in the previous months. There were no plans for how to continue the nuclear opposition in the case of a defeat. Moreover, it became difficult to question the expansion of nuclear power when a referendum had approved it, and a majority of the activists became disillusioned and quit the People's Campaign.

Type of event

This is the most well-known event in the history of nuclear power in Sweden and much research has been devoted in particular to the political aspects of it. There is however not so much research on the emergence, functioning and character of the anti-nuclear movement, despite its size and importance.

Identification of actors

The referendum was initiated by FMA; an umbrella organization for environmental groups and political parties that were critical of nuclear power. When the decision about a referendum was taken, the Line 3–alternative grew very rapidly all over the country, engaging several hundred thousand people. It was a rather heterogeneous movement but a central campaign office tried to organize it and to produce campaign material that was distributed to all the local groups. Line 1 and Line 2 organized campaigns that were more similar to ordinary election campaigns enrolling party organizations, trade unions, industry and lobby organizations.

Mass media played a very important role during the referendum campaign both as arenas for debates and by describing and discussing the likely consequences of the different alternatives in the referendum. Public service radio and TV are obliged to be impartial and objective, which was not easy. They organized debates with spokesmen of the three lines that were of particular importance. Daily journals in Sweden are often linked to a political party and many took a clear stance on their editorial pages, but most opened their pages for debates with participants from all lines.

Arguments and behaviours

The anti-nuclear, Line 3, focused primarily on the dangers of nuclear power. The risk of accidents in reactors, as illustrated by TMI, was particularly emphasized, but also the unsolved final disposal of spent fuel, the environmental risks of uranium mining and the risk of nuclear proliferation. Furthermore it proposed a fast development of renewable energy sources and of more efficient energy use. Such a development, it was argued, would make it possible to phase out the six operating nuclear reactors in ten years and replace them primarily with renewables and efficiency measures.

Line 1 and Line 2 also acknowledged that nuclear power had problematic aspects and should be phased out in the long run, when there were renewable energy technologies that could replace them. But they argued that it would be an enormous economic loss not to use the reactors that had been built or were under construction and that this would threaten jobs and economic welfare. Line 2 argued that twelve reactors should be used during their technical life time, which was assessed to be about 25 years. This would mean “a phase out with sense”.

Public engagement

The referendum was organized according to strict laws and rules that govern advisory referendums in Sweden in which Parliament has the final say about the setup for such a referendum. Nuclear power and energy issues in general have never been discussed as intensively and wide spread in Sweden as during the half year preceding the referendum.

3. Events

The showcase and the five events below have been chosen primarily because of their significance in themselves, but also in such a way that they jointly reflect, different political eras, different issues (weapons, nuclear power, nuclear waste), local issues versus national issues, transnational influences, and the involvement of different kinds of actors.

The first event is the nuclear weapons controversy in the late 1960s and early 70s. This was the first time that nuclear technology was seriously debated in Sweden, and this debate took place on three different arenas with different kinds of participants. It was also influenced from abroad.

The second event concerns a number of inquiries on energy futures in the late 1970s. In Sweden government commissions are often appointed when political conflicts emerge, and when energy and in particular nuclear power became a contested area several commissions were set up, with representatives from stake holders and political parties. These commissions analyzed different future options and tried to find compromises.

The third event is about the local protests that emerged in the early 1980s in response to attempts to make drillings and investigations for locating a nuclear fuel repository. The drilling teams came without prior notice, and they often triggered a strong local opposition. These local groups formed a national network called the Waste Chain to coordinate their resistance.

The fourth event is the Chernobyl incident in 1986 and its political implications in Sweden. This disaster was disclosed to the world by a Crisis team at the Swedish Radiation Protection Agency, SSI, and the fallout over Sweden was severe. The disaster thus led to a renewed debate about the risks of nuclear power and the pace of the phasing out of Swedish reactors.

The fifth event is about the further process of locating a place for a repository in the 1990s which was a comprehensive process including both geological investigations and striving for political consent. In the end the process became almost a “beauty contest” between two municipalities, both already hosting a nuclear plant, striving to be chosen as sites for nuclear waste. Bedrock quality decided the outcome.

3.1. Event 1. The nuclear weapons controversy

Case history

In 1956 the Swedish Parliament decided on an ambitious program for the development of nuclear technology, which came to be known as the "Swedish Path". The long-term goal of this program was the development of a domestic nuclear fuel cycle in order to increase self-sufficiency of energy supply. It also had a less overt military aspect to enable the production of nuclear weapons. When the knowledge about the military aspects of the "Swedish Path" became more generally known, nuclear weapons became a contested political issue. Partly the division was on the right-left scale, with most politicians from the right and centre parties supporting nuclear weapons, while many politicians from the left were more sceptical. In particular the governing Social Democrats were divided; a growing faction within the party led, by the Social Democratic Women's Association headed by Inga Thorsson, wanted to put a halt to the development of nuclear weapons. Also the government itself was divided on the issue with the Defence Minister, Sven Andersson, supporting nuclear weapons while the Foreign Minister, Östen Undén, was opposing them (Agrell 2002).

In 1957, the Supreme Commander, Nils Swedlund, openly demanded further funding for developing nuclear weapons, and this triggered an intensified debate. In March 1958 an influential little book entitled *Instead of the nuclear bomb* was published. It was co-authored by a well-known novelist and pacifist, Per Anders Fogelström, and a Social Democratic student leader and reservist officer, Roland Morell. They argued that Sweden should abandon the bomb and instead use the money for development aid. The book had a strong impact and was presented in newspapers, radio and even TV, which was for the first time used as an arena for political debates. The two authors were also invited to speak at meetings all over Sweden. At one of these meetings in June 1958, an initiative was taken to establish a new organization or network called Aktionsgruppen mot Svensk Atombomb (the Action group against Swedish Atomic Weapons), AMSA. In the following year the members of AMSA were very active; they wrote articles in newspapers, participated in radio and TV debates, talked at public meetings and prepared material for study circles.

AMSA chose to call itself an "action group" to demonstrate that it did not strive to become a long lasting peace organization and compete with existing organizations. It was very informal without

any membership fees, no board and it was limited to the 21 people that joined from the beginning. These included some well-known authors, journalists and academics and the Arch Bishop. They had their sympathies with different political parties, but none of them was communist. One reason for not admitting more members was that AMSA did not want to be suspected to be a pro-communist organization. Moscow spurred communist parties in Western Europe to create peace organizations opposing nuclear weapons, and the Swedish Peace Committee was one of these.

There were also many that actively argued that Sweden should develop nuclear weapons in order to defend itself against possible attacks by the Soviet Union: leading militaries, researchers at FOA and AE and most parliamentarians belonging to the Conservative, Liberal and Center parties were all in favor of this option. The main Swedish daily, Dagens Nyheter, had an influential editor in chief, Herbert Tingsten, who was a former professor of political science. He argued very forcefully for Swedish nuclear weapons. Moreover, in 1959, Per Edvin Sköld, an influential Social Democrat who had been Minister of Defence during WWII and Finance Minister after the war, edited a book with the title *Swedish atomic weapons*, which was a kind of reply to AMSA and to Fogelström's and Morell's book with six contributors – members of the armed forces, researchers, a diplomat and a journalist – all pleading for the development of nuclear weapons.

Within the Social Democratic Party the opinions were much more divided. In parallel with AMSA's public campaign the nuclear weapons issue was also intensively discussed in. In fact, the nuclear weapons controversy threatened to cause a major disruption in the party, and Prime Minister Tage Erlander therefore set up a special study group in the autumn of 1958 including the main proponents and opponents within the party. He appointed his newly recruited political aide, Olof Palme, as secretary in the group with the task to try to reach a compromise concerning the future nuclear weapons research. The choice was between on the one hand "protection research" aiming at understanding nuclear weapons better in order to construct bomb safe shelters and other protective devices, and on the other hand "construction research" aiming at constructing and producing nuclear bombs. After more than a year of discussions, the study group presented its report in November 1959 and recommended what they called "extended protective research" in the coming years until 1963, when a decision whether to build bombs or not would have to be made. In

reality, this compromise did not impede the efforts of the FOA researchers, as the production of plutonium in the “civilian reactors” would not start until 1964 anyway (Agrell 2002).

The main purpose of the study group was to “neutralize” the nuclear weapons issue in the coming parliamentary elections in September 1960. All parties, except the Communists, could agree on the formula of extended protective research and abstained from discussing the issue in the election campaign. However, AMSA did not want the nuclear weapons issue to be buried in this way. In April 1960 they made a plea for a referendum on nuclear weapons, and started to gather signatures for their plea, but they were not able to muster the necessary number of signatures. When this campaign failed, AMSA more or less dissolved.

One of the leading AMSA members, the journalist Bertil Svahnström, took the initiative to form a new organization called Kampanjen mot Atomvapen (Campaign against Atomic weapons), KMA in the spring of 1961. The establishment of KMA was inspired by the British organization Campaign for Nuclear Disarmament established in 1955 and the Danish Kampagnen mod Atomvåpen, and like these organizations it strived for different kinds of members and other types of activities than AMSA had done. While AMSA was dominated by middle age intellectuals, KMA attracted young people not least students, most with a middle class background. It had a more international orientation and opposed nuclear armament in general, not only in Sweden. And it focused on organizing marches and manifestations rather than meetings and study groups. The first major event was a 2-day and 35 kilometer long protest march from a square in central Stockholm to FOA’s research facility in Urvik in September 1961. The march assembled 800 participants and demonstrated the ability of KMA to mobilize activists. It also introduced a new kind of political manifestation in Sweden, following the examples from Britain and Denmark. The following year a new 50 kilometre march from Södertälje to Stockholm was organized during Whitsuntide attracting no less than 2000 participants, and similar marches were arranged also in 1963 and 1964, however with decreasing numbers of participants (Agrell 1999).

The issue of constructing Swedish nuclear weapons lost its political urgency in the early 1960s. The political compromise concerning “protection research” was meant to delay the issue. However, leading militaries, gradually changed their views on the military benefit of nuclear weapons, and after Nils Swedlund stepped down as Supreme Commander in 1961, no more concrete demands

for nuclear weapons were expressed from the military. The same year, the Swedish foreign minister presented a plan at the United Nations in which he proposed that nuclear free countries would shape regional nuclear free zones. This so called Undén-plan was adopted by the UN in November 1961. In 1968 Sweden formally decided not to develop nuclear weapons and to sign the Non-Proliferation Treaty.

In the international negotiations concerning non-proliferation in the 1960s and disarmament in the 1970s, Sweden as a small neutral country with high competence in the nuclear domain played a prominent role. One example is Sigvard Eklund, who was appointed director of the IAEA in 1961 and remained so for no less than twenty years, when he was replaced by another Swede, Hans Blix. Eklund's main task as head of IAEA was to prevent civilian nuclear programs from benefitting military programs, and he had the perfect background for this task, as this was something he had been doing in the previous fifteen years in Sweden. Another example is Rolf Björnerstedt, who had a senior position at FOAs division for nuclear weapons research. He took an active stance for Sweden abstaining from nuclear weapons in 1965 (Björnerstedt 1965) and was one of the founders of the Stockholm International Peace Research Institute, SIPRI. In 1969 Björnerstedt was appointed Head of the UNs Disarmament Division in New York.

It is hard to measure the direct impact of the anti-nuclear weapons movement, but official Swedish policy changed in the way this movement argued for. Sweden decided not to construct nuclear weapons and became a strong proponent internationally for nuclear disarmament.

Type of event

The nuclear weapons controversy took place in parallel both outside and within the formal political system. It was initiated in 1958 by a loose group (AMSA) of well-known intellectuals critical of nuclear weapons with access to mass media. They were able to create a media campaign and create a political debate, which in turn triggered a counter reaction from leading militaries and others. The controversy also became prominent within the Social Democratic Party, and in particular its Women's Association took a strong stand against the development of nuclear weapons. A special study group was setup to formulate a compromise. This compromise partly led to the dissolution of AMSA, which was replaced by a new political organization - inspired by the British CND - organizing protest marches and other public events. The nuclear weapons controversy has been recognized by some earlier research, but not very much.

Identification of actors

The controversy was initiated by independent intellectuals forming AMSA, by the Social Democratic Women's Organization and by the Swedish Peace Committee, dominated by the Communist Party, which were all opposing Swedish development of atomic weapons. Later on KMA took over after AMSA.

The main proponents for developing atomic weapons were leading militaries, researchers at the National Defence Research Institute (FOA), and researchers at the Atomic Energy Company.

Leading politicians, including government members, were also strongly involved in the controversy on both sides. Others, like the Prime Minister and his assistant, tried to find a compromise to neutralize the issue which threatened to split the Social Democratic Party.

Arguments and behaviours

The opponents of atomic weapons argued that such weapons would be detrimental to Swedish security and increase the risk of nuclear warfare affecting Sweden. Some of them further argued that Swedish security would increase if the resources used for nuclear weapons research were used for development aid instead. Most opponents did not question the civilian nuclear program or a strong military defense. They demanded that research and development of nuclear weapons should cease and that no bomb material should be produced in the future Swedish reactors.

The proponents argued that Sweden needed "tactical" nuclear weapons to effectively defend itself against an attack from the Soviet Union. They argued that the Soviet Union would use tactical nuclear weapons irrespective of if Sweden had such weapons or not, and that Sweden would be much more effective in its resistance if it also possessed such weapons. Thus the possession of such weapons would reduce the risk of an attack, as the cost for the attacker would be much higher. They demanded that research and development of nuclear weapons should continue and that the future Swedish reactors should be designed to produce weapons grade plutonium.

The members of AMSA were very active communicators; they wrote booklets, articles in newspapers, participated in radio and TV debates, talked at public meetings and prepared material for study circles. The proponents of nuclear weapons tried to match AMSA and also produced booklets and articles. KMA also organized other types of events, in particular protest marches.

Within the governing Social Democratic Party a special study group was set up with party members representing both opponents and proponents of nuclear weapons. This was a rather unusual measure to avoid a splintering of the party.

Public engagement

There was no attempt by public authorities to engage the public at large. On the contrary, the agencies involved in developing nuclear weapons tried to keep this as discrete as possible. The engagement was thus initiated from below, from influential intellectuals. Within the Social Democratic Party a deliberative process was organized to handle the controversy.

3.2. Event 2. Public inquiries on energy futures in the 1970s

Case history

In Sweden government commissions have played an important role for preparing political reforms and major changes of policy. When a commission has published its final report, the Ministry in charge sends it to stakeholders to get a consultation response. The report and these responses are often an important basis for the formulation of government Bills. In the early 1970s a number of conflicts emerged in the energy sector: the further expansion of hydro power was contested by environmentalists, nuclear power was questioned as risky, and the oil crisis in 1973 demonstrated Sweden's extreme dependency on oil imports. A large number of government commissions were set up to handle these issues. Some of the commissions that were primarily intended to provide new insight had mainly experts and civil servants as members, while others that were intended to try and reach political compromises, also had politicians and representatives from interest organizations as members.

In the early 1970s there was a firm belief among public servants, politicians and experts of different kinds that the fast growth in energy consumption that had prevailed for a century would continue in coming decades (Anshelm 2002). This is clearly reflected in the final report from a government commission which presented its report in 1970 (Energikommittén SOU 1970:134). It was a pure expert commission without any politician. The commission presented a forecast for 1985 in which it presumed that the high rate of increase in energy consumption in previous decades would continue and that electricity would provide an increasing share of the total. This implied that the increase of electricity production was expected to be about 7 % per year, most of which in the form of new nuclear plants and that more than 20 reactors would need to be built by 1985. Two years later the Swedish power producers made a forecast for 1990 (CDL 1972) in which 24 reactors were planned to be built by 1990. This forecast was taken as a point of

departure in two government commissions that investigated two aspects of nuclear power, the possible location of such plants close to cities to enable cogeneration of heat and power (Närförläggning av kärnkraftverk, SOU 1974:16), and the final disposal of nuclear waste (Kärnkraftens högaktiva avfall, DsI 1974:6).

This belief in an almost inexorable exponential future growth in energy consumption was modified in the mid-1970s. In the autumn of 1974, less than a year after the Oil Crisis, a government commission called the Energy Forecast Commission presented a report in which it foresaw a reduction in the rate of increase of future energy growth, from the historical growth of 4.5 % (since 1955) to between 2.4 to 3.4 % up till 1985 and between 1.6 to 2.8 % from 1985 to 2000. In the Energy Bill presented in the spring of 1975, the Social Democratic government based its planning on the lower of these forecasts and it presented a plan for 13 nuclear reactors in 1985.

The most extensive of all the government commissions in the 1970s was the so called Energy Commission set up by Olof Johansson, the new Energy Minister in the Fälldin government that took office after the elections in 1976. Johansson was, like Fälldin, critical to nuclear power and he thus wanted the Commission to inquire different energy futures including alternative in which nuclear power was phased out. The Commission had fifteen members, half of which were politicians from all the five parties in Parliament and the rest were experts or representatives of influential organizations. Moreover, the Commission set up five expert groups concerning health, safety and environment, energy supply, energy usage, policy instruments, and R&D with about a dozen experts in each. The Commission started its work in January 1977 and presented its final 600-page report after only fourteen months (Energi, SOU 1978:17). Seven of the fifteen members formulated extensive reservations to the conclusions of the Commission. In addition the expert groups produced more than 70 (!) background reports on a very large range of topics. The Commission even gave an assignment to three environmental organizations to formulate an energy plan, and this resulted in the report MALTE 1990 (The environmental movements alternative energy plan, DsI 1978:11), which later became the basis for Line 3 in the referendum.

The task of the Commission was to prepare a basis for a coming Energy Bill concerning Swedish energy policy for the time period until 1990. It did so by first assembling and analyzing much material on environmental, economic and technical aspects of energy sources, and then formulating four different scenarios for the development up to 1990, one with a phase out of the six nuclear reactors in operation to 1985, one with a phase out to 1990, one with an expansion to thirteen reactors in 1990, and one with an expansion to fifteen reactors in 1990. The majority of the members recommended the third of these alternatives, while the reservants recommended some of the others.

In many ways the intensive work in the commission was a breeding ground for its members. Two of the politicians, Birgitta Dahl and Carl Tham, became future energy ministers and some of the others became leading spokesmen for their parties in energy matters. Two of the members, Per Kågeson and Björn Kjellström, became leading spokesmen for the People's Campaign during the referendum, and wrote a very influential book "Vote No" that became something of a bible for the Line 3 activists and was printed in 170 000 copies. Thus much of the analysis and argumentation that was used during the referendum by the different lines were first developed within the Energy Commission.

The time frame of the Commission was up to 1990, a little more than 10 years. This is a rather short time for changing a country's energy system as it often takes at least 10 years to plan and build a major energy plant, and even longer to develop new energy technologies. In 1974 a Secretariat for Futures Studies had been established as a kind of think tank within the government. This Secretariat launched an ambitious future study on energy in 1975 and presented its final results in a book titled *Solar versus Nuclear* (Lönnroth et al. 1978), published half a year after the Energy Commission had published its report. This book outlined two dedicated future alternatives thirty years into the future, one based almost entirely on nuclear energy and the other entirely on renewable energy, and the authors argued that both these alternatives were feasible in this time perspective and that the choice of energy system affected society at large; a nuclear Sweden would be centralized, police guarded and expert dependent, while a Solar Sweden would be more decentralized, democratic and community based. *Solar versus Nuclear* received much public attention and its key message, that very different future

energy systems can be achieved with a clear energy policy, was important during the referendum campaign (Anshelm 2000).

The 1970s ended with two more energy commissions. After the TMI accident the new liberal Energy Minister, Carl Tham, appointed a commission to investigate if the accident motivated a reassessment of the risk of accidents in Swedish reactors. And after the decision to organize a referendum another commission was set up to investigate the consequences of a phase out of nuclear power to 1990 for the economy, employment and environment as compared with expanding to twelve reactors. The members of the former commission were all “experts” not politicians, while the latter included both categories. The first commission produced a report entitled *Safe nuclear power?* (SOU 1979:86) with an analysis of the TMI accident, suggestions for a number of measures to increase security in Swedish reactors (for example installation of filter chambers to reduce emission of radioactive isotopes in case of a reactor melt-down) and the conclusion that a reassessment of the risks was not motivated. The second commission originally had representatives from both the pro- and anti-nuclear camps, but the latter left the commission after some time because they thought that the whole approach was too biased. The commission concluded that a nuclear phase out in ten years would cause slower economic growth, an increase of unemployment and increased pollution due to higher use of fossil fuels but reduced risk of nuclear accidents (*Konsekvensutredningen*, SOU 1979:83).

All these government commissions in the 70s were mainly populated by engineers and economists and had a fairly technocratic and quantitative approach. They produced an enormous number of forecasts of future “energy balances” with the help of econometric models. And this approach affected the political debate which was often characterized by “reactor exercises” when proponents and opponents of nuclear power referred to different forecasts to substantiate their argumentation (Lindqvist 1997). But within this technocratic approach a paradigm shift occurred during the 1970s. While there was belief in a strong link between growth in GDP and energy consumption, and a conviction that energy consumption would continue to grow at a high pace in the beginning of the decade, the forecasts for future growth of energy consumption were much lower at the end of the 70s. This also affected the number of planned reactors in the 1990s which dropped from 24 to 12.

Type of event

Government commissions are an important instrument in the Swedish political system when there is a need for new reforms or policy changes, and such commissions often provide important material for government Bills. There were unusually many government commissions on energy issues in the 1970s and the work in these commissions shaped a discourse that was influential for a long time. There has not been very much research on this topic.

Identification of actors

The Ministers responsible for energy during the 1970s (Rune Johansson, Olof Johansson, Carl Tham) formulated the missions for the commissions and appointed their members. The members, and in particular the chairmen, of the commissions were of course important actors, but also the secretaries and experts working for a commission could play an important role. Many times some members/experts/secretaries participate in several commissions and they can get a particular influence through their overview. Most of the members of the commissions were economists or engineers working as civil servants or employees in energy companies, and they were often pro-nuclear. But gradually politicians and experts with dissenting opinions were also appointed to the commissions to broaden the discussions and help formulate compromises. The Secretariat of Futures Studies, which made the influential future study on energy *Solar versus Nuclear*, was a kind of a government think tank on the future with a fairly high degree of independence.

Arguments and behaviours

In particular the commissions that made energy forecasts employed a fairly technocratic and quantitative approach based on econometric models. The choice of different assumptions about key variables such as the future prices of different energy sources, or the growth or decline of different sectors of industry had a big impact on the forecasts, and the commission members would discuss such assumptions at length and outline a number of alternative scenarios including differing numbers of nuclear reactors, which was sometimes somewhat condescending referred to as “reactor exercises”. The government commissions on energy developed a specific discourse focusing on economy and technical choices, while wider societal

implications were often not discussed, and also the anti-nuclear members of the commissions adjusted their argumentation to this. They were subjected to the power of the discourse.

Public engagement

The ongoing work of a government commission was not public, but the resulting published report was at times widely discussed. Moreover, in some commissions there were representatives of different stakeholders, and these representatives had intense debates and arguments that later on could influence the public debate.

3.3. Event 3. Local protests against a repository

Case history

On April 21, 1980, less than a month after the referendum, a number of heavy trucks loaded with drilling equipment were heading for Kynnefäll, a mountain area about 100 km north of Gothenburg. Their aim was to set up a testing site for test drillings to assess if Kynnefäll was a suitable place for a nuclear spent fuel repository. However, the small forest road leading to the mountain was soft after heavy rain the previous days and the trucks got stuck in the mud. The news about the trucks spread quickly in the vicinity of Kynnefäll and within a day a protest action had been organized. The protesters surrounded the trucks and the drilling team realized that they would not be able to reach their intended destination and turned back. To prevent future attempts to establish a drilling site on the mountain, the protesters organized a continuous watch keeping at the road towards the mountain. At first a tent was set up, somewhat later it was replaced by a caravan, and finally a little house with four beds was built at the road site. The protesters formed an organization, Save Kynnefäll, and were able to gain much support from the local population and from a majority of the local politicians. Partly this had to do with a previous controversy in the late 1960s when the Atomic Energy Company had proposed to build an enrichment plant in this area, which had spurred an active local resistance (Anshelm 2006a).

After the first attempt to set up a proof drilling site had failed, the organization that was responsible for the proof drillings, PRAV, organized several information meetings when their experts explained the principles of the intended repository. But Save Kynnefäll enrolled counter experts that

questioned these experts and the local population remained hostile to drillings. As a result PRAV decided to give up its attempts to establish a drilling site there. However, the members of Save Kynnefjäll were not convinced about the retreat of PRAV. They kept guarding the road to Kynnefjäll from their little house for 20 years and became a symbol for local opposition to nuclear power (Lidskog 1994). They ended their guard only in February 2000, after the Minister of the Environment, Kjell Larsson, wrote a formal guarantee that no repository would be placed at Kynnefjäll.

The background to the attempt to establish a drilling site at Kynnefjäll was that the Swedish Parliament had introduced a new law in 1977 called the Stipulation Act, which stipulated that reactor owners had to demonstrate that they would be able to handle the spent fuel from their reactors in a totally safe way to get permission to start operating new reactors. This Act had spurred the Swedish power companies to jointly pursue an intensive research project about a methodology for final storage of spent fuel, alternatively of the high level waste created if the fuel was reprocessed. In 1979 they had received approval from SKI for their so called KBS method. After the referendum the uncertainties about the future of nuclear power had disappeared and it was now clear that about 8 000 tons (from 12 reactors operating 25 years each) of spent fuel would have to be stored. Moreover, all reactor owners had to pay a fee in proportion to how much electricity they had generated to a new Nuclear Waste Fund (Kärnavfallsfonden) to cover the future costs for disposing nuclear waste. All this triggered a search for possible locations of a repository, and Kynnefjäll had been identified as one suitable place by PRAV, an organization established by the owners of the nuclear plants, that was responsible for the search.

PRAV had identified about a dozen potential places for drilling sites, where geologists believed that the rock had a very high quality, and after the failure at Kynnefjäll they made a new attempt in December 1980 in the valley of the river Voxna. This time they were able to set up their drilling equipment before any locals managed to organize protests. But a protest organization, Save the Voxna Valley, was soon set up and was able to get strong local support. In spite of demonstrations and petitions, PRAV started their drillings and this spurred Save the Voxna Valley to organize a blockade of the drilling site. PRAV called the police, which broke the blockade and arrested three of the protesters, which were later sentenced to fines (Anshelm 2006a, 70).

Also at the other locations that PRAV had identified as suitable for drilling local opposition groups were established as soon as the drillings commenced, following the examples from Kynnefjäll and the Voxna Valley. These groups organized demonstrations, public discussions and were often able to mobilize strong opposition. At one occasion a local resistance group (in Klipperås) demanded that independent geologists should be allowed to make an analysis of the drilling materials. When this was rejected activists dressed as Santa Claus stole 40 meter of drilling cores, and the independent geologists analyzing this material came to the conclusion that the local rock had vast deformation zones making it unsuitable for a repository (Anshelm 2006a).

All these local groups not only created strong local opposition; they also formed a national network called the Waste Chain, which engaged critical geologists, chemists and engineers in a critique of the KBS method at large. Their resistance was thus not only of a NIMBY (Not In My Back Yard) character but questioned the plans for final storage in general. For example, in 1982 a delegation with representatives from four local groups went to Stockholm and made a visit to government officials to present their views. In 1981 the power companies responsible for the final storage of spent fuel had established a new organization for this purpose, SKB (originally SKBF, also handling fuel procurement). SKB made drilling attempts in 14 different places and were met by local resistance groups every time and at a number of times they even called the police to keep protesters away from the drilling sites. Finally, SKB came to the conclusion that it would be impossible to establish a repository at a site where the local population was strongly against it, and therefore abandoned all the drillings. In the early 1990s SKB had revised its strategy and would make a new start to identify possible locations, as is described in event 5 below (Anshelm 2006a).

Type of event

This event is an example of local resistance to the nuclear industry and of rather hostile confrontations where the industry called for assistance from the police at a number of times. There has been some research conducted on this event.

Identification of actors

Local individuals, upset by the nuclear industries' intention to make proof drillings in their neighbourhood, quickly organized new organizations, like Save Kynnefjäll, with the single purpose of stopping these drillings. They were able to get a strong support from ordinary citizens and from

local politicians. These local protest organizations formed a national network, the Waste Chain, and could muster support from counter experts, not least academic geologists who were critical of the nuclear industries plans for a repository.

The nuclear industry was obliged by the Stipulation Act to develop a method for storing spent nuclear fuel and for identifying a location for a repository. In the early 1980s the task of pursuing proof drillings in order to find places with suitable geological formations was given to PRAV, an organization established by the owners of the nuclear plants. In 1981 PRAV was replaced by SKB.

Arguments and behaviours

The local organizations first argued against a repository in their own backyard (NIMBY), but soon developed a more general critique of the intended method for a repository with the aid of counter experts in particular geological researcher at universities.

PRAV and later SKB argued that it was a matter of overarching ethical importance for the whole country to find places with the most suitable geological conditions for a future repository, and that proof drillings were a necessary step. PRAV tried to establish drilling sites without first informing the local public of their plans, and this proved to be very provocative and generated much resistance.

The local organizations primarily campaigned locally to get support for their opposition. At a few times they also used illegal methods, like erecting blockades and stealing materials from proof borings to let their counter experts analyze them. By forming a national network, the Waste Chain, the local groups could learn from each other and organize some joint visits to national politicians in Stockholm.

Public engagement

The local public engagement was very intense when PRAV commenced their proof drillings without informing beforehand, and the engagement thus came from below, from the opponents. There was a mutual distrust between the local protest organizations and PRAV/SKB, and very little dialogue between them.

3.4. Event 4. Chernobyl and its political effects in Sweden

Case history

Monday morning, April 28, 1986, was dramatic at the Forsmark nuclear power plant, 100 kilometres north of Stockholm. As the night shift came off work passing through the routine contamination control, the workers all showed enhanced levels of radioactivity on their clothes. Further investigation revealed a thin layer of radioactive dust on the grounds all around the power station, but no evidence of leakage or any other mishap. At 10 am, the contamination was reported to the Swedish Radiation Protection Agency (SSI) in Stockholm, which immediately assembled a Crisis team of diverse experts to investigate the situation. The nuclear specialists soon reached the conclusion that the radiation stemmed from a reactor, not a nuclear bomb test. The meteorologists analysing wind speeds and directions identified four nuclear stations in the Soviet Union as possible sources for the contamination.

When these findings were presented to the Swedish Minister for Energy, Mrs Birgitta Dahl, in the afternoon, she immediately instructed the Swedish ambassador in Moscow to ask the government what was happening. A few hours later the Soviet government confirmed it was handling a power reactor that had been "damaged", without specifying which reactor or what kind of damage. Further analysis by the Crisis team suggested that it was the Chernobyl nuclear plant in Ukraine that had been damaged, and it requested the Swedish Space Corporation for remote sensing images of the area. A few days later the Space Cooperation produced an image of the reactor site, with a strong heat plume from Reactor 4, proving that a major accident had indeed occurred. Thus, the radioactive measurements at Forsmark and the subsequent analysis by the Swedish Crisis team disclosed the Chernobyl disaster to the world (Dsl 1986:11).

Due to North Westerly winds a fairly large part of the radioactive particles that were released during the Chernobyl disaster passed over Sweden during the night between 27th and 28th of April. In areas where it rained that night fairly high levels of radioactive fallout came to the ground. In fact, outside the Soviet Union, Sweden was the most affected country by fallout from Chernobyl. Swedish mass-media reported intensively about the disaster and the increased radiation levels, and this caused much anxiety. Many parents were afraid to let their children play outside, and the Radiation Protection Agency had a hard time informing and calming the general public. Its General Director appeared on the TV news almost every day for a couple of weeks. Farmers in the contaminated areas could not let their cows out to graze and had to dump their milk if contaminated. Reindeer herders had to discard no less than 80 % of all the reindeer in the year after the disaster (Moberg 2001).

When Chernobyl occurred, the anti-nuclear movement was severely weakened after several years of decay. The incident led to a revival. The former members put on their "nuclear power – no thanks" badges again, and in mid May 1986, demonstrations were arranged in many places all over Sweden, and ten thousand people gathered in central Stockholm demanding an immediate start of the phasing out of nuclear power. Mass media were filled with articles about the disaster and with debates concerning the risks of nuclear power. The opponents to nuclear power argued that the disaster proved the danger of nuclear power in general, and some of them demanded an immediate phase out of all Swedish reactors. The proponents, including scientists, industrialists and trade unionists, claimed that Swedish reactors were fundamentally different from Soviet reactors, and that a disaster like the one in Chernobyl was impossible in Sweden. The poll institutes registered a large increase of negative attitudes to nuclear power (Anshelm 2000).

The governing Social Democrats were still in shock after the assassination of their party leader and the Swedish Prime Minister Olof Palme two months earlier. They were sensitive to the protests and the increase of anti-nuclear sentiments. Birgitta Dahl, the Minister of Energy and the Environment, had played an active personal role in the disclosing of the disaster and was shaken by it. Moreover, one of her closest advisors was Peter Larsson, a former leader in the anti-nuclear movement during the referendum campaign. Dahl rapidly commissioned an investigation of the disaster and its repercussions on Sweden with the heads of Nuclear Power Inspectorate, SKI, the Radiation Protection Agency, SSI, the Environmental Protection Agency, SNV, and the National Institute for Economic Research, KI, as members.

This commission worked fast and presented its report entitled *After Chernobyl. Consequences for energy policy, nuclear safety, radiation protection and environmental protection* after four months, by the end of October. It concluded that Chernobyl did not change the earlier assessment that it was extremely unlikely that an accident with radioactive releases of similar magnitude would happen during the Swedish nuclear program even if it could not be totally excluded. The Commission further argued that an immediate phasing out of nuclear power would have severe economic consequences. Based on this report Birgitta Dahl and her advisors made a Bill to Parliament in which she proposed a start of the phasing out of nuclear power in the mid-1990s; a first reactor would be decommissioned 1993-95 and a second in 1994-96. After additional investigations about the exact timing of the phase out, Dahl proposed a new Bill in 1988, with a phase out of the first reactor in 1995, and the second in 1996. After Parliament approved this Bill, Dahl emphasized that this decision to start the phase out was irreversible.

The People's Campaign of course urged for a much faster phase out of nuclear power, but two years had passed after Chernobyl and the re-mobilization of the anti-nuclear movement had faded out, thus it didn't have much political weight any more. The new energy policy was instead strongly

contested by the more nuclear friendly Conservative Party and Liberal Party and many industrial leaders. More importantly, many leading trade unionists, which traditionally had been a strong faction within the Social Democratic Party, also opposed it. They argued that a “premature phase out” – as they called it - would lead to increased electricity tariffs, which in turn would threaten jobs in industry. In the following year the Party experienced fairly strong internal conflicts that were referred to as the “War of the Roses” (a red rose is the symbol of the Social Democratic Party), between an economic growth oriented faction around the trade unions, and a more environmentally oriented faction around the youth’s and women’s organizations of the party. As a result of this conflict the party leader and Prime Minister Ingvar Carlsson transferred the energy portfolio from Birgitta Dahl to the trade union leader, Rune Molin, who became a member of the cabinet.

Molin started negotiations about a revision of the energy policy with two other parties, the Centre Party and the Liberal Party, and in early 1991 the three parties made an Energy Agreement in which the “premature phase out” of nuclear power in the mid-1990s was postponed to an undefined time. One argument for this new policy had to do with climate change, which had become an important political issue since 1988. Parliament had formulated a goal in 1988 that future emissions of CO₂ should not be increased, and this was used as an argument for postponing the phase out. Moreover, as a concession to the Centre Party, which has its traditional base among farmers, the Energy Agreement included a program for a fast increase of biomass production through subsidies and the introduction of CO₂ taxes. The three parties had a majority in Parliament, and even though there was strong opposition from the new Green Party and the Left Party (former Communist Party) against the postponement of the phase out, this new energy policy was adopted by Parliament in the spring of 1991 (Högselius&Kaijser 2007).

Thus five years after Chernobyl Parliament made a decision to continue the Swedish nuclear program essentially unchanged. The initial “irreversible” decision to fasten the phase out had been revised after a strong reaction from the pro nuclear side.

Type of event

Chernobyl resulted in a short revival of the anti-nuclear movement, which organized demonstrations and public meetings. There was also an intensive debate in mass media. This in turn led to a political process in government and parliament with two successive reformulations of energy policy. This event has been recognized by earlier research.

Identification of actors

The nuclear industry and regulatory agencies played an important role in disclosing the disaster. In the first months after the disaster, the anti-nuclear movement organized demonstrations but

was not able to regain its organizational strength from the referendum campaign and soon faded away again. Scientists, experts, environmentalists, industrialists and intellectuals engaged in an intense mass media discussion about the disaster and its implications for the Swedish nuclear program. Poll institutes reported a rapid increase in negative sentiments about nuclear power. This all led to a political process within the Ministry for Energy and Environment and Parliament, and later on within the governing Social Democratic Party.

Arguments and behaviours

The anti-nuclear movement argued that Chernobyl demonstrated the dangers of nuclear power once again (after TMI) and that the phase out should therefore be hastened considerably. The pro nuclear side argued that the Soviet reactors and nuclear industry were totally different from the Swedish, and that an accident like Chernobyl with large radioactive releases was impossible in Sweden. Therefore, they argued, there was no need to revise the nuclear policy. The anti-nuclear side at first organized demonstrations and meetings, but soon most of the process took place in mass media and within the formal parliamentary political system.

Public engagement

This was mainly a political process on the national level with much communication in mass media.

3.5. Event 5. A competition for getting a repository

Case history

In the beginning of the 1990s, SKB made a reorientation of its strategy. Previously it had tried to find sites with solid rocks without any cracks, through which water might reach to the surface. But based on more developed safety analyses SKB now started to underline that the rock itself was not the single most important barrier but that the other components in a repository, the copper canister surrounded by bentonite clay, also were crucial parts of a multiple barrier system. This reorientation meant that it was no longer necessary to search for the best possible geological location in the whole country, but that the geology in large parts of the country was sufficiently good. Other factors, like the attitude of the local population and the availability of suitable transport and other infrastructural facilities, were as important as geology.

In 1992 SKB sent a letter to all Swedish municipalities with a question if they were interested in a pre-study of a repository starting with test drillings. SKB emphasized that the process would be based on voluntariness and that no municipality would be forced to accept spent fuel against its will. Eight municipalities in northern Sweden responded positively and two of these were chosen by SKB for pre-studies, Storuman and Malå. These were both municipalities with high unemployment and a future repository, which was estimated to generate 350 jobs during 50 years, seemed a very attractive option to local politicians. Existing geological data, e.g. from prospecting for mines, were analysed in detail, and also other conditions were assessed. SKB came to the conclusion that both places could be suitable for a repository. However, local opposition had emerged in both places and it became so strong that the local politicians in both places decided to organize a local referendum. In both places a clear majority voted against a future repository (Lidskog 1998).

In 1996 SKB organized a conference in Stockholm with researchers and directors from nuclear companies in 23 European countries all sharing the same problem with local resistance to repositories. This led SKB to focus on municipalities that already had nuclear plants (Anshelm 2006a). Preliminary studies indicated that two of these, Östhammar (where Forsmark is located) and Oskarshamn, had the best conditions with inhabitants that were familiar with nuclear facilities and with suitable infrastructure. In 2002 more thorough studies of these two municipalities commenced including test drillings to investigate if the rock was acceptable. The ensuing process was very different from previous attempts. Instead of having to deal with very reluctant local populations, SKB now had two largely positive local populations, and in the following decade something of a beauty contest evolved. The local politicians in both places did their very best to convince SKB about the advantages of their place. SKB arranged a number of meetings and consultations with local people in both places to inform them about how the repository would be build. After a long evaluation process SKB reached the decision in 2009 that Östhammar would be the best place for the future repository for geological reasons. They simultaneously decided that the future plant for constructing copper canisters for the spent fuel would be located next to the existing interim storage facility in Oskarshamn.

Type of event

SKB gradually learned from previous processes and adopted a more open and cooperative attitude towards municipalities, emphasizing that a decision about a repository only would be made if a local municipality was in favor of it. When SKB turned to two municipalities with nuclear power plants both politicians and a large part of the population were favorable to a repository and even a sort of contest emerged between them. This event has been recognized by earlier research.

Identification of actors

SKB was a key actor and had a new attitude towards municipalities. In Storuman and Malå, many local politicians were initially positive to a repository that would give many jobs, but local environmentalists mobilized against it and were able to gain a majority in the local referenda.

In Östhammar and Oskarshamn a clear majority of both politicians and the local population were positive to the plans for a repository and cooperated actively with SKB in the investigations.

Arguments and behaviours

The job argument was important in all the municipalities, but in Storuman and Malå the environmental dangers with a repository became the dominant argument. In Östhammar and Forsmark the population was already accustomed to nuclear facilities and had a trust in the nuclear industry. This implied that no strong opposition emerged. On the contrary the job argument became dominant and the municipalities engaged in a sort of contest for the repository.

Moreover, SKB started to underline that the rock itself was not the single most important barrier but that the other components in a repository, the copper canister surrounded by bentonite clay, also were crucial parts of a multiple barrier system. Thus it was not necessary to find the perfect rock, only one that was good enough. SKB realised that local acceptance of a repository was a factor of crucial importance in the choice of location.

Based on the negative experiences from the 1980s, SKB adopted an open and cooperative attitude towards the municipalities. During all steps of the revised site selection process they involved the local populations in the communities studied in dialogues of various kinds.

Public engagement

SKB strived to engage the local populations in their studies. In the two northern municipalities this strategy failed in the end, but in the two municipalities which already had local power plants, the strategy was successful and many locals were actively involved in deliberations. When SKB made the decision to locate the repository in Östhammar, the large majority of the local population saw it as a positive outcome for the community.

4. Facts and figures (ca.4-5 pages)

4.1. Data summary

After a referendum in 1980, Swedish Parliament decided to phase out nuclear energy by the year 2010, but this decision was later changed and today there are 8 operating reactors that generate 40% of Swedish electricity.

4.2. Key dates and abbreviations

Key dates:

- 1947** Atomic energy research organization, AB Atomenergi, is established
- 1954** R1, a research reactor built in Stockholm, starts operation
- 1956** Government decision about an ambitious program, “The Swedish Path” to create a domestic nuclear fuel cycle, with uranium exploitation, HWR reactors and a reprocessing plant enabling atomic weapons.
- 1960** Two research reactors completed at AB Atomenergis research station in Studsvik
- 1964** The Ågesta HWR reactor starts operation
- 1965** OKG signs a contract with ASEA about the Oskarshamn 1 LWR
- 1969** AB Atomenergi and ASEAs nuclear division merge into ASEA-Atom
- 1970** The Marviken HWR reactor is completed but not taken into operation for security reasons, Sweden joins the Non Proliferation Treaty and the “Swedish Line” is definitely abandoned.
- 1972** O1 is inaugurated.
- 1974-75** Four more reactors are inaugurated.
- 1976** Nuclear power is a key topic in the election campaign. The Centre Party leader Thorbjörn Fälldin, who has a clear anti-nuclear stance, becomes Prime Minister.
- 1977** The Stipulation Act is introduced, which stipulates that reactor owners have to show that the spent fuel can be stored in a totally safe way.
- 1979** The TMI accident leads to a decision to organize an advisory referendum on the future of nuclear power.
- 1980** The pro-nuclear lines win the referendum and Parliament decides that 12 reactors shall be used until 2010, when all nuclear power shall be phased out.

- 1985** The 11th and 12th reactors are inaugurated.
- 1986** The Chernobyl accident affects Sweden substantially.
- 1992** An incident occurs in the cooling system of the Barsebäck 1 reactor. SKI stops it and four other reactors with the same design until it has been fixed.
The Barsebäck 1 reactor is phased out.
- 1999** The Barsebäck 2 reactor is phased out.
- 2005** SKB decides to choose Östhammar as location for a future repository
- 2009**
- 2010** Parliament vote to repeal the policy to phase out the nuclear energy and to make it possible to build additional reactors at existing nuclear power plants.
The owners of Oskarshamn and Ringhals decide to close down two reactors
- 2015** each by 2020 for economic reasons

Abbreviations:

- SKI** Swedish Nuclear Power Inspectorate
- SSI** Swedish Radiation Protection Institute
- SSM** Swedish Radiation Safety Authority
- IAEA** International Atomic Energy Agency
- WNA** World Nuclear Organization

4.3. Map of nuclear power plants

Figure 1 represents a map of nuclear power sites in Sweden.



Figure 1 – Operating nuclear power plants in Sweden 2016. Source: WNA 2016.

4.4. List of reactors and technical, chronological details

Tables below shows the list of reactors, operators as well as date details.

Table 1 - Operational and shutdown nuclear power reactors in Sweden.

Sources: IAEA 2016; WNA 2016

No.	Name	Operator	Type	Mwe net	Construction began	Grid power	Shut down	Status	Use
1	Agesta	AB SVAFO	PHWR	10	1957	1964	1974	Permanent shutdown	Commercial
2	Barseback-1	Barsebäck Kraft AB	BWR	600	1971	1975	1999	Permanent shutdown	Commercial
3	Barseback-2	Barsebäck Kraft AB	BWR	600	1973	1977	2005	Permanent shutdown	Commercial
4	Forsmark-1	Forsmark Kraftgrupp	BWR	984	1973	1980		Operational	Commercial
5	Forsmark-2	Forsmark Kraftgrupp	BWR	1120	1975	1981		Operational	Commercial
6	Forsmark-3	Forsmark Kraftgrupp	BWR	1167	1979	1985		Operational	Commercial
7	Oskarshamn-1	OKG	BWR	473	1966	1971		Operational	Commercial
8	Oskarshamn-2	OKG	BWR	638	1969	1974	2015	Permanent shutdown	Commercial
9	Oskarshamn-3	OKG	BWR	1400	1980	1985		Operational	Commercial
10	Ringhals-1	Ringhals AB	BWR	881	1969	1974		Operational	Commercial
11	Ringhals-2	Ringhals AB	PWR	807	1970	1974		Operational	Commercial
12	Ringhals-3	Ringhals AB	PWR	1063	1972	1980		Operational	Commercial
13	Ringhals-4	Ringhals AB	PWR	1118	1973	1982		Operational	Commercial
	R1					1954	1970	Dismantled	Research
	R2	Studsvik AB					2005	Dismantling by 2019	Research
	R2-0					1960	2005	Dismantling by 2020	Research
	R4		heavy water	140	cancelled				Research

5. References

Nuclear power and nuclear weapons have been issues high on the political agenda in Sweden for more than half a century. This means that it has attracted much interest not only from historians but also from social scientists, not least from political scientists. It also implies that there is very much official material in the form of reports from government commissions, government bills, discussions in Parliament etc. In addition there is material produced from the various stakeholders to be used in debates for and against nuclear power or nuclear weapons. (It is sometimes difficult to make a distinction between “research” and “debate publications”). Moreover, much of the media coverage of the nuclear history is becoming easily accessible thanks to the digitalization of major Swedish daily journals and the public service TV and radio.

All this means that it is difficult to get an overview of all the material, and the list below does not pretend to be exhaustive. It includes some of all the categories above, with an emphasis on historical research and political science research.

Within the Swedish part of the HoNEST project eight interviews have been made with some of the key actors, and these interviews are also included in the list below.

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Alf Lindfors, Former CEO of the Forsmark Nuclear Power plant

Mats Odell, Representative of the Christian Democrats in the People's Campaign against Nuclear Power.

Per Kågeson, Author of several influential books and leading anti-nuclear activist

Leif Josefsson, Former CEO of the Barsebäck Nuclear Power Plant

Lennart Daleus, Campaign general for the anti-nuclear side in the nuclear referendum in 1980.

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