An Overview of the Historical Experience of Nuclear Energy and Society in 20 countries

Summaries of the Historical Research based on 20 Short Country Reports

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DEAR READERS

The relationship between nuclear energy and society in European countries has been fraught with controversy and miscomprehension. In most countries the debate remains unresolved and the positions of nuclear power supporters and those against it seem entrenched. A view into the history of the conflict offers the chance to learn what motivates these people, facilitates mutual comprehension and improves societal engagement with this technology and with modern technologies in general.

This brochure offers a comparative overview of the diverse national histories of nuclear energy and societies in 20 countries in Europe – North and South, East and West – and overseas. The short presentations assembled in this brochure are based on more substantive country reports on the issue. They can be accessed at: www.honest2020.eu/deliverables.

These are the first results of the three year international Horizon 2020 research project “HoNESt - History of Nuclear Energy and Society”, funded by the Euratom Research and Training Programme 2014-2018 and started in September 2015. Its ambition is threefold:

First, to provide an overview of the rich and diverse historical experience of the relations between the nuclear energy sector and society in the past 60 years.

Second, to draw conclusions on the mechanisms of successful public engagement between the nuclear sector and society.

Finally, HoNESt’s research is not for the ivory tower. Indeed, HoNESt researchers will share and discuss their findings with the stakeholders involved in this issue, from the nuclear sector, industry, associations, and civil society. The goal is to help learn from the experience and enhance the ways of decision making about new technologies in democratic societies.
WHAT WERE THE PRELIMINARY FINDINGS?

FIRST: CIVIL SOCIETY AND PUBLIC DEBATE
Civil society and public debate engaged very differently with nuclear technology. While some countries saw the rise of strong anti-nuclear movements with mass demonstrations, in other countries opposition was muted. The authoritarian regimes of Southern and Communist Eastern Europe thwarted anti-nuclear protest as they did the development of civil society. Protest was strongly connected to a lack of trust in the technology and the state, with lasting consequences.

SECOND: PERCEPTIONS OF NUCLEAR POWER
Perceptions of nuclear power and its economics differed drastically: Since the Atoms for Peace Programme of the 1950s, nuclear industry has represented its technology as modern, inexpensive, reliable, safe and even a green way of generating electricity. For politicians, security of energy supply and reducing import dependency mattered a great deal. By contrast, since the 1970s, media and environmentalists have criticized the higher costs, potential risks to the environment and to democracy, and the long-term consequences of nuclear technology. Often they have promoted alternative sources of energy.

THIRD: POLITICS MATTERED
Where parties and political systems were divided such as in Austria or Denmark, it proved impossible to introduce nuclear power, despite the lack of alternative energy sources available at the time. In other countries, notably France, the UK or Sweden, mainstream parties’ commitment to nuclear technology ensured its continued development, even when issues of cost overruns or waste management suggested a ‘go-slow’ approach.

However, these findings constitute the first conclusions concerning a highly complex issue. Please take a look across the country studies and judge for yourself what you consider the most important lessons!

If you are interested to learn more about the country reports, check: www.honest2020.eu/deliverables

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History of Nuclear Energy and Society in 20 countries
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CIVIL SOCIETY AND PUBLIC DEBATE
From the beginnings of the 1970s, local anti-nuclear protest groups grew up to a broad national movement against the construction of the Austrian nuclear power plant in Zwentendorf. The protests led to a referendum, with the result that Austria never entered nuclear energy production.

ECONOMY AND DEMOCRACY:
PERCEPTIONS OF NUCLEAR POWER
After Austria’s “no” to nuclear power, supporters of nuclear power raised fears of steeply rising energy costs, and a shortage of electricity supply. Nevertheless, there were no negative effects on the Austrian economy.

POLITICS MATTERS
Despite its political neutrality, Austria was well integrated in the Western Bloc. Therefore – unlike in Finland – offers for nuclear technology from the USSR were ignored – in contrast to offers from the USA, which were accepted quickly.

Austria planned to construct three nuclear power stations from the 1970s onwards. Even though Austria had a long tradition of radioactivity and nuclear research dating back to the beginnings of the 20th century, transnational knowledge transfer was crucial for Austria’s plans. That transfer started in the 1950s with the US-American Atoms for Peace programme. Industry and utilities, academia, and government struggled for leadership in the process of implementation of this knowledge. Industry and government managed to successfully collaborate in the newly founded Austrian Research Centre for the Peaceful Use of Nuclear Energy in Seibersdorf. Finally, the Austrian universities received their own TRIGA reactor, located in Vienna.

The Seibersdorf institute took a leading role together with the industry sector as consultant, during the construction of the nuclear power plant in Zwentendorf from 1971 onwards. At the beginning of that decade, local anti-nuclear protest groups emerged. They were largely ignored before they formed a broad national movement. Increasing public concern led the Austrian social democratic chancellor Bruno Kreisky, a staunch supporter of nuclear power, to call for a referendum in November 1978. This prevented the fully completed power plant at Zwentendorf from starting its activity.

Today the nuclear power plant in Zwentendorf serves as a training area for nuclear engineers, as well as location for social and cultural events.

Nowadays, the acceptance of nuclear energy in Austria is one of the lowest in the European Union. Together with political neutrality, being free of nuclear power became a central part of the Austrian identity.
CIVIL SOCIETY AND PUBLIC DEBATE

Public hearings held in October 2009 allowed to start the public awareness campaign about the nuclear power plant (NPP) among the Belarusian population and neighbouring countries as well as to organize the public expertise of the Belarusian NPP, in relatively limited political conditions for civic engagement.

ECONOMY AND DEMOCRACY: PERCEPTIONS OF NUCLEAR POWER

The Special Commission dealt with the revival of the debates about the necessity of the nuclear programme for the independent Belarus, after the collapse of the Soviet Union, and recommended, in 1998, the suspension of nuclear facilities construction for 10 years.

POLITICS MATTERS

The launching of the nuclear programme in 2008 came as an exclusively political decision. The necessary assessment and preparation works, discussions and debates, public consultations and deliberation came later, after the political decision had been taken.

The first projects of nuclear developments in the Byelorussian Soviet Republic (BSSR) were discussed from 1960 to 1980, when it was still part of the Soviet Union. They started with the creation of the first Governmental Commission on Nuclear Development in 1967 and finished with the beginning of the construction works at the Nuclear Thermal Power Plant in 1983.

During the first stage, the core issues of nuclear developments in the BSSR were related to the innovation process of the Joint Institute for Power and Nuclear Research. The history of the relations between nuclear energy and society in Byelorussian Soviet Republic and in Belarus reflects different political and technological contexts, before and after the Chernobyl disaster in 1986 as well as before and after USSR collapse in 1991, illustrating the different forms of civic engagement and participation of the public actors.

With an overview of the 1980s, we can distinguish the periods before and after the Chernobyl disaster. Various projects of nuclear power plant construction that had been developed before Chernobyl were eventually never implemented. During the independence process, the national nuclear programme was actively discussed. These debates were followed by a 10 year suspension on new nuclear power plant construction. Nevertheless, the nuclear programmes in Belarus remained present.

In conjunction with exposure of post Chernobyl disaster problems, nuclear risks and uncertainties were discussed and perceived by the population. Despite the consequences of the Chernobyl Disaster for the country, the Belarusian government decided in 2008 to build a nuclear power plant.

This political decision appears on the political agenda as inevitable from an energy point of view – given the lack of alternative national energy resources - and from a technological point of view – given the unclear trend to the development of renewable sources of energy by the government.
History of Nuclear Energy and Society

Bulgaria

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CIVIL SOCIETY AND PUBLIC DEBATE
The Communist regime propagated a positive interpretation of nuclear power. In 1988 a civil society debate about nuclear power took place in Bulgaria. Yet the Communist legacy persisted. In a referendum initiated in January 2013 by the former communist party, more than 50% of the population voted in favour of nuclear energy.

ECONOMY AND DEMOCRACY: PERCEPTIONS OF NUCLEAR POWER
After 1974, Bulgaria launched six power reactors, which in 2006 provided 42% of total electricity production. In 1993 EU demanded closing four of them as condition for Bulgaria’s membership. The two remaining now produce about 18% of the country’s electricity.

POLITICS MATTERS
Traditionally the former communist party, the DPS (representing most of the Turkish minority) and the newer nationalist parties in Bulgaria support nuclear power as a positive heritage from the Socialist period. Parties of the right seek to follow the EU policy for energy diversity and promote renewables.

Despite being a small country, Bulgaria had scientists who worked with the pioneers of nuclear research, such as Elisaveta Karamihailova at the Institute for Radium Research in Vienna. Supported by the Soviet Union, a Nuclear Experimental Facility was established in 1956, and the construction of the IRT-2000 research reactor began, being operational in 1961. The country was co-founder of the IAEA and supported all Atoms for Peace initiatives of the COMECON.

In 1966 Bulgaria and the Soviet Union signed an agreement for building a nuclear power plant near the isolated town of Kozloduy, on the Danube river. However, its implementation was delayed due to the internal struggles inside the communist leadership, until 1969 when the nuclear power supporters eventually took over. In 1974/1975 the first two reactors WWER 440 became operational. Two more Soviet reactors were added at Kozloduy in 1980 and 1982. A further two reactors, with a capacity of 1000 MW, became operational in 1987/1991.

In 1982 Bulgaria signed another contract with the Soviet Union for a second nuclear power plant near the Danube town of Belene. It was suspended in 1991 under public pressure. In 2004 its construction was re-opened by the Bulgarian Government. It was never finished due to the stalemate of pro and anti-nuclear lobbies in the country and their international backing.

The Communist government of Bulgaria concealed the scale of pollution from the Chernobyl accident and its health hazards, leaving the population without any protection. When this became public by 1988, together with rising awareness of other acute environmental problems, the ECOGLASNOST civil movement was founded. It demanded information about the consequences of Chernobyl and other heavily polluted industrial sites. When the communist regime collapsed in 1989, the green platform became part of the new democratic Bulgaria. During the next decade, under the pressure of EU, Bulgaria agreed to close all four WWER-440 reactors as part of its membership agreement.

Since December 31, 2006 only two 1000 MW reactors remained operational at Kozloduy. Nevertheless, the majority of Bulgarian society remains positive about establishing new reactors.
CIVIL SOCIETY AND PUBLIC DEBATE
A well-organised and non-confrontational anti-nuclear movement highlighted the risks and potential problems of nuclear power in a small country, and managed to have a strong presence in an open, publicly supported “debate on energy”, which influenced public opinion.

ECONOMY AND DEMOCRACY:
PERCEPTIONS OF NUCLEAR POWER
In the public debate of the 1970s, critics represented nuclear energy as contradicting the small-scale economic structures of Denmark. They further argued that the long-lasting impact of nuclear materials affecting future generations tested the limits of democratic decision-making.

POLITICS MATTERS
Party politics and the divisions within parties and the fragmented Danish party system mattered greatly for the political decision to reject nuclear power.

Even though Denmark was home to one of the pioneers of nuclear research, Niels Bohr, the country never introduced commercial nuclear energy. Until the early 1970s, Denmark’s development conformed to the general path among developed countries.

The Danes participated in the Atoms for Peace programme and attempted to develop their own reactor type. However, when most countries moved ahead with nuclear plans after the oil crisis, Denmark took a different route. The decision not to “go nuclear” was taken in three steps.

In 1974, the Danish government proved very open to civil society concerns, advanced notably by the newly founded Organisationen til Oplysning om Atomkraft (Organisation for Nuclear Information, OOA). The decision on nuclear power was to be taken by the parliament. It was postponed, in order to allow for a public debate. For this “debate on energy” public funds were made available to civil society via the EnergiOplysningsUdvalget (Energy Information Committee).

In the summer of 1976, the Social-democrat-led government further delayed the decision to licence nuclear power plants, for two reasons: internal divisions within the party, as a consequence of the intense public debates about nuclear power, and adverse public opinion due to the well-organised campaigns of the Danish anti-nuclear movement.

The Danish parliament decided, in 1985, to exclude nuclear power from future energy planning. Changing positions within the social democratic party, adverse public opinion, and concerns about nuclear waste disposal within Danish borders informed this decision. However, Danish civil society continued to engage with nuclear power – outside Denmark. Near Copenhagen, the Swedish nuclear power plant Barsebäck remained the target of annual marches. After Chernobyl, the OOA started a campaign against “radiating neighbours”, protesting against Swedish, West and even East German reactors. Most recently, the public engaged with nuclear waste issues from the research reactors and potential uranium mining in Greenland.
CIVIL SOCIETY AND PUBLIC DEBATE
Pro and anti-nuclear debates in Finland have involved professionals, authorities and politically active citizens. Engagement took place in organized meetings, publications and academic settings. Very little direct action has been taken against nuclear energy.

ECONOMY AND DEMOCRACY:
PERCEPTIONS OF NUCLEAR POWER
Since the 1950s the aim of the energy policy in Finland has been to increase the energy self-sufficiency. This goal has overshadowed all political, technological and environmental risks. Nuclear energy has been perceived as risky and dangerous, but as irreplaceable.

POLITICS MATTERS
A small elite of engineers, managers, authorities and politicians has managed nuclear energy since the 1950s. The public has participated in nuclear debates mostly through representative democracy. With all other parties in favour, the Green Party has been the most prominent voice against nuclear power.

Finland entered the nuclear age in 1955 when the Finnish delegation participated in the Geneva Atoms for Peace Conference. Ten years later Finland was ready to launch a commercial nuclear power project. However, it took five more years and endless hours of hard negotiations to decide whether the first reactors would come from the west or east. The Soviet Union regarded Finland as one of its political “satellites”: hence the first two reactors and steam turbines had to come from the Soviet Union.

The Loviisa nuclear power plant (NPP), operated by a state-owned utility (Imatran Voima), with two pressurized water VVER-440 MW reactors went critical in 1977.

On the west coast of Finland (Eurajoki), Teollisuuden Voima Oy, a private utility, built “the western NPP” with two ASEA-Atom 660 MW boiling water reactors from Sweden. Since the 1980s these four reactors provided about 30% of Finnish electricity. In 2002 the Finnish Parliament authorized a fifth reactor, the 1,600 MW European pressurized water reactor managed by the French company AREVA. After enormous difficulties and delays it is expected to go critical in 2018. Pending permission, a sixth reactor - 1,200 MW VVER - pressure water reactor will be built by Russian Rosatom for the youngest nuclear power company Fennovoima, in the North-western part of Finland, in Pyhäsjarvi.

The interaction between nuclear energy and civil society in Finland has developed since the 1950s without major political and ideological clashes. There have been public debates, demonstrations, and an intellectual counter-culture lobbying against nuclear energy at national and local levels.

The Finnish parliament has accepted some, but also turned other down reactor applications. Utilities have withdrawn applications when they have encountered heavy public opposition. At the same time, nuclear energy has remained at the very core of the Finnish energy policy since the 1950s. The main argument in favour of nuclear energy was self-sufficiency, an argument that connects to Finnish national self-understanding. Furthermore, the discussion has been shaped by a high level of trust in engineers, managers and authorities, and a discursive environment that pays attention to anti-nuclear arguments, but respects arguments from the nuclear industry and nuclear lobby as well. The result is a consensus that is neither pro- nor anti-nuclear, but rational and pragmatic.
CIVIL SOCIETY AND PUBLIC DEBATE
The massive anti-nuclear demonstrations in the 1970s met with strong repression by the state. Despite the gradually increasing transparency and attempts to dialogue, powerful public and semi-public actors still lead nuclear policy with a heavy hand.

ECONOMY AND DEMOCRACY:
PERCEPTIONS OF NUCLEAR POWER
Public opinion has been divided, with acceptance at its lowest in the mid-1970s and post-Chernobyl years. Perceived as a solution for cheap electricity and job creation, nuclear power is today reluctantly accepted by many, while strong opposition remains.

POLITICS MATTERS
A broad cross-party consensus in favour of nuclear power has prevailed in France, with the exception of the Green Party. Their entry into government sealed the decision to shut down the industrial prototype fast breeder reactor, Superphénix, in 1997.

In the immediate post-War period, civilian nuclear power developed hand in hand with France’s ambitions to develop its own nuclear weapons programme. Until the 1970s the Atomic Energy Authority (Commissariat à l’Energie Atomique) enjoyed an exceptional level of independence conducting R&D and developing both military and civilian nuclear technology.

The long dispute over the choice of reactor technology in the late 1960s ended in the abandonment of the gas-graphite reactor system developed by CEA, and the American light-water reactor (PWR) technology was chosen instead. The subsequent “Frenchification” of the PWRs helped consolidate the hitherto fragmented national industry, led by the state-owned electricity company, EDF. The essential conditions were therefore in place for the French response to the first oil crisis, the launching of a massive nuclear programme in 1974. As part of the attempts to regain French “grandeur”, the programme also led to strong opposition. However, the widespread anti-nuclear activism was systematically suppressed, and 56 reactors were built in only 15 years.

The Three Mile Island accident (1979) marked the first openings of the hitherto highly secret nuclear technocracy. The uncovering of authorities’ attempts to conceal the impact of Chernobyl fallout in 1986 started a period of doubt and mistrust of the state and the nuclear technocracy. The turn of the century was marked by the EU-imposed electricity market liberalisation, reorganisation of the sector in order to promote nuclear technology exports, and the re-emergence of radical anti-nuclear controversy.

Largely for economic and financial reasons, the French-led “nuclear renaissance” has failed to materialise. Today the country’s nuclear industry struggles with major economic and technical challenges – notably the upgrading of the 58-reactor nuclear fleet to enable life-span extensions. Local and industry opposition make the government commitment (from 2012) to reduce the share of nuclear electricity from the present 75% to 50% by 2025 highly uncertain.
CIVIL SOCIETY AND PUBLIC DEBATE
Societal opposition to nuclear power faced severe difficulties under the repressive conditions of a Communist state. The first unstructured protest groups in GDR emerged at the end of the 1970s, establishing meeting places in church circles.

ECONOMY AND DEMOCRACY: PERCEPTIONS OF NUCLEAR POWER
Nuclear technology was part of a state doctrine, presented as a decisive element of socialist GDR identity, representing the superiority of the socialism and contributing to prosperity.

POLITICS MATTERS
The socialist planned economy did not allow democratic elements of participation. All decisions were made at political level, dominated by the Socialist party (SED).

The German Democratic Republic (GDR) as the East Part of Germany stood in the longer tradition of radioactivity and nuclear research in Germany, dating back to pre-war times.

Nevertheless, transnational knowledge and technology transfer was crucial for GDR plans of building nuclear power plants. This transfer from the Soviet Union to GDR started in the early 1950s. It was asymmetric due to the Soviet Union’s insistence on protecting its own hegemony in Eastern bloc states. Government and academia of GDR struggled for a stronger position in the relationship with USSR. However, the position of Soviet Union determined the process of implementation of knowledge and technology in the nuclear sector.

Given the lack of alternative energy resources, except for heavily polluting, low-grade lignite, energy policy in GDR favoured the nuclear energy option. However, the actual installation, expansion and use of nuclear power constantly lagged far behind planning targets, not least due to the economic problems of a centrally planned socialist economy. The first imported Soviet research reactor was installed in 1957. In 1966 the first nuclear power plant was connected to the grid. Since 1973, the NPP II followed and made a notable contribution to electricity generation for the first time. The socialist state’s economic deficiencies manifested themselves in ambitious nuclear energy programmes which never have materialised.

Crucially relying on Soviet technology and military presence for its survival, the GDR government adopted a very restrictive stance in informing the public after the Chernobyl disaster. Despite a lack of solid Soviet pressure, authorities gave only incomplete and often misleading information. This backfired and further eroded trust in GDR authorities, as most GDR citizens had access to more complete information from West German television, which for instance warned against the consumption of fresh milk or vegetables.

The anti-nuclear movement in GDR remained very limited and heavily suppressed until 1989. However, after the fall of communism it grew and together with West German groups successfully lobbied for the shut-down and decommissioning of all nuclear power facilities in East Germany.
CIVIL SOCIETY AND PUBLIC DEBATE
The societal controversy over nuclear energy began in the 1950s. From the 1970s, it involved citizens at all societal levels. It integrated not only groups of experts and stakeholders, but numerous intermediary social groups and actors such as citizen action groups.

ECONOMY AND DEMOCRACY:
PERCEPTIONS OF NUCLEAR POWER
In the early period, the utilities were hesitant to engage in the nuclear sector. They needed the state to set the scene. Subsequently electricity providers like RWE power became core proponents of nuclear energy and continuously attempted to enlarge nuclear markets.

POLITICS MATTERS
All political parties advocated nuclear energy as a trigger for technological and industrial modernization during the 1950s and 1960s. Gradually they became critics of it and decided the nuclear phase out. While the social democrats changed sides in the 1980s, Angela Merkel moved the Christian democrats to support phase out after Fukushima.

When the United States launched the Atoms for Peace programme in 1953 and shortly after the federal government adopted the Atomic Energy Act on the peaceful utilization of atomic energy and the protection against its hazards six years later, the first nuclear power plant Kahl went online at the border of Hesse and Bavaria. Thus nuclear power in West Germany started as an industrial business.

The 1960s were characterized by intensive development and planning for expansion of nuclear power that was hardly noticed by the public. The first commercial nuclear reactor went on the grid in 1961, but it took many government incentives to induce energy companies to switch to nuclear power. Given that they had heavily invested in coal and cheap oil many utilities were reluctant to substantially invest in nuclear power. Planning and building nuclear power plants, radioactive waste disposal facilities, or reprocessing plants in the federal states of Baden-Württemberg (Wyhl), Schleswig-Holstein (Brokdorf), Lower Saxony (Gorleben), North Rhine-Westphalia (Kalkar), and Bavaria (Wackersdorf) generated massive protests throughout the 1970s and 1980s.

A role model for all subsequent protests were the demonstrations against the construction of the plant in Wyhl (Kaiserstuhl) on the French border in Germany’s southwest. In 1975, up to 30,000 people were called for demonstrations, occupying sites and developing protest structures.

The Chernobyl catastrophe in April 1986 led to an upswing of intensified debates on nuclear power in West Germany. As a result, the pro-nuclear Christian democratic-liberal government set up a federal ministry for the environment that was responsible also for the safety of reactors.

Numerous citizens’ initiatives sprang up. In 1998, the red-green coalition decided to phase out nuclear energy within 20 years. After the accident in the Japanese nuclear power plant Fukushima Daiichi in 2011, the topic received renewed attention with continued protests. Chancellor Angela Merkel announced the shutdown of all German power plants by 2022, with eight of the 17 operating German reactors shutting down immediately.
CIVIL SOCIETY AND PUBLIC DEBATE
Public protests against the construction of a nuclear power plant grew in the late 1970s. They were focused on sites short-listed for the construction of a nuclear plant, especially Karystos, Evia.

ECONOMY AND DEMOCRACY: PERCEPTIONS OF NUCLEAR POWER
The nuclear programme was linked to achieving energy autarky. During the 1967-1974 military dictatorship, the programme was scaled up and became connected to a rhetoric concerning national sovereignty.

POLITICS MATTERS
All plans for a Greek nuclear plant were cancelled in 1981, following a strong earthquake and the decisive victory of a government from the centre-left that appeared prepared to endorse the widespread concerns about the safety of nuclear energy installations in a country suffering from high seismicity.

Greece does not have any nuclear power plant. Plans for a Greek nuclear power plant lasted from the early 1960s until the early 1980s. The final cancellation of these plans was accompanied by the increased use of lignite in power production and the development of transnational electricity network interconnections. Through transnational interconnections, critical energy flows came from electricity produced in nuclear power plants in Bulgaria and other countries. This means that Greece became ‘nuclear’ even though it did not have a nuclear power plant or infrastructures for the extraction of uranium.

The plans for one or more Greek nuclear power plants were redrawn several times by various actors. The 1967-1974 dictatorial government was supportive. Right-leaning, centrist and pro-soviet parties were also broadly pro-nuclear. Supporters of nuclear energy stressed political reasons, including the prospect of energy autarky and the strengthening of the geopolitical position of Greece.

The engineering community was rather skeptical. Parties and intellectuals from the pro-western left and the nascent environmental movement were certainly not enthusiastic. Arguments against the establishment of a nuclear plant focused on the real cost of energy production and the technological dependence from a country that would provide uranium or/and the know-how to construct and operate nuclear reactors. Several scientists and engineers insisted that the seismicity of Greece was making any plan for a nuclear plant problematic. They emphasized the risks and the uncertainties in the case of an earthquake near Athens.

These concerns were amplified by the accident on Three Miles Island in USA in 1979 and the strong 6.7 Richter earthquake on the Corinthian Gulf in February 1981. Anti-nuclear public protests took place throughout the late 1970s, by activist groups who were either against nuclear energy in general or against plans for an installation of a nuclear plant at the proposed locations. The 1981 earthquake led to the final cancelation of plans for a nuclear plant.
CIVIL SOCIETY AND PUBLIC DEBATE
In socialism there was no detectable civil resistance to the construction of Hungary’s nuclear power plant, only a short-lived local movement against waste disposal. Hungarians have largely demonstrated support for nuclear power, from the 1970s to today.

ECONOMY AND DEMOCRACY: PERCEPTIONS OF NUCLEAR POWER
When Hungary’s nuclear power plant was under construction in the 1970s, it was represented as a symbol of modernity as well as technological cooperation between the Socialist States of Eastern Europe.

POLITICS MATTERS
The nuclear issue in Hungarian life has been treated for years by planners and politicians as primarily an economic one; only very recently have people started to treat nuclear power as a matter of politics.

The study of Hungary’s nuclear history offers scholars a fine opportunity to examine how scientific and technocratic decision-making took place in the socialist states of Eastern Europe. Civil society was highly restricted, under the control of state authorities, and therefore did not have a role in the decision-making process that led to the introduction of nuclear power. Rather, this process took place within the government and bureaucracy of the Socialist State. Influence came not from the building of coalitions of citizens who voiced their opinions in public, but instead from the constellations of interest and power consisting of important figures in the State government, administration, and bureaucracy. This process was international, because of the hegemony of the USSR in Eastern Europe. International negotiations between the Hungarian and Soviet governments were vital to this history; in addition, there were transnational exchanges of personnel and technologies between various Eastern European countries, evidenced in the history of nuclear energy in Hungary.

Hungary’s nuclear development began with a research reactor in 1959 and a training reactor in 1971. Together they allowed Hungary to create a core of nuclear scientists and engineers who were familiar with nuclear technology and could defend it in government circles. They met opposition to nuclear power production within the socialist state bureaucracy. They overcame this opposition with arguments of economic effectiveness and technological virtuosity. The nuclear power plant built in Paks became a centrepiece for socialist propaganda, and indeed was the largest, most complicated technological project carried out in modern Hungarian history.

This frame of nuclear had a lasting effect. Today, Hungarians are used to the idea that nearly half of their country’s electricity is produced at Paks, and a large group are supportive of nuclear power.
Newspaper columnists and political leaders welcomed atomic energy. The support was strong primarily on the left parties. In 1957, when the siting of power plants was announced, there was no real opposition. Protests began after the Three Mile Island accident. Overall Chernobyl and Fukushima affected the referendums in 1987 and 2011.

Nuclear energy was considered a beacon of progress during the years of the post war reconstruction. The early economic critics emphasized the large investment needs in the nuclear sector, as opposed to oil and gas.

Both sides of the political spectrum supported nuclear power until the 1980s. The main leftist parties backed nuclear power but opposed nuclear arms. In the centre and the right there were both supporters and opponents.

The interest of Italians in nuclear sciences can be dated back to the first researches of Enrico Fermi’s group, in the late 1930s. After the World War II, the first centre for applied nuclear research was promoted by the oligopoly of electric power and the major industrial groups, with the support of academia in 1946.

The Italian State started its involvement in nuclear energy, in an institution building process which was intertwined with public debate on the nationalization of electric power. The research centre at Ispra was given to the new European Atomic Energy Community (EURATOM), and the Italian nuclear energy committee opted for United States technology.

The eventual nationalization of electric power in 1962 seemed to bring a stronger consensus toward nuclear power, but the sentencing of the Nuclear Commission’s chairman guilty for minor administrative crimes in 1963 split the public opinion in two.

This did not change the basically positive attitude toward nuclear energy in Italian public opinion. The cost of nationalization slowed the nuclear power investment by the public electric utility, while the first nuclear euphoria slowed down internationally. Nevertheless, the efforts in the nuclear sector continued with the work for a national reactor to be commercialized, and with a strong international cooperation in the field of fast breeders.

This created an Italian nuclear complex, which was questioned when the first referendum abrogated in 1987 some relevant parts of nuclear legislation. The opponents group included a broad alliance ranging from local protesters from reactors sites – broadly concerned by the effects of nuclear accidents – to left-wing pacifists fighting against nuclear missiles. The main mass parties, including the communist party, shifted to anti-nuclear positions at the eve of referendum, and this rejected all the nuclear power programmes in Italy. In 2011, the second referendum on the timid bipartisan reprisal of nuclear power option – promoted by the Silvio Berlusconi government – provided the same results.
CIVIL SOCIETY AND PUBLIC DEBATE
Two referendums in 2008 and 2012 illustrate the linkages and variations between political strategies and public opinion. The 2012 referendum shows the anti-nuclear attitudes.

ECONOMY AND DEMOCRACY: PERCEPTIONS OF NUCLEAR POWER
The decommissioning of the Ignalina power plant demonstrates all the difficulties, debates and contradictions within the processes of admitting Lithuania to the EU as well as the incompatibilities of democratic modes of governance with an outdated technology created under authoritarian rule.

POLITICS MATTERS
After the Ignalina nuclear power plant shutdown and the negative referendum results about the construction of the new nuclear power plant, the Lithuanian government are postponing the final decision about a nuclear power programme.

From the first years of construction until its full decommissioning in 2009, the Ignalina nuclear power plant (NPP) shaped nuclear relations between the population and the authorities in Lithuania – both as a Soviet Republic and an independent country after the reestablishment of independence in 1990.

The case of the Ignalina NPP demonstrates how different claims were articulated and used by scientists and experts, political actors and grass-roots organizations from the Soviet period to the moment of Lithuania’s admission in the European Union. It illustrates the interplay of the pro- and anti-nuclear contexts of the political, environmental and citizenship claims.

If the scientific mobilization of the 1980s was against the construction of a nuclear power plant on the territory of Lithuania, the political and nationalist responses at the end of the 1980s were deeply linked to issues of national identity and sovereignty.

During the 1990s the anti-nuclear claims were framed in terms of energy independence and self-sufficiency, and then became an issue for the EU accession. For policy makers, opinions polls replaced anti-nuclear activism.

After the 1990s anti-nuclear claims were introduced into new democratic procedures and tools, such as public opinion surveys and referendums.

The first referendum held in 2008 with insufficient turnout concerned Ignalina’s decommissioning. The second referendum about nuclear power in Lithuania in 2012 focused on whether to build new nuclear power plants.

In the late 2000s, after the second reactor was shut down, anti-nuclear claims reappeared in the context of the debates about the revival of a national nuclear programme, as part of what the defenders of nuclear power called the “nuclear renaissance”.

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European Humanities University
After 1945 the Netherlands wanted to quickly recapture its strong pre-war position in science as well as to rebuild and modernize the country, including its energy supply. Investing in nuclear research and technology was part of the attempt of achieving both aims.

The period 1969-1973 marks a turning point in the history of nuclear energy and society in Netherlands. In these years the two nuclear energy reactors went critical (Dodewaard and Borssele) and – joining an international consortium – a uranium enrichment plant was built (URENCO Netherlands). Furthermore, the Netherlands decided to take part in the development of a fast breeder reactor in Kalkar, together with West-Germany and Belgium.

At the same time that these technological projects proved the Dutch nuclear ambitions – institutionalized by legislation and regulations – nuclear technology became publicly contested. The ‘Kalkar-levy’ on people’s electricity bills to finance for the fast breeder project gave an impulse to the anti-nuclear movement that was emerging.

In the late 1970s the government responded to the growing broad societal resistance against nuclear energy and the deadlock this created for policymakers by organizing a Broad Societal Discussion (Brede Maatschappelijke Discussie or BMD) on energy policy. The outcomes were in favour of the opponents of nuclear energy but were neglected by the right-wing government. They planned new nuclear reactors. The Chernobyl disaster, and later changes in government, put these initiatives on hold.

This situation changed as global warming reached the political agenda in the late 1990s. To meet the Kyoto demands and in the meantime assure the supply of energy nuclear re-entered the societal and political debate in the Netherlands. The discussions lack the fierce polarization of the 1970s and 1980s. While the government expressed its support for nuclear initiatives of the electricity sector, the financial-economic crisis hampered their intentions. The nuclear accident in Fukushima in March 2011 played its role too but polls are inconclusive about the lasting and determinative effects on public opinion about nuclear energy.
From 1933 to 1974, Portugal was a dictatorship ruled under the banner of law and order, and against parliamentarianism, labour unions, and freedom of speech, for the press to the assembly of groups. During this period, societal participation in the nuclear debate was impossible.

The fact that Portugal had uranium deposits was crucial for Portugal in entering the nuclear age. In 1949 and 1956, there were major agreements for the sale of uranium oxide involving Portugal and the Combined Development Agency (UK/US consortium). The outcome was the export of 1,250 tons to the US until 1962.

Portugal participated in the American Atoms for Peace programme through a Bilateral Agreement to acquire a nuclear experimental reactor in 1955. The construction of the Laboratory for Nuclear Physics and Engineering and the reactor building were financed by uranium oxide sales, being inaugurated in 1961. Training technical and scientific experts was the chief objective.

From 1958 to 1964, the private Companhia Portuguesa de Indústrias Nucleares was engaged in a project to implement nuclear power. It failed to secure the dictatorial government’s support and declared bankruptcy. After this start, all subsequent projects, both private and public support, were unsuccessful.

In March 1976, after the April 1974 Democratic Revolution, the Portuguese state monopoly utility Companhia Portuguesa de Electricidade took the first steps to build a nuclear power plant at the village of Ferrel, in the coastal centre of Portugal, but the process did not continue due to significant opposition of local population. This was the first and last case of people’s uprising against nuclear power. However, the nuclear debate has been kept alive.

After 1976, government attempts to install nuclear power faced the opposition of environmentalists. The Chernobyl disaster on 26 April 1986 led to the end of the nuclear power programme. The repeated discussion of the Ferrel incident in the media has been a source of re-inforcement of nuclear aversion until the present day.
CIVIL SOCIETY AND PUBLIC DEBATE
Active supporters and active opponents of nuclear energy represent a minority in Russian society. The public influence on the sphere of nuclear energy in Russia has never been quite strong.

ECONOMY AND DEMOCRACY:
PERCEPTIONS OF NUCLEAR POWER
Industry officials and advocates of nuclear energy see its competitive advantages in the use of the cutting-edge technology, availability of significant raw material base, qualified labour, relatively low operational costs, and the stability of nuclear power costs.

POLITICS MATTERS
The state and the government support the development of nuclear power engineering. The opposition is represented by the Russian United Democratic Party “Yabloko” and Russian Ecology Party “The Greens”.

From the first days of the evolution of nuclear energy, Russia positioned itself as a nuclear country. Over that period, state policy (and hence the position of the nuclear industry) underwent an evolution: from a tight blanket of secrecy regarding to all information about any possible or actual problems related to nuclear energy or accidents during the Soviet era, to complete openness and transparency, wide public involvement and various forms of dialogue with society. The Chernobyl accident became a catalyst for “nuclear” transparency and public involvement. The peaks of public activism in Russia were observed in the early 1990s and 2000s.

Today the state corporation Rosatom occupies second place in the world’s ranking uranium reserves and third place in uranium production. It is the world’s second largest in terms of nuclear power generation, controls 36% of the global uranium enrichment services market and 17% of the nuclear fuel market. Rosatom is engaged in promotion of Russian technology and industrial companies, their environmental and technological safety, and educational campaigns. The state-owned corporation enjoys state support.

The prevailing attitude towards nuclear energy of the majority of Russians is somewhere between fear of nuclear accidents and acceptance of nuclear power engineering as a high-potential energy source. In everyday life situations a rational perception of nuclear energy and industry has the upper hand over the emotional one. Given the state’s strong role and relatively scarce anti-nuclear public demonstrations it may be assumed with a high degree of probability that this technology has good development prospects in Russia.
The socioeconomic and political context led to a marked polarization among actors. Relations are often characterized by mutual mistrust. This favoured non-interactive processes of communication over active engagement procedures until the 21st century.

During the 1950s and 1960s, nuclear promoters portrayed nuclear power as the only plausible alternative to meet the electricity needs, arguing that the alternatives were effectively: “nuclear or candles”. At the time the Spanish public had little knowledge, if any, of the technology. Thus, early nuclear projects barely faced opposition. Yet competing uses of the territory, such as tourism at the coast and agriculture’s water needs in the interior, brought early critical voices and administrative complaints from the late 1960s. Complaints were not directed against nuclear technology, but more against the change of the traditional use of land, a conflict familiar from other industries. By the early 1970s Spain became one of the western countries where nuclear power grew fastest. The dictatorship did not tolerate civil activism. Yet, informal and unstructured groups opposing nuclear projects emerged before the end of the regime.

In Spain, the economic crisis following the oil crises was aggravated by the uncertainties of the transition to democracy (1975-1982). Terrorism and the fear of military coups threatened democracy’s early steps. Among terrorists’ targets were nuclear power plants in the Basque Country. By the late 1980s, just about 7000 MW of nuclear capacity were installed of the over 22,000 MW projected. All remaining plans were abandoned or subject to the nuclear moratorium adopted by the government in 1984. The moratorium was a response both to excessive borrowing and to power plants exceeding demand. Private utilities obtained compensation for the 5 reactors halted.

Democratic Spain emerged as one of Europe’s societies most critical of nuclear power, with a latent public opposition acknowledged by all actors. Nevertheless, the Spanish nuclear industry had grown to become an international player in engineering services and components, thanks to the experience and human capital accumulated. The industry opted for keeping a low public profile over the last 30 years. The selection process for a centralized temporal storage site (ATC), became the first attempt of a transparent and consultative decision making process. In 2017, it remains politically blocked.
Sweden has for long time had a very ambitious nuclear programme, and since the early 1980s it has generated the most nuclear power per capita in the world. When the programme began in the late 1940s it had a dual aim: to create energy self-sufficiency by using domestic uranium resources, and to enable the production of nuclear weapons. However, in the late 1950s an active anti-nuclear weapons movement emerged. It led to the decision not to produce such weapons. At the same time the self-sufficiency ambition was abandoned and long term contracts for uranium imports were signed.

In the early 1970s the first large commercial reactors were inaugurated. A very influential nuclear industrial complex developed in Sweden, capable of constructing, building and operating nuclear plants. It had ambitious plans to build 20 reactors in the coming two decades, and enjoyed broad political support.

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 nuclear issues were very high on the political agenda. In 1980, in response to the Three Mile Island accident, an advisory referendum on nuclear power was held. The outcome was a defeat for the anti-nuclear side, and Parliament decided to continue nuclear expansion in the short run, but to phase out all nuclear power by the year 2010. However, this phase out has not occurred.

After the referendum, the issue of nuclear waste disposal became increasingly controversial. There was strong local opposition in many places where the nuclear industry searched for suitable locations for a repository.

In the end, two municipalities that already had nuclear plants were identified as suitable locations for a repository and one of them was then chosen to host it without local resistance.
Debate in the UK has focused on nuclear weapons rather than nuclear energy, although siting of nuclear waste facilities has proven controversial. Anti-nuclear power protests have remained local, rather than national concerns. From the late 1960s onwards, nuclear economics rather than nuclear safety was the prime public concern. Nuclear safety has largely been absent from a debate focused on the costs of over-budget and late running nuclear reactor construction programmes.

The UK has generated nuclear power since 1956, when the first large-scale plant in the world opened at Calder Hall. From 1956 to the mid-1970s the UK developed reactors and a variety of enrichment and re-processing technologies. Until the mid-1970s the UK was the largest producer of nuclear energy in the world by any measure. Initially, this electricity came from UK designed gas-cooled reactors. However, since 1979 water-cooled reactors have been constructed under licence from private companies, much like the rest of Europe. As a result of the UK’s early entry into the nuclear field, British discussions on nuclear power began much earlier than those in the rest of Europe, predating 1968.

The UK experience has been characterised by public acceptance of nuclear energy, rather than strong support or opposition. This is in contrast to the debate over nuclear weapons, which is far more active, yet separate from discussions of nuclear energy. Debate about nuclear energy in the UK has been limited. Controversy has been infrequent, protests have been local, and opposition has often focused on individual topics of concern such as economics, or the siting of facilities.

The operating and safety characteristics of the UK’s gas-cooled reactors have been portrayed to the public in a way that reduced debates about reactor safety. As such, UK reactors are usually regarded as safe, but expensive. The availability of other energy sources has had an impact on the role of nuclear energy. From the 1970s onwards, the availability of relatively inexpensive gas and oil from the North Sea limited the development of nuclear power. By the mid-2000s North Sea oil and gas reserves were depleted, and this increased political support for nuclear power. Politicians have reframed nuclear power as a key part of the UK’s efforts to reduce carbon dioxide emissions. Political support, along with public acceptance, has led to continued development of nuclear power. Replacements for old reactors are now being ordered.
Ukraine’s nuclear power programme, consisting of 15 reactors at four stations (with the Chernobyl station closed), in many ways will always be connected with the explosion of Chernobyl reactor unit 4, in April 1986.

The Chernobyl disaster has continued to affect relations between the nuclear energy industry and society. After several years of cover-up, the extent of the disaster was finally revealed to the general public in 1989. At that time, a broad independence movement developed, being centred largely on environmental concerns. A great number of Ukrainian citizens participated in anti-nuclear protests that eventually led to a moratorium on the construction of nuclear reactors.

Shortly after Ukraine became independent, though, the moratorium was overturned – and to little public reaction. Starting from the mid-1990s Ukrainian citizens have become much less involved in discussions about the future of nuclear power; only NGOs have remained active in discussing nuclear issues. The Chernobyl disaster and anti-nuclear protests led industry representatives to become more open about the problems the industry faces. They have sought to develop the public understanding that Chernobyl was an unfortunate accident of the Soviet past, while stressing that the expansion of nuclear power is important for Ukraine’s future.

Today, especially because of Russia’s annexation of Crimea and war in eastern Ukraine, many people in Ukraine see nuclear power as a way to achieve energy independence from Russian oil and gas. However, the country also relies on Russia for nuclear fuel and technology for its Soviet-designed reactors. Recently it turned to the EU and western corporations to supply fuel and technology. On top of this, the nuclear industry faces growing costs of maintenance of power stations, license extension processes, and unsolved problems of spent nuclear fuel and radioactive waste storage and reprocessing. Chernobyl is a tragic reminder of the importance of broad societal discussions of all these problems, discussions where a special place for critics (and potential whistle-blowers) is always preserved.
CIVIL SOCIETY AND PUBLIC DEBATE
From the 1960s citizens, experts, and industry representatives contested nuclear power over questions of siting, safety, and environmental change. Mass protests occurred in California and New Hampshire, to fall quiet after a virtual moratorium on reactor construction in the 1990s.

ECONOMY AND DEMOCRACY: PERCEPTIONS OF NUCLEAR POWER
To this day industry and its critics dispute whether nuclear energy is safe, a solution to global warming, and economically competitive with other sources of electricity production, with the majority of US citizens usually supporting it.

POLITICS MATTERS
High level political support for nuclear power has returned to Washington in Congress in the Energy Policy Act of 2005. Anti-nuclear groups remain active but muted in response. But cost questions and worries over the Fukushima disaster may slow new orders.

The United States, among the first nations to commercialize nuclear power in the 1950s, built more nuclear power stations than any other country. Roughly one-quarter to one-fifth of all power reactors in the world were operated or are still operating in the US – currently 99 of them – and many others built abroad. The US nuclear power programme took off in an atmosphere of competition with the USSR, with its Atomic Energy Commission (AEC) pushing rapid commercialization. The AEC believed it could manage the new technology. Yet the AEC kept a number of findings that raised safety concerns out of public view and adopted ad hoc regulatory procedures.

Anti-nuclear sentiment grew during the anti-war, environmental, civil rights and women’s rights movements of the 1960s, encouraged by greater government openness. The publication of AEC documents led to a mistrustful relationship between the public and the nuclear industry. To rebuild trust and ensure safety, the government established the Nuclear Regulatory Commission (NRC) in 1974 “as an independent agency” to ensure environmentally safe operations. Yet mass protests over licensing new stations, and growing construction costs and times, unsettled the industry even as new stations opened. A partial meltdown at Three Mile Island in 1979 and persistent problems at other stations raised questions about industry safety culture and the need to improve regulatory functions. Both of these improved into the 2000s, while public oversight and protest – so crucial in the 1970s, 1980s, and 1990s – waned as industry ceased building new reactors after Three Mile Island.

A question is whether the public will become active again as the NRC begins to review licenses to prolong the operation of existing stations and as industry seeks a renaissance in nuclear power, especially after the US 2005 Energy Act that offered the potential of massive subsidies in the billions of dollars to nuclear industries, but was hardly “green” in also subsidizing oil and gas in allowing fracking fluids to go unregulated.