‘Tobacco for Atoms’: Nuclear Politics, Ambivalences and Resistances about a Reactor that was Never Built

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INTRODUCTION

Since the 1960s there has been a continuous discussion about the nuclear future of Greece and the introduction of nuclear technology to secure the increasing energy demand.[1] Greek engineers, scientists and foreign consultants, along with politicians and political activists, shaped the conditions for the emergence in Greece of what Gabrielle Hecht called ‘nuclear exceptionalism’.[2] Gabrielle Hecht has shown that following the Second World War the public discourse of Western societies presented nuclear power as fundamentally different from other technologies. For supporters, the exceptional status of nuclear power was related to the expectation of a nuclear future of low cost and abundant electricity – a utopia of promises within a capitalist and liberal context. For opponents, political activists and sceptics, nuclear power represented a continuous threat of apocalyptic disaster.[3] Some state and corporate campaigns attempted to present nuclear power as a domesticated and riskless technology. Hecht argues that ‘Nuclearity, like many other categories, can be deployed as a tool of empowerment and disempowerment. Its significance depends on its techno-political distribution’.[4] She explains that ‘nuclearity’ varies from country to country and from region to region, as it depends on the socio-cultural and political setting. Different actors configure different meanings and visions and shape different discourses and socio-political agendas in regards to nuclear technologies.

In the present article, we tell a 'nuclearity' story about a reactor that was never actually built. We situate our narrative within the context of the Cold War and seek to unravel how the prospective 'nuclear' age of Greece was conceptualized, debated and contested from the 1960s to the early 1980s by local engineers and atomic scientists, foreign consulting companies, economists, state officers, politicians and governmental ministers, protesters, local lay people, and participants to ecological movements. The geopolitical context of Cold War Europe influenced Greece's energy policies, plans and aspirations in many ways. For many of the actors involved, the nuclear vision was legitimized in the public discourse as a necessary step for the energy autarky of the country and its more robust positioning in the geopolitics of the South-East Mediterranean and the Balkans. On the other hand, ambivalences and opposition to the nuclear plant were influenced by scepticism for the economic feasibility of the project and by concerns about the ensuing technological dependency, which could result in socio-political dependency. They were also influenced by emerging concerns about the environment and public health. These concerns were amplified by the accident at Three Mile Island in the USA in 1979 and were reinforced by the strong 6.7 Richter scale earthquake on the Corinthian Gulf of Greece on 24 February 1981. These two events provided an extra legitimacy to opposing environmental movements and to local protestations in Karystos, a town on the island of Evoia that had been selected for building the first Greek nuclear power station. In this context, the newly elected socialist and populist government of Andreas Papandreou moved on to cancel the plans for a nuclear power plant. The abandonment of these plans boosted exploitation of Greek lignite ores and the reliance on timely transnational electricity flows from linkages with neighbouring countries. Interestingly, just as Greece abolished its plans for a nuclear plant, in the midst of rising anti-nuclear criticism, it became dependent on critical imports of electricity produced in nuclear power facilities in neighbouring Bulgaria and other Balkan countries.[5]

FROM IMPORTED COAL AND PETROLEUM TO LOCAL LIGNITE: NETWORKS, CONNECTIONS AND ENERGY FLOWS

The first five decades (*c*. 1890–1940) of the electrification history of Greece shared common organizational and governance characteristics with other European countries. The urban or suburban electric lighting and power lines were small-scale and isolated, owned either by private companies or municipal corporations. Electricity generation was based on imported coal or petroleum. Lignite would start playing a prominent role in electricity generation only after the 1960s.[6] In 1938 only 8 per cent of energy generation was based on lignite. Ten years later this had increased to 12 per cent.[7] After the Second World War, the national energy programme, which was implemented by the infant Public Power Company (PPC, 1950) and unfolded under the auspices of the national reconstruction programme from 1948 to 1958, brought to the fore the argument of energy autarky as a main priority. Initially hydroelectricity attracted the interest of the Greek and foreign engineers and managers. Yet by the 1960s, lignite became the dominant source to define the electricity generation regime

TABLE 1: Sources of electricity production, 1961–2005

	Lignite (%)	*Oil (%)*	*Hydro (%)*	*Gas (%)*	*Renewables (%)*	*Import (%)*
1961–1967	42	32	24			2
1968–1973	35	41	22			2
1974–1979	48	37	14			1
1980–1985	54	28	13			5
1986–1991	69	20	9			2
1992–2000	84		8			2
2001–2005	63	9	6	16	2	4

Source: Data from the PPC Monthly Reports 1961–2005.

of Greece (see Table 1).[8] In 1958 64.3 per cent of lignite in Greece was used in electricity generation. This percentage increased to 80.9 per cent by the 1970s. Energy dependency was a primary concern after the 1950s due to the reliance on imported petroleum and coal and the comparative low development of hydroelectricity. During the 1960s and the 1970s the dependence of Greece on imported fuels was as high as 75 per cent.[9] This was considered a drawback that made the country vulnerable to the energy crises and the geopolitical pressures of the period.[10] The first and the second oil crisis, in 1973 and 1979, had a strong impact on the Greek energy system. Noticeably, soon after 1973, strong pressure resulted in the temporal reduction of electricity demand by 9 per cent.

The second oil crisis triggered reactions and policy strategies that structurally transformed the country's energy regime in general and the electricity regime in particular. Among other things, the 1979 crisis initiated industry and state policies that promoted programmes for the search for oil and natural gas sources in the Ionian and the Aegean Seas. New investments were made in the State Oil Distilleries. Yet, the major investments were actually made in lignite mines by the PPC.[11]

THE QUEST FOR ENERGY AUTARKY: POLICIES AND POLITICS SURROUNDING THE GREEK NUCLEAR PLANT IN THE 1960s

The 1950s was the period of the emergence of atomic and nuclear research in Greece, the establishment of the Greek Atomic Energy Commission (1954) and the preparations for the establishment of the Nuclear Research Centre 'Democritos'. With considerable assistance by the United States, through the political patronage of the Greek Palace and Queen Frederika, nuclear physics was symbolically linked to the quest for the modernization of the Greek state and the dominance of Western values in the country.[12] It was the period of Eisenhower's 'Atoms for Peace' policy, which promoted the expansion and diffusion of industrial, technological and scientific expertise as a way to forge the techno-political dominance of the United States in Europe.[13] This policy resonated with the priorities of Queen Frederika who sought legitimization as a key figure in the political life of the country. Aiming to

promote herself as the guardian of the state from the communist danger, she aligned interests and forces with the US government and the state research foundations, the International Atomic Energy Agency as well as with key European scientists with important roles in CERN.[14] Research in nuclear and atomic physics was institutionalized with the establishment of the 'Democritos' research centre while Greece's involvement in CERN was secured.

On 28 June 1963, Professor Mihail Angelopoulos gave a lecture at the National Technical University of Athens (NTUA), on the 'evolution in the construction of nuclear plants', which was attended by Queen Frederika and a crowd of Greek engineers. It was sponsored by the PPC, which had started to consider the possibility of having a nuclear power station built in Greece.[15] A graduate of the electrical and mechanical engineering department of NTUA, Angelopoulos had received a PhD in engineering at Braunschweig, Germany. He had the opportunity to familiarize himself with nuclear energy while being at the Imperial College and at the UK Atomic Energy Commission. After a thorough review of the international situation from a technical and economic viewpoint, Angelopoulos focused on the Greek case. A nuclear plant was for him a 'basis station' of electricity generation that would have to operate continuously. This led him to the estimation that a nuclear reactor in Greece ought to operate above the capacity of 150 MW. Angelopoulos moved on to argue that the available thermal plants could 'easily compete against' a nuclear station of this size in Greece.[16] He insisted that planning 'on indigenous sources' – like lignite – for the following ten years would have to cover the expected increase in the demand for electricity in response to the hopeful advance of industrialization.[17] He also pointed to the high installation cost and the lack of trained personnel to run a nuclear plant as additional defects of a nuclear power station. For Angelopoulos, further complexities would stem from the fact that the economics of a nuclear power plant would necessitate its installation near a large urban and industrial centre like Athens. This would require extra precautionary measures for the health and safety of the population.[18]

Three years later, Professor Angelos Th. Angelopoulos (a different Angelopoulos), a well-known economist and editor of the journal *New Economy* (*Νέα Οικονομία*) would start from the opposite direction. Lignite – the key indigenous source of energy in Greece – was not a priority for him. Angelopoulos was a leading centrist intellectual whose sympathy to the political left dated back to the turbulent 1940s. Speaking in his capacity as President of the Greek Society for Planning (Ελληνική Εταιρία Προγραμματισμού),[19] Angelopoulos agreed on the priority of hydroelectric plants, but he also argued in favour of the erection of a 280–300 MW nuclear plant so as 'to cover the big gap in the energy economy of Greece'.[20] In his opinion, everything was on the side of nuclear energy. First, he was estimating that nuclear electricity would cost less than half of its conventional alternatives. Second, the cost to build the nuclear plant was for him reasonable, about 40–45 million US dollars. Angelopoulos contrasted this to the 50 million dollars that were about to be spent on building two lignite units that would together give only 230 MW, which was less than the 280 MW expected from one nuclear unit. Third, he stated that the installation of a nuclear plant could offer the Greek scientific community a unique opportunity to develop rapidly and substantially.[21]

Considering that uranium was becoming a commodity,[22] Angelopoulos believed that Greece could take advantage of a competitive uranium market to secure a good deal on uranium supply by Britain or France, or even the Soviet Union. Moreover, he saw no problem in the high consumption load that the availability of a nuclear plant would necessitate. For him this could be a problem only if the industrial development of the Greek economy would be slow so that the country would become an industrially underdeveloped 'province for tourists of the European Common Market'.[23] Angelopoulos viewed the nuclear plant as an infrastructure that would secure energy supply and forge Greece's economic and diplomatic position in Europe.[24] Being of the opinion that the energy problem of Greece was 'extremely urgent', he stressed that Greece had to increase its electricity generation capacity by five times.[25] His arguments had the support of the influential centrist Greek economic journal, *Economic Postman* (*Οικονομικός Ταχυδρόμος*).[26]

A favourable public discourse and a friendly political climate set a rather supportive context for a nuclear plant. In 1966, Industry Minister I. Toumbas, publicly supported the creation of such a plant and suggested that the state should subsidize the high cost of generation in the early stages of its operation.[27] By 1966 there was an increasing interest by foreign countries and their industrial interests in the nuclear future of Greece.[28] Consulting and contracting engineering companies as well as manufacturers of nuclear reactors were competing in order to secure the central place in an emerging market. The Swiss engineering companies Electrowatt[29] and Bonnard-Gardel,[30] as well as the Belgian Societé de Traction et d' Electricité,[31] submitted proposals to conduct studies in relation to the construction and operation of a nuclear plant in Greece. The American manufacturers General Electric and Westinghouse were also keenly interested. On 23 January 1967, General Electric proposed the establishment of a boiling water reactor that would be using enriched uranium and common water for freezing and deceleration purposes.[32]

Negotiations with the British Atomic Energy Committee started in the middle of the spring of 1996. They resulted in a detailed proposal for the establishment of a nuclear power plant in Greece, based on design principles, practices and technologies from Britain.[33] The aim was the establishment of a British-designed advanced gas-cooled reactor, different from those proposed in the same period by American interests.[34] A joint committee of experts from Greece and Britain was to carry out a relevant study.[35] The committee would be presided by K. J. Norman, from the British Atomic Energy Committee. Globally renowned consulting companies like Merz and McLellan would also be represented.[36] Greece was expected to contribute a group of economists and engineering experts from the Economic Planning Centre of the Ministry of Coordination, the PPC and the Greek Atomic Energy Commission. The scope of the study would be to assess the state of the energy system of Greece, the existing and projected demand, to calculate the cost of conventional and nuclear power stations, to study to carry out the integration of nuclear power generation into the existing electricity production and transmission system, and to forecast the repercussion of the use of nuclear power generation in the economic, industrial and commercial life of the country.[37]

FROM JUNTA TO NUCLEAR DEMOCRACY: BETWEEN POLITICS AND TECHNO-POLITICAL VISIONS

In the late 1960s the PPC engineers appeared cautious about the prospect of a nuclear plant. As a result, the company remained vague about the plans for a nuclear plant.[38] The discussion and planning of the nuclear power station acquired rhetorical momentum during the years of the military dictatorship by a group of colonels (1967–1974), when it was formally added to the PPC agenda. The regime of the colonels presented its nuclear policy as part of a broader agenda that emphasized national sovereignty and political empowerment in the context of Cold War Europe. The regime continued the patronage and the political support of the Greek Atomic Energy Commission, following the practice instituted by Greece's Queen Frederika.[39] It stressed the importance of keeping pace with the developed world through a comprehensive programme of industrial policy and energy politics that sought energy independence, the ending of technological dependence, and the forging of an advanced capitalist economy.[40]

The colonels' regime promoted the ideals of the atomic age as a means to advance its nationalist and militarist ideology. By August 1968 it had developed a plan for increasing the experimental nuclear reactor of the state research centre 'Democritos' from 1 MW to 5 MW. The project was completed three years later, in November of 1971. It was celebrated through a series of festivities.[41] The Greek Atomic Energy Commission was given the funding and the space to advance the ideals of the atomic age through educational programmes for young physicists.[42] From 1967 to 1974 several educational seminars and conferences were organized, along with more than 1,000 educational tours for Greek scientists and engineers to countries with nuclear facilities.[43] The increased interest by the Greek government on a nuclear reactor generated corresponding interest among foreign governments and companies from USA, Britain and Italy, which wanted to be involved in the business of consulting about and constructing the first nuclear plant in Greece.[44] In the first half of 1969 the Greek Atomic Association and the PPC sought further discussions with the British Atomic Energy Committee for the installation of a nuclear reactor in Greece.[45]

At the same time the regime began promoting a public discourse that assumed Greece's self-sufficiency in natural resources, placing special emphasis upon the exploration of uranium ores to be found in Greek territories. Exploratory mining began near the town of Kilkis in 1968. In April 1970 experts from the Development Programmes of the United Nations visited Greece to meet and discuss the prospects of uranium mining in Greece with representatives from the Greek Atomic Energy Commission. The initial negotiations resulted in an agreement between the Greek state and United Nations about the research for uranium deposits in Greece, a $500,000 project that would be funded by the United Nations.[46] The 18 June 1972 issue of *Macedonia* informed readers that a programme for research into uranium ores in Eastern Macedonia and Thrace had been planned at a joint meeting of scientists from the state nuclear research centre 'Democritos', the state institute for geological research and other research institutions. 'The pure uranium discovered in the Serres county is as much as 1,000 tons,' claimed *Macedonia* on 9 September

1979. This was estimated to be enough to run a planned uranium nuclear plant of 600–700 MW for about 25 to 30 years.[47]

In January 1972, P. Demopoulos, the PPC director, presented long-term plans that included nuclear plants that would be introduced by 1980.[48] In the midst of the junta period, utopianism surrounding nuclear energy was reaching a peak. By June 1972 the PPC had actually introduced grandiose plans to install eight nuclear 600 MW units by 1991, and six more that would be ten times more powerful (6,000 MW each) between 1993 and 2000. In a press conference designed to promote citizen support for a large loan for the PPC, president Demopoulos and vice president G. Pantazopoulos stated that the technical consultant on nuclear stations and their possible location would be chosen before the end of 1972. The PPC officers added that the final choice of a nuclear plant would be based on an international competition. Expectations regarding the discovery of uranium ores also reached a peak during the same period. According to the PPC officers, the results of a preliminary search for uranium were 'very encouraging' and the search for it was already entering its 'second stage'.[49] In an attempt to present PPC as the guardian of national energy security, Demopoulos and Pantazopoulos coupled the announcement of the PPC's ambitious nuclear energy planning with information about negotiations to double the exchange of electricity between Greece and Yugoslavia and to raise the voltage of their interconnection from 150 KV to 400 KV. They also mentioned studies to connect to the Bulgarian network by a 400 KV line, and, also, to the Italian and the Turkish network.[50]

It made sense to announce plans for transnational electricity infrastructure alongside plans for developing national infrastructure. Such announcements could strengthen the country's negotiating power over transnational infrastructure while at the same time boosting the nationalist ideology that was at the core of the colonels' political regime. Lacking legitimacy within Greece and in Western Europe, the dictatorial government had extra reasons for announcing plans that promised both national abundance of electric power by nuclear plants and transnational infrastructural links. At the September 1972 Thessaloniki International Fair – a national and international trade and industrial fair – Pantazopoulos announced the construction of a 600 MW plant by 1981. To make this sound more convincing, a miniature of a nuclear unit, modelled after the 800 MW Kraftwerke nuclear plant that was installed at Brunsbuttel (near Hamburg, Germany), was a central piece of the PPC fair room.[51]

PPC director, Demopoulos, established a Nuclear Office in 1971. In 1972, the Greek Atomic Energy Commission announced some ambitious nuclear plans, which included the availability of 4,2000 MW from nuclear plants by 1990. These plans were similar to those announced by the PPC in the same year. The junta had already tried to obtain a nuclear plant through the so-called 'atoms for tobacco negotiations' of the late 1960s and early 1970s. In 1971, 40,000 tons of tobacco were offered to Great Britain in exchange for the construction of a nuclear station that would be ready as early as in 1974. The British tobacco industry showed no interest so this junta initiative was quickly killed. Interestingly, the Soviet Union expressed some interest but the Greek dictators did not enter negotiations.[52]

Plans for a Greek nuclear plant were given further consideration after the fall of the dictatorship and the election of the conservative governments of Konstantinos

Karamanlis and Georgios Rallis. In July 1975, the first Karamanlis government established the National Energy Council and invited an MIT professor, Elias Gyftopoulos,[53] to chair the Council and advise on energy issues. Gyftopoulos believed that nuclear power electricity generation would be 30–40 per cent cheaper than that from conventional power plants. Anticipated techno-scientific advancements would, for him, make the cost of electricity generation from a nuclear plant less than 20–25 per cent lower than that from coal. Gyftopoulos also expected that technological advancement would also lower the risks. The MIT professor argued that even though the dependency on reactor technology and nuclear fuel was a major concern for most countries, there was no reason for fear of monopolist interests that would threaten the sovereignty of countries.[54] In 1976 the plan for a nuclear reactor was incorporated into the PPC ten-year development programme. The nuclear facility was supposed to be operational by 1986.

The plans of the conservative government generated interest from foreign countries that sought an opportunity to promote both their geopolitical agendas and their commercial interests. In October 1977, during a visit to France by the Minister of Industry, Konstantinos Konofagos, the French authorities expressed interest in getting involved in the Greek nuclear programme.[55] Pressures from the French government were also exercised by the French Prime Minister, Raymond Barre, during his visit to Athens in July 1979. In a meeting with Prime Minister Karamanlis, Barre praised the French nuclear programme and argued that Greece should invest in small nuclear reactors of 600 MW rather than in larger ones of 900 MW or 1200 MW.[56] Karamanlis revealed that he would discuss the issue with the president of the French Republic, Valery Giscard d'Estaing. In the hope of pursuing Greece's inclusion in the European Community, Karamanlis negotiated the construction of a nuclear plant with both d'Estaing and the German Chancellor Helmut Schmidt.[57] D'Estaing was very active in pushing the collaboration between his country and Greece. The French company Pechiney, the aluminium plant of which at the Corinthian Gulf had been the largest consumer of electricity in Greece since the beginning of its operation in 1960, had already recommended ten sites for the installation of a nuclear plant.[58]

In the end, it was an American consulting company that became seriously involved in selecting a site for the nuclear plant. In 1980, after an international competition, EBASCO was engaged by the PPC to identify possible sites and provide consulting services. The contract made provision of a fee of 5.3 million dollars.[59] While it is not clear when exactly EBASCO first became involved, we know that as early as 1976 the southern Evoia town of Karystos (70 km from Athens) was chosen as the most appropriate site for the installation of a 1,000 MW nuclear plant. The consulting company conducted geological, geophysical, seismological, demographic, aquatic, ecological and power systems surveys and, where necessary, exploratory drillings, in order to provide evidence-based assessment of suitable installation sites. The PPC was expected to consult on a list of sites based on the shortlisting of EBASCO. In a memoir, Evangelos Kouloumbis, a leading engineer and president of the Technical Chamber of Greece – the professional association of Greek engineers – during this period, who subsequently (1982) became Energy Minister of the populist socialist government of Andreas Papandreou, mentioned that he found in his ministerial

office a secret EBASCO report on the site selection process. According to Kouloumbis, EBASCO was hired to select ten possible locations for the installation of a nuclear plant, all far from the northern borders of the country, below Olympus and as far south as the Peloponnese. They should also all be as far as possible from urban centres and areas with high seismic activity.[60] The initial shortlist included five sites: a site in Evoia (codified in a relevant report as ES-1-2), at the extreme southeastern coastline of the island, along the Strait of Kafireos, near the town of Karystos; a site in Lakonia (LA-9A) about 5 km west of Cape Maleas; a site in Ilia about 3 km northwest of the Kendron Reservoir (PK-1); a site in Arcadia, 3 km southeast of Dafni (PC-2); and a site 18 km from the city of Larissa (LR-2). The PPC decided to replace the site near Larissa with one in Lakonia, just 2 km from Archagelos (LA-7), and the site in Ilia (PK-1) by a second Evoia site, 3.5 km north of Mandudi (EN-5).[61] The Karystos site became the focus of a prospective plant, and, as a result, of protests and demonstrations. For EBASCO, this was the most appropriate site.[62]

In its report EBASCO reassured that 'there are regions in Greece which are suitable and defensible for the siting of nuclear power plants'.[63] This resonated with members of the conservative government.[64] In their view, given there was adequate international experience with nuclear energy, and, also, that other Balkan countries were heading towards their own nuclear future, Greece had to follow the nuclear path in order to secure its geopolitical position and the satisfaction of its energy needs.[65] Several expert communities did not share the optimism of this view, while plans had already been undermined by reservations, tensions and opposition by civilians, particularly in Karystos. Political and ideological change as well as political activism and a lack of consensus among experts led to the abolition of plans for a nuclear reactor and the Greek nuclear programme altogether.

IN THE MIDST OF PUBLIC CONTESTATION, CONFRONTATION AND EARTHQUAKES: FROM POLITICS OF EXPERTISE TO NATIONAL POLITICS

Experts on their toes: debating plants and policies

The second half of the 1970s was a period of intense deliberation about the nuclear plant, with engineers and scientists from a variety of disciplines participating in public discussions. Professional and scientific associations, in their attempt to contribute to the broader discussion of the energy crisis following the 1972 oil crisis, organized workshops, seminars, conferences and other public events to publicly promote their position. The Technical Chamber of Greece, the Association of Greek Physicists, the Association of Greek Nuclear Scientists, the Greek Atomic Energy Commission and the Panhellenic Association of Biologists, were institutions and professional bodies that contributed to public debates. The arguments of critics contributed to a lack of enthusiasm for the nuclear plant while they gave crucial support to local protestations in Karystos.

The Technical Chamber of Greece did not reject the nuclear reactor in principle but pointed to the local conditions that would increase uncertainties and risks. To

start with, it insisted that Greece had done very little towards the exploitation of its hydraulic potential and that only 16 per cent of this potential had been used in an optimal way. In 1977 the Technical Chamber came to doubt that nuclear power would reduce energy costs and came to argue that any decision towards a nuclear future would further increase the technological dependence of Greece on American military and industrial interests. The official body of Greek engineers also brought up the uncertainties in managing nuclear waste or nuclear leakages in case of accidents and war conflicts, considering the geography and the geopolitics of the region and given the recent conflict with Turkey over Cyprus. The Chamber representatives argued that the projected cost would exceed the modest predictions of its supporters while, at the same time, a plant of 600 MW or 1,000 MW would be excessive and therefore most of the investment on it would remain in a latent state.[66]

The Technical Chamber wanted to have a stronger role in the making of energy policy and so it organized a key conference in 1977, entitled 'The Present Energy Problem of Greece'.[67] During a roundtable discussion entitled 'Hydrocarbons or Nuclear Power'[68] several scientific groups registered their opinions: the group of scientists 'Physics in the service of man'; the Technical Chamber's Permanent Committee on the Environment; the Union of Greek Nuclear Scientists; and representatives of PPC. The arguments advanced by the 'Physics in the service of man' group against the installation of a nuclear plant in Greece were based on international experiences regarding the economic and social risks from nuclear energy. In regards to the Greek case, the group mentioned a 1976 study that estimated the cost of the installation of a nuclear plant in Greece to be 30 per cent higher due to extra costs to transfer the technology and educate the necessary technical personnel. This cost could rise much higher if the plant was to be built underground. The group thought that this was necessary for a nuclear plant that was to be installed in a politically unstable region.[69]

The group's argument concerning the percentage of national energy to be supplied by a nuclear plant deserves special attention. It started by assuming that the capacity of a nuclear reactor could not be less than 1,000 MW, because international experience has shown that even a 600 MW reactor was economically unsustainable. Based on existing predictions, the group estimated that a nuclear reactor in the order of size required would cover 15 per cent of the overall estimated capacity of the Greek electricity system by 1985. This was understood as a very high percentage, which would incur major investments in reserve generating facilities for periods of regular or other maintenance.[70] This anti-nuclear group argued that countries that produced electricity from nuclear power relied far less than 15 per cent on nuclear power.[71] Quite naturally, the presentation of the 'Physics in the service of man' group started with an analysis of nuclear energy only to conclude by recommending research into alternative energy sources, which were described as especially appropriate for the Greek climate and geography.[72]

The seismicity of Greece was by then a key argument of the anti-nuclear camp. Foreign experience and standards argued in favour of building nuclear power stations away from urban centres. At the 1977 conference, the Technical Chamber's Permanent Committee on the Environment pointed out 'the difficulty to find in Greece an area that is non-seismic and is adequately distant from the urban centers'.[73]

Expressing well-established views within the Technical Chamber, the Committee reminded that in the event of an accident, radioactivity could spread easily and quickly into Greek urban centres. More specifically for the case of Karystos, a leakage would threaten more than a third of the Greek population because of its proximity to the country's sizable metropolis.[74]

The pro-nuclear plant groups used information and experiences from existing nuclear countries to show that the international comparison was in favour of a Greek nuclear plant. A leading actor in the pro-nuclear camp was the Union of Greek Nuclear Scientists, a scientific body comprising engineers, biologists, physicists, doctors and agriculture scientists that supported the use of nuclear power and promoted the establishment of the new plant. The Union wanted to play a role in shaping energy policy and especially in the decision-making process about the nuclear plant. It referred to a well-circulated international report – the Rasmussen Report – that listed the annual possibility of an accident to an individual: 1 per 4,000 for a car crash, 1 per 25,000 for a fire, 1 per 100,000 for an airplane fall, 1 per 2,000,000 for a lightning strike. The calculated possibility for a nuclear accident was identified to 1 per 5,000,000,000.[75] The Union sought to deconstruct the arguments from the anti-nuclear camp that stressed the possibility of illegal circulation of smuggled nuclear materials surrounded by nuclear neighbours, Greece could become a route for stolen nuclear materials for this camp.[76] The neighbouring countries as exemplary cases for energy policy were stressed by K. Kasapoglou, a representative of the PPC group. He noted that 'introducing a nuclear unit in Greece by 1986 would not be premature, because countries of the region that are richer than Greece or have comparable resources already have or would have nuclear plants by 1986: Yugoslavia, Bulgaria and Turkey'. Kasapoglou referred to a PPC study that showed that the Greek grid could remain stable and absorb a surplus of 7 per cent due to the integration of a nuclear plant. To him, this meant that a 600 MW plant could be safely integrated into the Greek network.[77]

In February 1978, the Union of Greek Nuclear Scientists organized a public discussion on nuclear reactors. Members of the Union in favour of the establishment of the nuclear reactor complained about the obscure and excessively cautious governmental procedures as well as about their own exclusion or marginalization from the decision-making process.[78] During this public discussion, the president of the Union, Chr. Markopoulos, proposed that the country's existing mineral sources should be surveyed and mapped to provide a basis for the organization and systematization of the energy policy. A new, supposedly more technologically advanced reactor was proposed, which would not necessitate additional expenditure for the enrichment process.[79]

In 1980 the Union organized a similar meeting of professional bodies, scientific groups and individual experts.[80] It was so overwhelmed by a pro-nuclear majority that it was accused of excluding anti-nuclear experts like the Union of Greek Physicists. Among the participants there was consensus that lignite and nuclear power would be the solutions for the energy requirements of Greece. While the establishment of the reactor was approved as the optimal energy solution, there was disagreement about the conditions or preconditions for its construction. The energy demands of the country, the type of the reactor, the role of the scientific and

technological human capital that existed in Greece and could assist in the construction of the technology, were all topics of interest for the speakers. Authoritative experts like M. Angelopoulos, the aforementioned Professor of Nuclear Physics and Technology at the National Technical University, presented the nuclear future of Greece as necessary. He saw technological dependence as an unavoidable side effect of the need to expand the energy mix of the country.

In the absence of the anti-nuclear groups, Kouloumbis, president of the Technical Chamber, appeared to be one of the more cautious and ambivalent participants. While he neither questioned nor criticized the establishment of the plant, Kouloumbis insisted that this should only be realized under specific conditions and within a strict legal and institutional setting. The Chamber president stressed the use of local engineering expertise rather than external American advice as a critical factor in avoiding the problem of technological dependency. This was a straightforward criticism of the practice of PPC and the Greek government, which relied on foreign expertise like that of EBASCO in order to identify locations and evaluate technologies for the plant. On this issue, A. Markopoulos, the president of the Union, argued that there was a lack of technologically oriented research and therefore a lack of experts with the credentials necessary for the planning and design of a nuclear reactor. He argued that this was a problem of leadership, both managerial and political, directing his criticism against those who headed the 'Democritos' Nuclear Research Centre and its projects. In his view, the Centre was dominated by a culture of strict separation between pure and applied science, giving emphasis and being successful on the first but completely neglecting the more applied or technological research that would make it possible for the state to base its policies on native expertise.[81]

This 1980 meeting took place in a highly critical period for nuclear energy, functioning as a key forum to attempt to reaffirm the need and the appropriateness of a nuclear plant. The accident at Three Mile Island had changed the attitude towards the plans for the nuclear plant. It had shaken certainties, bringing into the fore the uncertainties and vulnerabilities of nuclear power infrastructures, raising in the most prominent way the primacy of the issue of safety. In his public statements and analysis of the accident, Efstathios L. Bourodimos, Professor of Engineering at Rutgers University, argued that the accident on the other side of the Atlantic would be a starting point for changes in state policies. In his view, no expert would be able to design and plan a safe plant in a country as seismogenic as Greece. Small mechanical faults and failures could result in large-scale contamination and disaster. Instead of raising hopes and boosting further the nuclear 'hubris', a new moral, social and political contract was, for Bourodimos, necessary, particularly after the accident in the US. In his opinion this accident increased the evidence of the great risks involved in the operation of a nuclear plant.[82]

From local protests to national politics

While experts debated the nuclearity of Greece, local citizens' groups and ecological groups developed a more location-specific strategy. The late 1970s and early 1980s were the period of the emergence of a series of public reactions and protestations in

several areas in Greece, by locals who reacted to the environmental degradation of their regions through the establishment of environmentally harmful factories, petrochemical plants or fossil-fuelled power stations. The public discourses that emerged from the processes that resulted in the early environmental movements were characterized by a dominance of the local factor and an emphasis on the local context and environment. The people's struggle in Karystos is a case in point.[83] The information about EBASCO's search of appropriate locations for the nuclear power station triggered concerns by people that gradually transformed local protests to national politics. The 'noise' about the plan to install a nuclear plant in Karystos quickly became very loud. The thousands gathered at the central square of Karystos on 15 May 1977 included not only people from Evoia, but also elected parliamentarians from the whole of the political spectrum. In his talk, the Karystos mayor, Avg. Saravanos, argued that 'our country will come to depend on the country that will construct and sell to us the nuclear reactor'.[84] Several gatherings took place over the next four years. On Sunday 28 May 1978, the main speaker, the president of a club of Evoians living in Athens, sought to discredit the nuclear plant as a 'junta plan'.[85] The last Karystos meeting took place on Sunday 3 May 1981. The Karystians gathered at this meeting to protest the nuclear plants were 'holding black flags and did not stop ringing church bells'.[86] The Karystos mayor, Dimitris Chatzinikolis, gave the main speech. He asked for a formal government confirmation that the nuclear plant would not be built. Mayors from other Evoia towns and from the Cycladic island of Naxos were there to support him.[87] Representatives from the conservative party, the main opposition party (by then that of Papandreou) and the rest of the political parties were also there.[88]

While few were as determined against the nuclear plant as Mayor Chatzinikolis and his fellow Karystians, there were even fewer who were determined to support it. The pro-Soviet communist party was not against nuclear energy in general. Several *Rizospastis* (the party's newspaper) articles of the period between 1976 and 1977 supported the Evoia protests but also stated that the party would support nuclear energy development following the Soviet model. This was not the model to be followed in the case of the Karystos plant, so this party could not defend it. The pro-Soviet communist party was against the construction of the technology by private interests and private companies. For this party, the construction of the reactor by private companies would increase the risk of the technology. This was framed as a major defect. On the other hand, the communist party claimed that reactors of Soviet design and construction were technologically, morally and politically appropriate, representing a riskless technology.[89]

The pro-Western communist party, which was smaller than the pro-Soviet one but enjoyed recognizable appeal among intellectuals and the engineering and scientific communities, was against nuclear energy more generally. Several of its members were pioneers in the pursuit of the substitution of the choice between alternative energy sources and nuclear energy for the choice between Western and Eastern nuclear reactors. The members of the populist socialist party of Papandreou were not explicitly against the nuclear plant but neither were they eager to support it. The situation changed drastically after a 6.7 Richter scale earthquake hit the Greek capital on 24 February 1981, with an epicentre near the Halcyon islands, 77 km away from

Athens, about the same distance to the west of the capital as Karystos was to the east. Despite the earthquake, the conservative government tried to keep a strong and robust political stance in support of the nuclear plant. Against the concerns raised with the earthquake, the conservative Minister of Industry and Energy, Stephanos Manos, argued a month later that 'despite the earthquake, the nuclear production unit of 600 MW will be constructed by the PPC'.[90] He insisted that since the buildings in the metropolis remained untouched by this strong earthquake, it would be difficult to support any argument for the vulnerability of the prospective power station. This was a view that had the support of the EBASCO company in Greece.[91]

Primed by the compound effect of the Karystos protests and anti-nuclear arguments like the ones heard at the 1977 TCG conference, Greek society quickly moved on to abort plans for a nuclear plant.[92] The conservative government came under massive fire from the leaders of the opposition parties, who took the parliament floor one after the other to argue that the state had been proven totally incapable of preparing for a strong earthquake hit. 'Fifty per cent of Europe's seismic energy is released in Greece,' noted Papandreou before moving on to ask for the resignation of the government. The chaotic conditions prevailing in Greece after the earthquake were an issue that presented the opposition leader with an opportunity to gather additional support for his own political agenda. A few months before an election that would give him a commanding electoral victory, Papandreou seized the opportunity to eliminate from this agenda an issue that could undermine him in the same way that it had undermined the conservative government. On 14 March 1981, just a few months before his party's victory in the national elections, Papandreou argued in a parliamentary speech:

> There is another issue that we want to state our position on. Our country is seismogenic. Dangerously so. This is why the construction of nuclear reactors is not a desirable path for our country. The reactor is not the only issue. The waste is also an issue. Where in Greece should we place the nuclear plant? I challenge for an answer . . . In any case, I believe that we should all agree on the following position: No to the nuclear reactors. No to the nuclear plant.[93]

In the autumn of 1981 Papandreou won the elections. A thermonuclear unit of 600 MW appeared in the PPC plans up until the 1981–1985–1990 programme, which was announced on August of 1981. Starting with the following programme (1983–1987–1992), which was announced in September 1982, there would be no thermonuclear unit in the PPC programmes.[94]

CONCLUSIONS

In this article, we have introduced the unrealized plans for a nuclear power plant in Greece. We have unravelled the phases of an incomplete transition and of a failed project as processes that were politically, ideologically and culturally embedded.[95] The Greek nuclear programme passed through several stages, from its visionary conceptualization to its political deconstruction. During these different stages, Greece's nuclearity was co-constructed with political power and the ideological priorities of the governments and the Greek state. The Greek 'nuclear exceptionalism'

was embedded in the political and social context of the Cold War in the South-East Mediterranean. For both the conservative and the centrist governments of the 1960s the integration of nuclear power in the energy mix of the country was conceived as an issue of energy economics. The colonels' regime sought to integrate the nuclear plant into its energy agenda, attempting to denote autarky as a national duty and as way for the country to find its place and position in the geopolitical arena of the South-East Mediterranean. Nationalism was fused with the grandiose nuclear visions of a political regime that wanted to invest in energy sufficiency and energy supply at low cost.

In the second half of the 1970s, conservative Prime Minister Karamanlis brought into his agenda the nuclear option in order to respond to the energy crises of 1973 and 1979 but also in order to integrate Greece into the European Community. The political priorities of the populist socialist party that succeeded the conservatives in the government, the increasing concern by expert scientists and engineers about the dangerous character of nuclear power generation, local protests and, more importantly, a strong earthquake, framed nuclear power generation as dangerous.

In the 1960s the arguments about autarky and sovereignty were enriched by a technocratic deterministic vision that linked large-scale technologies with 'progress' and growth. This was also the case in several other countries in Cold War Europe, including Denmark, France and the UK. In France and the UK military purposes strongly influenced policies, aspirations and discourses.[96] In Greece there were engineers and scientists who prioritized and directed public policy towards a nuclear future within a technological discourse that constructed and represented nuclear energy as a possible and, for some, optimal option for the energy autarky of the country. Greek and foreign experts framed the establishment of a nuclear reactor as an energy-related problem. Based on this, their public discourses, arguments and reasoning stressed the economics of nuclear plants and their integration into the electricity system and the energy regime. In the 1960s and 1970s any public or quasi-public contestation was related to the economics and the politics of nuclear power rather than the risks involved. Concerns about the environment and the concept of the nuclear power plant as a highly risky technology for nature and human alike started to emerge in public discourses in the late 1970s, both as part of a cautionary engineering rationale and as an integral component of political activism against the prospects of the establishment of a plant. Citizen arguments and protests – particularly those from Karystos who were the most energetic – were effective in shaping the public representation of nuclear power as uncertain, risky and dangerous.

While political activism was far from being the sole reason for the cancellation of the plans, it framed the problem in ways that encouraged a large part of society to politically delegitimize nuclear power generation as a possible solution to Greece's energy problem. The cancellation of the project to construct a nuclear power plant in Karystos and, in effect, the cancellation of a nuclear programme of any kind in Greece, took place in a period of restructuring the country's energy mix. It also overlapped with the construction of large-scale lignite plants and the introduction of electrical interconnections with the neighbouring countries to the north, and,

through transnational networks, with the rest of Europe. The irony is that despite the delegitimization of the plan for a nuclear power plant, Greece indirectly became a nuclear country, since critical incoming flows of electricity were secured from nuclear power plants in Bulgaria.

The story of the cancelled nuclear reactor in Greece has striking similarities and differences with the Danish nuclear programme. In Denmark, the environmental movement and continuous social opposition to the project, along with the gradual positioning of the Danish Social Democrats against nuclear energy, created a strong coalition that resulted in the complete disappearance of the nuclear programme from any energy planning since the mid-1980s. Yet, Denmark set policies that boosted further its tradition in the use of renewable energy sources, most importantly wind energy, while Greece's policies carved a different energy pathway, one that was dominated by the extraction and burning of lignite.[97]

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69. See *Τεχνικά Χρονικά*, Μάρτιος-Απρίλιος 1978, 261–298. It included the following: Κίνηση Φυσικών, 'Η Φυσική για τον άνθρωπο', 'Πυρηνικοί Αντιδραστήρες Ισχύος στην Ελλάδα', *Τεχνικά Χρονικά*, Μάρτιος-Απρίλιος 1978, 261–268, and, Μόνιμη Επιτροπή Περιβάλλοντος του ΤΕΕ, 'Αντιδραστήρες και Περιβάλλον' *Τεχνικά Χρονικά*, Μάρτιος-Απρίλιος 1978, 268–278. For information on other forums of scientific and engineering debates over the plans for a nuclear plant, see Μάριος Νικολινάκος, *Έκθεση Πάνω στο Ενεργειακό Πρόβλημα: Συμπεράσματα και Προτάσεις από το Ενεργειακό Συνέδριο του Τ.Ε.Ε. που διογρανώθηκε τον Μάη του 1977*, Τεχνικό Επιμελητήριο της Ελλάδας, (Αθήνα, 25 Απριλίου 1978), see especially 55–67.
70. Κίνηση Φυσικών, 'Η Φυσική για τον άνθρωπο', 'Πυρηνικοί Αντιδραστήρες Ισχύος στην Ελλάδα', *Τεχνικά Χρονικά*, Μάρτιος-Απρίλιος 1978, 264.
71. *Τεχνικά Χρονικά*, Μάρτιος-Απρίλιος 1978, 261–298, here quoting from page 288.
72. Κίνηση Φυσικών, 'Η Φυσική για τον άνθρωπο', 'Πυρηνικοί Αντιδραστήρες Ισχύος στην Ελλάδα', 265.
73. Φυσικών, 'Η Φυσική για τον άνθρωπο', 'Πυρηνικοί Αντιδραστήρες Ισχύος στην Ελλάδα', 277.
74. Φυσικών, 'Η Φυσική για τον άνθρωπο', 'Πυρηνικοί Αντιδραστήρες Ισχύος στην Ελλάδα', 277.
75. *Τεχνικά Χρονικά*, Μάρτιος-Απρίλιος 1978, 261–298, quoting from page 289; On the Rasmussen Report, a standard reference in debates over the risks of nuclear energy, see a Greek translation of it: Ερωτόκριτος Τσίγκας, 'Μελέτη της ασφάλειας των πυρηνικών αντιδραστήρων', *Επιστημονικό Δελτίο Δ.Ε.Η.*, Τεύχος 25, Ιούνιος 1980, 29–41.
76. *Τεχνικά Χρονικά*, Μάρτιος-Απρίλιος 1978, 261–298, quoting from page 289.
77. *Τεχνικά Χρονικά*, Μάρτιος-Απρίλιος 1978, 293.
78. *Βήμα*, 7 Αυγούστου 1979.
79. Πρακτικά Δημόσιας Συζήτησης, Ένωση Ελλήνων Πυρηνικών Επιστημόνων, Φεβρουάριος 1978, Αθήνα, 443–450.
80. The group of attendees included leading figures of the engineering and scientific community like: R. Moses, president of the PPC, M. Angelopoulos, Professor of Nuclear Technology in NTUA, E. Kouloumpis, president of the TCG, K. Ntokas, president of the Greek Association of Atomic Science, P. Orfanidis, president of the National Energy Board.
81. ΒΗΜΑ, 16 Μαρτίου 1980, 6.
82. Ε.Λ. Μπουροδημος, 'Ο εφιάλτης του Χαρρισμπουργκ και το ελληνικό πρόβλημα', *Καθημερινή*, 31 Μαΐου 1979.
83. Σ. Αλεξανδρόπουλος, Ν. Σερντεδάκις and Ι. Μποτετσάγιας, 'Το ελληνικό περιβαλλοντικό κίνημα', *Ελληνική Επιθεώρηση Πολιτικής Επιστήμης*, 30 (2007), 5–31; S. Alexandropoulos and N. Serdedakis, '*Greek Environmentalism: From the Status Nascenti of a Movement to its Integration'*, ECRP Workshop on Environmental Organizations, Copenhagen, April 2000, 13–14; M. Kousis, 'Local Environmental Protest in Greece, 1974-1994: Exploring the Political Dimension', *Environmental Politics*, 16(5) (2007), 785–804; M. A. Boudourides and D. Kalamaras,

'Environmental Organizations in Greece', STAGE Thematic Network, Gothenburg Workshop, October 24–26, 2002.

84. 'Όχι στο πυρηνικό εργοστάσιο', *Ριζοσπάστης*, 17 Μαΐου 1977, 6.
85. 'Όχι πυρηνικό εργοστάσιο στην Κάρυστο', *Ριζοσπάστης*, 30 Μαΐου 1978, 2.
86. 'Παγώνει η σύμβαση για το πυρηνικό εργοστάσιο ηλεκτροπαραγωγής', *Μακεδονία*, 23 Μαΐου 1981, 3.
87. 'Διαμαρτυρία στην Κάρυστο για το πυρηνικό εργοστάσιο', *Μακεδονία*, 5 Μαΐου 1981, 3. According to a web posting by Charis Karanikas, Mayor Chatzinikolis and a group of Karystians that included some municipality workers visited the EBASCO people on-site and threatened to burn their equipment. They were holding gasoline containers, which made them look rather convincing. The EBASCO people had to leave the site. To protect the main EBASCO equipment, they moved it right outside the Karystos police department. It had to stay there for a few days. A group of Karystians had also chased the EBASCO people two years earlier, in April of 1978. See http://indy.gr/other-press/pali-dimosieyma-gia-pyrinika-ergostasia [accessed 27 September 2009].
88. 'Συγκέντρωση ενάντια στην εγκατάσταση πυρηνικού εργοστασίου στην Κάρυστο', *Ριζοσπάστης*, 5 Μαΐου 1981, 7.
89. 'Το θέμα της εγκατάστασης πυρηνικού αντιδραστήρα στην Κάρυστο, έφερε στη Βουλή το ΚΚΕ', *Ριζοσπάστης*, 18 Μαΐου 1977.
90. 'Δήλωση Μάνου: Ολοταχώς για πυρηνικές μονάδες', *Ελευθεροτυπία*, 13 Μαρτίου 1981.
91. Γ. Παπανικολάου, 'Προχωρούν οι μελέτες για την εγκατάσταση πυρηνικών μονάδων: Συνέντευξη του διευθυντή της ΕΜΠΑΣΚΟ ΔΡ. Ιωάννη Κωστόπουλο',*Οικονομικός Ταχυδρόμος*, 26 Μαρτίου 1981.
92. The earthquake had exposed the vulnerability of the country's existing infrastructure. For an engineering report written by an international team that included an EBASCO employee, see Panayotis G. Karydis, Norman R. Tilford, Gregg E. Brandow and James O. Jirsa, *The Central Greece Earthquakes of February–March 1981: A Reconnaissance and Engineering Report*, National Academy Press, Washington, DC, 1982.
93. 'Η Βουλή για τα μέτρα μετά τους σεισμούς', *Μακεδονία*, 14 Μαρτίου 1981, 6.
94. On the place of the first (1968–1972) and last (1981–1990) PPC programmes to include plans for nuclear plans in the history of the PPC, see Τσοτσορός, ~~*Ενέργειακαι Ανάπτυξηση*~~ *Μεταπολεμική Περίοδο*, 95 and 102 respectively.
95. Trevor Pinch, 'Understanding Technology: Some Possible Implications of Work in Sociology of Science', in *Technology and Social Process*, Brian Elliot (ed.), (Edinburgh, 1988), 75–76; David Noble, *Forces of Production: A Social History of Industrial Automation* (New York, 1984).
96. Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity After World War II* (Cambridge, MA: MIT Press, 1998); E. Rough, 'Policy Learning through Public Inquiries? The Case of UK Nuclear Energy Policy 1955–61', *Environment and Planning C: Government and Policy*, 29 (2011), 24–45; I. Welsh

and B. Wynne, 'Science, Scientism and Imaginaries of Publics in the UK: Passive Objects, Incipient Threats', *Science as Culture* 22 (2013), 540–566; Henry Nielsen, Keld Nielsen, Flemming Petersen and Hans Siggaard, 'Risø and the Attempts to Introduce Nuclear Power into Denmark', *Centaurus* 41 (1–2) (1999), 64–92.

97. Sezin Topçu, 'Confronting Nuclear Risks: Counter Expertise as Politics Within the French Nuclear Debate', *Nature and Culture*, 3 (3) (2008), 225–245; Nielsen et al., 'Risø and the Attempts to Introduce Nuclear Power into Denmark', 64–92; Kristian Nielsen and Matthias Heymann, 'Winds of Change: Communication and Wind Power Technology Development in Denmark and Germany from 1973 to ca. 1985', *Engineering Studies*, 4 (1) (2012), 11–31; Kristian Nielsen, 'Technological Trajectories in the Making: Two Case Studies from the Contemporary History of Wind Power', *Centaurus* 52 (3) (2010), 175–205; Matthias Heymann, 'Signs of Hubris. The Shaping of Wind Technology Styles in Germany, Denmark, and the USA, 1940–1990', *Technology and Culture*, 39 (4) (1998), 641–670.