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Nuclear Energy Futures: the Appropriation of the "Atomic Age" in post-war Austria

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1 Introduction

"Federal Chancellor Werner Faymann (SPÖ) and Vice–Chancellor Reinhold Mitterlehner (ÖVP) are 'not willing to accept the decision to grant subventions for nuclear power. In accordance with our announcement we will prepare and take legal actions at the European Court of Justice.'" (08/10/2014)[1]

When the Commission of the European Union approved of granting subventions for the planned European Pressurized Reactor Hinkley Point C, UK in October 2014 by a majority of 16 (opposed to 5) votes, reactions in Austria followed a well practised routine. The federal government gratefully took the chance to demonstrate unity in the light of "foreign folly", the Green party pledged its support, while the FPÖ demanded Austria to leave the EURATOM treaty in order to serve anti–EU sentiments (ibid.)

Obviously, mobilizing national identity and the nation state in the context of the nuclear is understood as a chance by almost everyone in Austria. No matter what position one takes on other topics, issues and problems, the nuclear seems to unite a large majority of people who perceive themselves as Austrians. Hence questioning such positions is to be understood as a necessary form of criticizing nationalism that articulates through the nuclear. While Austria has a long history of nuclear research and nuclear energy programs itself, a dominant anti–nuclear position was stabilized after the struggle over the non–commissioning of the already completed nuclear power plant at Zwentendorf (1978), in the context of the Chernobyl reactor explosion and its aftermath (1986). Ever since "being anti–nuclear" stabilized in terms of a sociotechnical imaginary of keeping certain technologies out of Austrian territory. This imaginary of being able to resist to the deployment of certain technological innovations, was regularly rehearsed from the 1980s until today, using any single occasion (e.g. Fukushima) to reformulate and thus to memorize Austria's position on that matter. The nuclear experience of rejection was then taken up in similar ways in the GMO debates, thus building the ground in developing a robust Austrian anti-GMO position (Felt, 2015a). As a result of this imaginary Austria's history with the nuclear is usually only referred to in the context of the nuclear controversy. The phase of nuclear enthusiasm that was also very present and effective in Austria is usually left aside or portrayed as an irrational "back in the days"–position, that was fortunately overcome by public reason. In other words a narrative of public learning is created, a narrative which implies that public protest led to the correction of Austrian nuclear policy, a policy that was crafted under false pretences in the "atomic age".

To challenge such views of Austria's nuclear history in the context of the anti–nuclear imaginary I will trace the nuclear in Austria in the 1950s — the heydays of nuclear enthusiasm after World War II —, namely between US President Eisenhower's *Atoms for Peace*

[1] DerStandard.at, Österreich will gegen britisches AKW klagen, 08.10.2014, 17:17. http://derstandard.at/2000006572568/Gruenes-Licht-aus-Bruessel-fuer-Staatsgeld-fuer-britisches-AKW, last visited: 25.02.2015.

address in front of the UN General Assembly in late 1953 and Austria's participation at the UN Conference on the Peaceful Uses of Atomic Energy in Geneva in 1955 and its immediate aftermath. My analysis focuses on how the nuclear was imagined in Austria in this phase, how "being pro–nuclear" was entangled with being Austrian, and how the future was imagined to be essentially nuclear. As a result of the current anti–nuclear imaginary aspects of nuclear prowess, hopes and expectations have been of less interest in scholarship across various fields so far. By investigating the sociotechnical imaginary that the nuclear was part of in the immediate post–war era in Austria, I aim to further our understanding of how technologies are institutionalized and made sense of in specific societal contexts. In doing so this investigation also contributes to comprehending the fundamental shift in dealing with the nuclear, that took place in the second half of the 20^{th} century in the Austrian context. Understanding how societies deal with the nuclear provides an excellent starting point for questioning black–boxed and naturalized assumptions with regard to the nuclear and beyond.

Unveiling the entanglements of the nuclear and nationhood in Austria in the phase of nuclear enthusiasm is of special interest because of the dominance of the anti–nuclear imaginary today. In dealing with the nuclear a certain need to imagine and mobilize national collectivity seems to be served. Debates and struggles around nuclear research and nuclear technologies allow for the imagination and mobilization of the national collective, and within this process they allow to cover up societal contradictions and antagonisms. Throughout my analysis it will become clear how nationhood is mutually brought into existence and naturalized in dealing with nuclear technologies. Consequently, we will see that even though the dominant nuclear position in Austria was completely reversed, several mechanisms and forms of how the Austrian society was and is dealing with the technology in question have been preserved: Most prominently these are singling out technologies and tying them to national fate as well as conceptualizing technological development in the form of trajectories.

An analytical perspective stressing these aspects not only allows for the deconstruction of ideological narratives of public learning and reason as mentioned above, it also directs our attention towards the fact that the mobilization of national collectivity needs constant rehearsal. In the light of societal contradictions, which are continuously produced, reproduced and also reinforced (e.g. by economic crises), dealing with the nuclear in the observed ways seems to serve as a cover up and to stabilize power structures. The recent protests against Hinkley Point C by Austrian politicians is only the latest of a long list of examples to illustrate this aspect. While the Austrian Green party contests the nuclear with regard to sustainable energy production, the FPÖ is using the nuclear to further anti–EU positions (something that other parties usually at least play with as well). What they have in common is that they are dealt with in the form of a sociotechnical imaginary that is deeply entangled with nationhood. Mobilizing the anti–nuclear imaginary goes hand in hand with black–boxing and naturalizing nationalism and other sociotechnical orders.

As a result the continuous rehearsal of the anti–nuclear imaginary reinforces nationalist sentiments and naturalizes the idea of a national collective. Rather than attracting our attention to the ways in which nuclear energy production relates to modern forms of social organisation, rather than questioning what sociotechnical dynamics drive the institutionalization of this large scale technological system, the entanglement of sociotechnical imaginaries and nationhood seems to fatally unite actors in national harmony.

Throughout the next section I review existing historical research, scholarship in Science and Technology Studies and inquiries in Science and Technology Policy in order to build the grounds for analyzing nuclear enthusiasm in the immediate post–war era in Austria. In section 3 the overall question of how hopes, promises and expectations towards the "atomic age" were perceived and shaped throughout this period is operationalized for analysis. Following the central assumptions of Hård and Jamison (2005) I draw upon the concepts of technopolitical cultures (Felt, Fochler, & Winkler, 2010) and sociotechnical imaginaries (Jasanoff & Kim, 2009; Felt, 2015a) in section 4 in order to account for the coproduction of social and technical orders, focussing on the entanglement of aspects of nationhood and science and technology. In doing so I will also discuss temporal aspects, the mobilization of *the future* as a central resource and form of imagination, before these conceptual considerations are followed by an outline of the adopted methodologies based on the framework of situational analysis (section 5). On these grounds I investigate archival records of the Austrian Commission on Atomic Energy accompanied with a variety of materials, documenting Austrian nuclear enthusiasm in the mid 1950s in section 6. Throughout section 7 the presented development is scrutinized in detail, focussing on aspects of technopolitical culture, the coproduction of nationhood, national identity and science and technology as well as different practices of mobilizing and imagining the future in dealing with the nuclear. This analysis enables me to reflect upon the composition of the sociotechnical imaginary around the nuclear in the immediate post–war era in Austria, demonstrating how the nuclear was increasingly imagined in reference to power production, related to Austrian hydro power installations, the reconstruction effort and a more broader innovation trajectory in general (section 8). Finally, the confrontation of the ways in which Austrian society made sense of the nuclear in the 1950s and the anti–nuclear imaginary of today allows for returning to a more general discussion on the entanglement of science, technology and society with regard to the imagination of nationhood and the mobilization of imagined futures.

2 State of the art

I will start by drawing together scholarship in the field of Nuclear History, History of Science and Science and Technology Studies. Historical scholarship provides an excellent starting point, because history on nuclear matters in general as well as works on the history of science have scrutinized the relations between nuclear research and development and the social for a long time. Beyond the history of the super powers' engagement with nuclear weapons and the development of nuclear energy, the role of the nuclear in countries "on the nuclear periphery" has been investigated recently.

However what appears to be missing — beyond a few examples — are accounts on distinct national styles, when it comes to imaginations revolving around the nuclear. While national nuclear programs and developments have been under scrutiny, the imaginations of nuclear technologies as innovative, promising and new have hardly been questioned in relation to their specific socio–political setting. Hence I draw upon scholarship in Science and Technology Studies to bring in this perspective, while I also connect to works from STS scholars investigating science and technology policy, to question the role of the future orientation of such imaginations in this regard.

2.1 Nuclear History and the history of nuclear imagery

It was throughout the last phase of the Cold War, when the first full scale history of the Manhattan project was published. Richard Rhodes (1988) provided his classic study on the history of nuclear weapons, which is still an excellent starting point for investigating nuclear history: Among other things Rhodes was tracing the origins of *the bomb* and delivered an exceptional overview on the history of nuclear physics from the late 19^{th} century up to the end of World War II. Rhodes' study clearly showed that the production of electricity by utilizing nuclear energy was closely entangled with the development of nuclear weapons in the first place. The first self sustaining chain reaction in Enrico Fermi's Chicago Pile in 1942, was only one of many steps to be taken on the road to the end of the war in the pacific. Only a few years later David Holloway (1996/1994) published a study on a similar scale on the Soviet nuclear program. In a very different setting and under different circumstances, the Soviet Union cultivated its own nuclear industry, also performing an artificial distinction between the peaceful uses of atomic energy and nuclear armament.

Throughout the second half of the 20^{th} century it had become quite clear that the distinction between two kinds of nuclear energy is artificial, mostly a rhetorical tool used in different contexts to further different interests. Beyond that the production of nuclear energy had lost its glorious claim of a future without scarcity. In the 1970s and 1980s anti-nuclear movements and environmental activism started to challenge nuclear technologies. Now the question, whether the production of nuclear energy would have a future arose (Morone & Woodhouse, 1989). In retrospect nuclear protest and questioning the future of nuclear energy seem to have been characteristic aspects of the late Cold War era throughout

Western countries, or at least a wide-spread phenomenon (Kolb, 2007). Since the end of the Cold War nuclear energy production experienced a revival, e.g. in dealing with the global challenges of climate change. A more recent depiction of nuclear history (Cooke, 2011) shows that the problems, difficulties and dangers are well known all over the world. However, the glorious promises of nuclear energy still seem to be effective and in operation in various forms and contexts. The voices calling for a ban of nuclear power are again followed by claims relying on the earlier promises of the "atomic age". An overview of contemporary visions and promises with regard to small modular reactors (SMR) was provided by Sovacool and Ramana (2014).

Recently reedited, Spencer R. Weart (2012/1988) has been tracing the origins of the glorious as well as frightening imagery around nuclear technologies. This kind of imagery was present long before the construction of nuclear weapons and reactors. It was present from the very beginning, when Frederick Soddy and Ernest Rutherford were working on the puzzles and riddles around radioactivity. These images were also present when Marie Curie discovered radium, not only a new metal, but more importantly a radiation emitter far more potent than uranium and thorium. Not only was this new field of research associated with alchemy — *transmutation* — from early on, it was also closely associated with energy. As Weart argues, early nuclear scientists soon realized that radioactivity transformed matter into a *"storehouse of energy"*. Against this backdrop Frederick Soddy coined one of the most famous examples to describe the enormous powers of atomic energy: *"a pint bottle of uranium contained enough energy to drive an ocean liner from London to Siydney and back!"* (ibid. p. 4). Furthermore electricity became increasingly equated with civilization and progress. In 1893 the Chicago International Exhibition included the so called *White City*, the materialization of the imagined perfect city of the time, which offered nightly illumination by newly developed electric lamps. By the time the energies of the atom started to carve out their imagery in the first half of the 20$^{\text{th}}$ century, the *White City* and its popularity was *"well positioned to become the first symbol associated with the energy of the atom.* [...] *After all, modern civilization was founded on energy"* (ibid. pp. 4–5). According to Weart the warnings that fossil fuels might run out originate in the late 19$^{\text{th}}$ century as well and speculations on solving the issue by developing solar energy had already started. Taking these forerunners in making energy futures into account, it seems everything but arbitrary that the futures imagined with the increasing knowledge in the field of nuclear physics became about nuclear energy. After all, these images had been penetrating the industrialized world at an enormous pace. When newspapers and magazines referred to the ocean liner metaphor in the 1920s, it was nothing more than *"repeating a tired cliché known to schoolchildren around the world"* (ibid. pp. 5–6).

Besides this emergence of nuclear hopes the development of nuclear research also came along with nuclear fears. Quite similar to what is explained above with regard to nuclear hopes, the fear of mutations and sickness caused by radiation fell on the fruitful grounds of multiple forerunners. After World War II the words *nuclear* and *atomic* were mostly

equated with *the bomb*. On the one hand the atomic bomb was a symbol of power and prowess, on the other hand *the bomb* meant shivering and consternation because of the horrors it caused. With the Cold War evolving and the nuclear monopoly of the United States disappearing, fear and awareness of nuclear destruction evolved as well (Stölken-Fitschen, 1993). When the Eisenhower administration decided to implement the so called *New Look* doctrine, a national defence policy based on the threat of *massive retaliation* with (mostly airborne) nuclear weapons, there was a need for a large scale concerted framing action. Martin Medhurst (1997) highlighted that these are the origins of the *Atoms for Peace* program. His analysis of *Atoms for Peace* superseded earlier views, which rationalized the program either as a plan for nuclear disarmament or mere propaganda. As Medhurst has shown, *Atoms for Peace* had four deeply entangled dimensions, which not only completed each other, but co–evolved. One central aspect was *"to 'take the curse off the atom' by presenting atomic energy as a boon to humankind"*, while the biggest buildup in nuclear weaponry in history was undertaken. Economically the campaign was designed to strengthen the buildup of the US nuclear industry and to open and secure global markets in the field. On a diplomatic level *Atoms for Peace* was supposed to build trust, while the psychological dimension was to portray the United States as a peaceful nation helping the rest of the world to develop (ibid. pp. 575–576). It was again Weart (2012/1988, pp. 82–84) who connected the dots with regard to nuclear imagery. Not only in the United States but even more drastically in Europe, World War II had shown that scarcity in energy could not only fully immobilize armed forces, it also was attached to hunger, cold winters and immobility after the war. While good hydroelectric sites for energy production were already used in most countries, the cheap sites for mining coal were becoming scarce and oil was mostly imported anyways. As Weart puts it: *"Atomic scientists of every nation promised to solve the problem with nuclear power"* (ibid. p. 82). In this context *Atoms for Peace* did not only fall on fruitful grounds, one might easily say that it exceeded expectations and generated research and investment in all fields evolving around the term *nuclear*, while transatlantic cooperation was strengthened. Over 40 countries signed contracts with the United States, many bought research reactors or participated in the exchange of uranium or thorium (ibid.).

Regarding the bigger picture of transatlantic scientific cooperation the works of John Krige (2006a) are unquestionably a point of reference. Investigating the history of science and technology in the United States and Europe after World War II, Krige carved out how the reconstruction effort in European science was a process of coproducing American hegemony. In the context of the emerging Cold War the United States of America were the dominant superpower, an empire which was able to exert power over the rest of the world, able to shape the international structure along its interests. This dominance was not exerted in terms of grabbing land and exerting direct power, though. At times in a covert process, at times so subtle that it could hardly be noticed and at times so overt that one could not help but acknowledge that we are talking about nothing other than the imposition

of order by the dominant actor, the United States shaped European sciences. However, Krige speaks of coproduction (see section 2.2), because on the European end, there was ample room for contribution, decision making, active participation as well as rejection. As Krige points out, the coproduction of hegemony was based on the cooperation with local European elites. As long as the US could find a stable partner to foster its interests, this has to be understood in terms of a contribution in the process of coproducing hegemony. The first institutional setting for this coproduction was the Marshall Plan. As Krige points out, US scientists and politicians understood financial support for basic science through the framework of the European Recovery Program as a central element to stabilize European nations and to integrate countries into the Western block (ibid. pp. 30–39). European scientists and political elites on the other hand understood this as a chance to close the gap. Throughout the 1930s and especially throughout World War II the United States of America experienced an enormous progress in (economic) development *based on* as well as *in* science and technology. The support offered by the US satisfied the urge of European scientists to catch up, close the gap and recover in order to be able to participate and compete again (ibid. p. 13).

Atoms for Peace served several purposes in the context of the *New Look* doctrine, among which the economic dimension was a central element. Not only was the reconstruction of European science important to strengthen European economies — in the sense of Vannevar Bush's *Science the endless frontier* – the field of nuclear research can be seen as an exemplary case of the coproduction of hegemony. As Krige pointed out on another occasion (Krige, 2006b) the United States switched to a model of open scientific cooperation, once the monopoly of nuclear weapons was lost. From their dominant position in international and economic relations, they institutionalized transatlantic cooperation in nuclear research. This way, they also made sure that the US would be dominant in the field of nuclear industry, while they could profit from nuclear science in a quite open, non–restricted context. In Krige's words *"the advantage to the United States of access to science produced abroad cannot be overestimated"* (Krige, 2006a, p. 11), because US nuclear science was almost completely restricted for security reasons. On this constitutive character of security for US science after World War II see also Jessica Wang (1999). In Europe scientists were eager to cooperate with the United States. Among the many reasons the material dimension cannot be overseen: Like in other fields *Atoms for Peace* included *"political support and scientific legitimation, supplemented by money for grants, fellowships, and training programs"* (Krige, 2006a, p. 10) as instruments to establish this cooperation.

How these dimensions meshed into each other in the Austrian context can be exemplified by existing research on Austrian nuclear history. Reiter and Schurawitzki (2005) scrutinized the history of Austrian physics in Vienna with a focus on political shifts and continuities in 1938 and 1945. After World War II the situation regarding staff and financial support was perceived as completely insufficient in Austrian physics. The demand for people led to a comeback of only a few of those, who had been forced out of their positions between 1934

and 1945, such as Hans Thirring and Erwin Schrödinger (who came back to Vienna on an extra–professorship in 1956). Mostly the need for trained academic staff led to the silent and slow rehabilitation of those, who had lost their positions because of denazification, e.g. Georg Stetter, who became head of the first physics department of the University of Vienna in 1952, or Gustav Ortner, who was brought back from Kairo by Berta Karlik, to play a central role in the construction of the first Austrian research reactor.

In his history of Austrian nuclear programs Christian Forstner (2012, p. 165) argues that the institutionalization of nuclear research in form of a coordinated program needed an external stimulus to transform initial ideas into actual possibilities. Forstner shows that this stimulus and the necessary possibilities were provided by *Atoms for Peace*. In order to understand the perception of Austrian physicists, with regard to the idea of catching up, closing the gap or lagging behind, one has to consider the dominant position of Austrian nuclear scientists at the beginning of the 20^{th} century. Throughout the 1910s and 1920s, Vienna was one of only a few global centers for the study of what was emerging as nuclear physics. A position that could not be maintained in the following two decades (Fengler, 2014).

In the realm of international relations Oliver Rathkolb (1997) demonstrated the central role of *Atoms for Peace* in the relationship between Austria and the United States. While the negotiations on the Austrian State Treaty were still ongoing, scientific cooperation served as a playing field to strengthen the ties between Austria and the US, although the Soviet Union demanded Austria to become a neutral country. Right after the Austrian State Treaty was signed, Austria signed a contract on nuclear cooperation with the United States, which was the first of many steps to clearly integrate the Austrian nation into the Western block.

Going back to the level of imaginations towards the nuclear, Helmut Lackner (2000) was the first to hint towards the central role of the vision of *nuclear energy* in Austria after World War II. In terms of a *Leitbild der Moderne* (a model of modernity) Lackner conceptualized the idea of economic progress being attached to an increase in energy consumption, which would in the end lead to bursting limited energy sources by the utilization of nuclear energy. Building on Lackner's work Andreas Kuchler (2012) speaks of the *"arrival of the atomic age in Austria"* [tranlation, FB]. This arrival was characterized by the competition with the production of electricity by hydro power, which was also framed as a central aspect of an independent Austria. Alexander von Schwerin (2012) highlighted that this vision of nuclear energy was accompanied by an equally important one, based on the future and contemporary use of radioactive isotopes. In investigating the establishment of research and trade with isotopes in Austria after World War II, he demonstrates that the vision of a nuclear future, was everything but narrowed down and confined to the production of nuclear energy in the 1950s.

2.2 Nuclear science–technology–society relationships

A systematic integration of the institutional dimensions carved out by Krige and the symbolic level exemplified above was provided by Hård and Jamison (2005) in the form of a cultural history of science and technology. The authors conceptualize science society relationships in terms of appropriation: *"we tell the history of technology and science in terms of processes of cultural appropriation, by which new things and new ideas are made to fit into established ways of life"* (ibid. p. 4). This way the processes of appropriation include a cultural and symbolic dimension of making something one's own, of integrating something into someones life as well as the institutional dimension of implementing science and technology in society, e.g. by various forms of organisational and institutional structures. While the latter is focussing on the material realization of science and technology in a specific socio–political context, the former stresses the sphere of acceptance, approval and consent. These two sides of such processes of appropriation are not to be understood as isolated spheres though. Even though it sharpens the analysis to separately look at these dimensions in the first place, their intertwinement, the ways they constitute each other have to be questioned.

In Science and Technology Studies such mutual shaping processes have been conceptualized as processes of *coproduction* by Sheila Jasanoff (2006). While the notion of *coproduction* aims to stress the mutual production of scientific and social orders, it also highlights that these boundaries are very artificial. Krige used the concept to analyse the development of scientific institutions with regard to international relations, however the idiom of coproduction originally revolved around analyzing social and technological orders. E.g. the basis for the analysis of the appropriation of nuclear technologies in the United States and South Korea by Jasanoff and Kim (2009). As is discussed in detail below (see section 4) the authors introduced the concept of *sociotechnical imaginaries* in order to describe *"collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects"* (ibid. p. 120). In doing so they provided a framework to deepen our understanding of processes of appropriation, and delivered two case studies in the field of Nuclear History. They demonstrated, how the appropriation of nuclear energy in the United States was strongly attached to the notion of "containment". The only nation state to have ever made use of nuclear weapons to end the war in the pacific implemented its nuclear capacities and nuclear energy program after World War II under a discursive framework — in line with the works above we might also call it imagery — that emphasized the containment of the enormous powers and energies of the atom. Quite contrary such aspects hardly played a role in South Korea, where nuclear energy was framed as a key technology to reach national independence.

Employing the notion of sociotechnical imaginaries to a different context, Ulrike Felt (2015a) has shown, how the failed appropriation of nuclear energy production in Austria led to the formation of a sociotechnical imaginary of the absent. While some (or rather

most) technologies have been appropriated by a vast majority of Austria's population without significant resistance or even questions, some technologies have been singled out to perform an understanding of the Austrian nation, as free of the technology in question. This analysis can be seen in the tradition of earlier works by Helga Nowotny (1979), who had studied the relationship between scientific expertise and public concerns throughout the Austrian controversy over the non–commissioning of the Zwentendorf nuclear power plant. Later on she related her analysis to corporatist elements in Austrian political culture (Nowotny, 1980). Especially in the post–Chernobyl era STS scholars increasingly investigated the public uptake of scientific expertise in relation to nuclear matters. Most prominently Brian Wynne (1992) investigated the ambiguous relationships between bureaucratic actors, scientific experts and affected locals in the management of post–Chernobyl radioactive fallout in the surrounding area of the Sellafield–Windscale nuclear installations in the United Kingdom. In a similar vein Robert Paine (1992) studied the consequences of the Chernobyl reactor explosion in Norway. Again public institutions, scientific and lay expertise clashed in dealing with the effects of radioactive fallout. Besides issues of different forms of expertise, risk and trust both cases provide interesting cases of how local collectives reshaped their identities in the light of a nuclear catastrophe.

The cases of the United States, South Korea and Austria already direct attention to the entanglement of technological systems and national identity. In the words of Gabrielle Hecht (1998) the development and implementation of technologies has to be related to *"the ways in which people imagine the distinctiveness of their country and define uniquely national ways of doing things"* (ibid. 10). In studying the French nuclear program Hecht described how the development of nuclear capacities, and even more the development and implementation of nuclear energy, were deeply entangled with the imagination of France as the "grand nation". Hecht (2001) speaks of technopolitics to describe how technologists of the French nuclear programs practiced technological expertise not only in a highly politicised context, but also for overt political aims and ideals, e.g. the understanding of France as a nation having a great past in developing technologies, that will inevitable be superseded by a French nuclear future. Investigating the Pavilion of Atomic Energy at the "Exhibition of the Achievements of the People's Economy of the USSR" (VDNKh) Sonja Schmid (2006) very carefully described how nuclear technologies were staged in terms of *"technological prowess, along with an emphasis on 'national' distinction"* (ibid. p. 354) in the Soviet Union. Reflecting the specific circumstances of the exhibition in real socialist Russia she demonstrates how the display of the atom was associated with ideas of *"constructing a communist society"* and a *"Soviet concept of public education"*. As Schmid puts it:

> *"By disseminating political ideas through the lens of successful nuclear sicence and technology, the VDNKh specifically aimed to influence the public's consciousness and to mobilize them morally, in order to get them actively enrolled in a common objective."* (ibid. p. 355–356)

Departing from such observations Felt et al. (2010) argue that the development of technologies as well as scientific institutionalizations can be investigated by analyzing and taking into account the specific techno–political cultures they are embedded in. In doing so they argue that the non–appropriation of nuclear energy in Austria *"represents one of the first pluralistic challenges to a hegemonic corporatist culture"* (ibid. p. 4).

2.3 Science & Technology policy and the future

In his study of the British nuclear program Ian Welsh (2000) reflects what he calls the "nuclear moment" as an expression of "mobilizing modernity". In doing so he defines the period between the 1930s and the 1970s as *peak modernity*, a *"moment during which the will to back heroic scientific projects intended to modernise the world"* found broad resonance. He characterizes the phase as a *"period when the ideological objectives of nation states and the scientific ambitions and aspirations of various constituent sciences were united behind visions of the planned transformation of society by rational, scientific means"* (ibid. p. 18). Welsh further argues that this confluence between political and scientific elites, as well as the underlying political agenda that *"drove the quest for nuclear capability"* (ibid. p. 20) are deeply rooted in modernity. In both eastern and western states an active approach towards nuclear capability *"became a defining feature of the political, ideological and economic anatomy"* (ibid.). Consequently this not only found an expression in different arrangements between the state and science in every single nation, it also was attached to and oriented towards the future. In studying the nuclear moment in Britain Welsh demonstrates, how nuclear power was portrayed and perceived as a project of modernisation and understood as the beginning of the "nuclear age". On an institutional level actors within the state, e.g. political leaders as well as staff within bureaucracies, had to learn how to govern science in a new, state driven, quality. Within these evolving structures the idea of a "nuclear age" or more precisely of a "nuclear future" was very prominent. As Welsh demonstrates for the British context, promises with regard to nuclear driven ships and trains, submarines and aircraft, as well as washing machines and peaceful nuclear explosions for modelling the surface of the earth tied and fed into envisioning a future based on nuclear energy. In turn this vision shaped the institutionalisation of nuclear research and nuclear energy production in Britain (ibid. 50–54).

In studying the role of promises, visions and futures scholars concerned with S&T policy and innovation (Brown, Rappert, & Webster, 2000) highlight the contested nature of these futures that are shaping the implementation of science and technology. Different individual and collective actors craft, shape and share various forms of what is usually understood as *the future*. These different futures are however subject to negotiation and conflict, because of their role and effects in the present. Ulrike Felt (2007) argues that future scenarios have become a central resource in contemporary sciences and speaks of an economy of promise. The fight over different futures, or also the trade with promises, can be understood as a form of creating one's own present, by claiming space and resources for oneself (or for the

collective one is part of) and by narrowing down and closing the present of others through challenging or delegitimizing their vision of the future.

In the so called Sociology of Expectations in Science and Technology (Borup, Brown, Konrad, & Van Lente, 2006) such futures are understood as an assemblage of different expectations, which means a combination of technological, scientific and social expectations. The authors stress the fundamentally generative character of such expectations, their role in guiding activities, providing *"structure and legitimation, attract*[ing] *interest and foster*[ing] *investment."* (ibid. p. 286). Most importantly these processes are in operation on different levels and in different contexts. Expectations are not only shaped, shared and contested among scientists and politicians. They matter within a laboratory or university as well as on a national level, when it comes to decision making and legislation on S&T policy for the near and distant future. They are also part of more broader societal processes of appropriation, e.g. the media has to be understood as an important actor and multiplier. The media, like all other actors involved, is not only disseminating these expectations, visions and futures, but is actively performing and shaping them. Similarly "the public" has to be understood as an heterogeneous set of actors, that are not only positioning themselves towards these futures, but participating in their construction or challenging them. Taking these considerations into account, important questions to be asked are: Who is able to impose his or her vision of the future, to enroll which actors, and what are the consequences in institutionalization and organisational processes? As Harro Van Lente (2006) argues, nuclear energy played a crucial role in the establishment of European S&T policy, because it was the first field to become subject of a joint, coordinated policy effort. As Van Lente describes the development of a dynamics of promises and requirement, that established throughout the 20^{th} century, this opens up the question of the role of expectations and nuclear futures in this early phase and their relationship to the evolving dynamics.

3 Research Question

The history of nuclear physics and nuclear energy programs in Austria is already well documented. In terms of History of Science the first half of the 20^{th} century and the immediate post–war era have been thoroughly studied. We have equally meticulous accounts on the Austrian history of nuclear energy, the struggle over the construction and non–commissioning of the nuclear power plant in Zwentendorf and the formation of an Austrian technopolitical identity, that is founded on the idea of rejecting nuclear energy and nuclear technologies. As a result of this prominent position of opposing the nuclear in Austria, little attention has been paid to nuclear prowess. Even though studies on nuclear imaginations and the promises and hopes towards nuclear energy production are integrated into national accounts on nuclear history, they lack a specific focus on national distinctions and specificities with regard to imaginations towards the nuclear. However the importance of national distinctions has been stressed by scholars in the field of Science and Technology Studies in several outstanding case studies.

Departing from this discrepancy between historical research and STS scholarship I provide an account on how promises and expectations towards the "atomic age" were perceived and shaped in post–war Austria. The object of study, so to speak, is the "atomic age" as it was appropriated as well as produced in a specific national and historical setting. This allows for a focus on two central aspects in the analysis of the subject at hand.

First I will investigate the appropriation of the "atomic age" with regard to national identity and the nation state as such. The guiding questions to reach this goal are: How was the "atomic age" institutionalized? What were the spheres where the "atomic age" was perceived, produced, shaped and formed? Who was involved in these processes and on what level? Answering these questions will allow for the creation of an account of the bigger picture, meaning reflecting upon and analyzing how the Austrian nation was imagined, performed and hereby brought into existence in the first place through the appropriation of science and technology, in this case nuclear research and nuclear energy in the 1950s.

Second I analyze the temporal structures of these imaginations. One of the "atomic age's" characteristics were its hopes and hubris, as has been demonstrated by various scholars in the field of Nuclear History as well as in Science and Technology Studies. While the set of expectations that came along with nuclear technologies has been addressed in general (see section 2.1), specific expectations and promises in the Austrian context as well as their role within the processes of implementing science and technology in post–war Austria have not been investigated so far. Narratives of development, promises towards the future, the hope to solve specific problems while being ignorant of others will be analyzed as argumentative resources and performative structures in science and technology policy. My aim is to investigate how visions of the future were used and produced by different actors in a specific historic setting. How were specific visions of the future shaping the processes of institutionalizing science and technology? And how was the institutionalization of science and technology shaping and framing the vision of a certain kind of future?

4 Appropriating science and technology

I treat dealing with the "atomic age" in Austria as a process of social and cultural appropriation in line with the works of Hård and Jamison (2005). Introducing their theoretical framework the authors identify a certain need for new story lines of how technologies have been used, learned to use and given meaning throughout history. In other words they speak of a demand for a new kind of history of science and technology, that is dedicated to investigating and narrating such processes of appropriation and implementation. A history that is focussing on how science and technology are *"connected to broader frameworks of perception and unterstanding, to ideas and visions"* and how science and technology *"are made to fit into established ways of life"* by making and keeping up connections of this kind (ibid., p. 4–5). According to the authors these connections, the act of giving meaning to science and technology, not only transform our lives, they also change the artifacts and technological systems in question (ibid., p. 15).

Such an understanding of science–technology–society relationships is to be grasped as reciprocal, acknowledging mutual shaping processes between social and technoscientific orders. Science and technology have to be appropriated within specific societal contexts and orders, which implies that the ways in which science and technology are implemented are deeply influenced by the societal surroundings, by the societies technologies are "implemented in". Societal orders on the other hand are also shaped by science and technology. The appropriation of certain technologies not only forms and structures technological artifacts and institutional settings of science, but also transforms other societal structures and social orders. Understood this way, processes of appropriation neatly fit what Sheila Jasanoff (2006) termed processes of co–production.

Throughout this section I elaborate on the notions of technopolitical cutlures and sociotechnical imaginaries as analytical angles to systematically investigate the institutional and symbolic dimension of appropriation processes. The separation of these two spheres is to be understood as an analytical move as well as a constraint in depiction.

Similarly I decided to reflect upon accounts on national identity as well as accounts on the future in the form of subsections to the notion of sociotechnical imaginaries. Even though such a hierarchical organisation appears doubtful on a theoretical level, it proved to be very helpful in terms of operationalization. This way the theoretical assumptions discussed could be organized from more general reflections on the relationship between imagination as a social practice and its institutionalizations, down to two examples. The reader should keep in mind though that national identity and specific relations with regard to the future, are more than just two arbitrary chosen examples. Rather these are to be understood as intrinsic and deeply entangled imaginations modern sociotechnical imaginaries are built upon.

4.1 Technopolitical cultures

In their historic account Hård and Jamison (2005) describe the era from the 1940s to the 1970s as the period when big science was actually established on both sides of the Atlantic ocean. Already from the 1930s onwards the formation of a new *"intellectual regime"* had started, a *"new political contract between power and knowledge"* was formed (ibid., p. 251–252).

Overall the period can be characterized by an increasing role of the state, which had its origins in the new role of the state in science and technology policy in the Soviet Union in the interwar period, and also found early expressions in the United States, most prominently in the Tennessee Valley Authority. Eventually World War II lead to the breakthrough of large scale research and an increasing hybridization of industry, military, bureaucracy and academia (Elzinga & Jamison, 1995, pp. 580–581). The new intellectual regime that was implemented in the US at the backdrop of Vennevar Bush's recommendations in *"Science the endless frontier"*, was — according to Hård and Jamison (2005, p. 255) — nothing more than the American appropriation of ideas first described by John Desmond Bernal, holding the Soviet Union and its policies in the interwar period in awe. Furthermore this new role of the state in science and technology came along with new tasks and demands for scientists. From now on they were given increasing political authority, they were expected to collaborate within national bureaucracies as scientific experts, while science as such became a national priority in the context of increasing international competition. In Europe this new intellectual regime started to form throughout and/or after World War II and found its first expressions in newly founded national laboratories of atomic energy (ibid., p. 255–256).

Unfortunately such systematic investigations of science and technology policy in Austria throughout the 20^{th} century are still a desideratum of research. Nonetheless the remark that the new intellectual regime found its expression in the national institutionalization of atomic energy research in Europe, is supported by recent works in the field of history. Rathkolb (2012) notes that Austrian nuclear energy policy in the immediate postwar era up to the end of the 1960s was in the hands of a small group of decision makers. Forstner (2012) highlights the central role of scientists such as Berta Karlik in the constitution of Austrian nuclear policy. In a diploma thesis Marcus Rößner (2013) traced the origins of the Austrian Foundation for Atomic Energy Research (*Österreichische Studiengesellschaft für Atomenergie, SGAE)*, which clearly shows that in the case of nuclear energy and nuclear research, a regime constituted by bureaucracy and scientific expertise was put in charge in Austria.

Felt et al. (2010) demonstrated how the investigation of technopolitical cultures contributes to our understanding of instituionalized science–society relationships. In taking a closer look at the concept of technopolitical culture and explicating a few important aspects for the case in question, I aim at providing further insights for later analysis.

The notion political culture dates back to the 1950s and the works of Gabriel A. Almond. Criticising the dominant position of systems theory in contemporary political sciences — almost exclusively focussing on questioning legal and ethical norms in the analysis of political systems — Almond suggested a broader understanding of political systems in the tradition of Max Weber and Talcott Parsons. In this sense political systems are understood as the sum of human actions based on roles, complemented with different forms of coercion (Almond, 1956). Consequently Almond described the context of human actions, which is decisive in their formation, as the political culture they are situated in. In doing so he expanded the analysis of legal and ethical norms of political systems to values and belief systems as relevant aspects of analysis (ibid.).

Hence investigating political cultures and comparing political systems includes the analysis of the ways of decision making by political elites, the norms and values guiding them in doing so, as well as value and belief systems of citizens. As Almond and Verba put it: *"When we speak of a political culture of a society, we refer to the political system as internalized in the cognitions, feelings, and evaluations of its population"* (Almond & Verba, 1989/1963, p. 13). The authors differentiate between these three forms of orientation towards the political system and its objects: With cognitive orientations they mean knowledge about the political system and the way it works. Affective orientations describe more subtle feelings and positions towards the political systems and its representatives. Evaluative orientations finally mean judgements and beliefs based on explicit criteria or belief systems (ibid., p. 14).

About twenty years later Almond fine grained the concept of political culture by differentiating three different levels: systems culture, process culture and policy culture. While policy culture assesses cognitive, affective and evaluative positions towards the output of political systems, process culture deals with these aspects among political elites. Analyzing systems culture on the other hand means dealing with general cognitive, affective and evaluative positions towards authorities, public officials, political institutions and the nation as such (Almond, 1987).

Even though the concept underwent heavy criticism in terms of being too open or even indefinite (most prominently in the German speaking context: Kaase (1983)), analyzing political culture enjoyed repeated popularity (Greiffenhagen, 2009). Since the end of the 20^{th} century research in the domain of political culture underwent some updating and shifts though. Karl Rohe for instance argues for a more broader understanding of politics in analyzing political cultures. Scholars should not only examine and question attitudes and orientations of people towards political systems/regimes, but also question the more general views on the world, patterns of perception and evaluation etc. Besides such general assumptions political culture also includes knowledge and a common understanding of politics that transform into conventions, which in turn structure our actions and thinking. Furthermore they provide us with a specific repertoire of what kind of actions have proven to be successful in the past as well as how one would act and perform in different public

settings (Rohe, 1994, pp. 1–2). Along with this more general understanding of the concept Rohe argues for methodological consequences. While research on political cultures in the tradition of Almond/Verba usually focussed on surveys to describe the cognitive, affective and evaluative orientations of different groups and populations, Rohe argues for a more pluralist approach. As political culture describes a broad and multifaceted phenomenon, it requires the researcher to ask different questions and answer them with appropriate methodology (ibid., pp. 3–17).

In this tradition research on political culture not only opens up to the analysis of science–technology–society relationships, it also brings in new dimensions in STS research. As Felt et al. (2010, p. 528) demonstrated, we can employ *"the term 'technopolitical culture' to capture the ways (i.e., the practices, structures and mechanisms) in which technologies are interwoven into a specific society."* Building on the works of Helga Nowotny (1979, 1980) they argue that the Austrian protest and vote against nuclear energy production in 1978 *"represents one of the first pluralistic challenges to a hegemonic corporatist culture"* (Felt et al., 2010, p. 528). Investigating the appropriation of the "atomic age" in Austria in the 1950s therefore means looking at a process of appropriation within this corporatist culture.

One of the earliest works on political culture in Austria highlights the submissive character of the relationship between citizens and public authorities. From the 18$^{\text{th}}$ century and the reforms of Joseph II up to the end of the 20$^{\text{th}}$ century there does not seem to be a single revolution or reform "from below" that was successful. Quite on the contrary reforms and change "to the benefit of the people" have been implemented by authorities, if necessary also against initial resistance. And as cannot be expected otherwise in a political culture that is characterized by a strong submissive mentality of its citizens, based on such experiences trust in public authorities developed to be unusually strong (Hanisch, 1984) and found its expression in an authoritarian disposition throughout the 20$^{\text{th}}$ century (Rathkolb & Ogris, 2010).

From the turn of the century up to the 1930s Austrian society was increasingly characterized by the establishing political parties, that increasingly developed into two political camps during the first republic (Kriechbaumer, 2001). The polarization between the Socialist Democratic Workers' Party and the Christian Social Party resulted in the civil war of 1934 and consequently in the oppression of the former by the latter during the austro–fascist regime, before the political cleavage was overcome in the national socialist *Volksgemeinschaft*. After World War II the political parties of the interwar period were reactivated and regained their dominant position. Pelinka and Rosenberger (2007) define the newly founded Second Republic as a very distinctive (two-)party state. The post–war era was generally dominated by political and economic reconstruction and Austria's striving for national sovereignty.

While the newly established two party state was characterized by proportional representation and concordance (Lehmbruch, 1967), what was to become an integral part of the Austrian political system and national identity was (re)constructed as well: the austro–

corporatist system. Having its roots in the first republic and the austro–fascist regime (Tálos & Kittel, 1995) the austro–corporatist structures developed as an integral part of Austrian policy culture. Because of the described circumstances the strong sense of cooperation between government and corporatist bodies developed out of practice, while its main peculiarity was unanimous decision making without public participation (Tálos, 2006). As Rathkolb (2005, pp. 126–127) and Karlhofer (2001) point out, the main reason for the success of Austrian corporatism is its combination with the strong party state. Members of both political parties held key positions within governmental and corporatist bodies. This way decision making could be easily coordinated among political and economic elites, while public consent was assured through the dominant role of the political parties in public life.

While the notion of technopolitical culture helps to systematize the relationship of technological developments and their implementation into a specific socio–political context, I want to draw upon the notion of sociotechnical imaginaries, in order to reflect upon the role of imaginations around technological artifacts and their relationship towards the social to systematize the symbolic dimension of appropriating science and technology.

4.2 Sociotechnical imaginaries

The notion of sociotechnical imaginaries was first introduced to the STS community by Sheila Jasanoff and Sang-Hyun Kim in a cross-national comparison of post–war nuclear policies in the United States and South Korea. In their paper the authors defined the term as follows:

> *"We introduce the concept of 'sociotechnical imaginaries' to explore the sources of long-lasting cross-national variations in S&T policy. We define national sociotechnical imaginaries as 'collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects.' Imaginaries, in this sense, at once describe attainable futures and prescribe futures that states believe ought to be attained."* (Jasanoff & Kim, 2009, p. 120)

Their understanding of imagination as a social practice is built on earlier works — most prominently the reflections of Benedict Anderson (2006/1983) on nations as "imagined communities", which is discussed in detail in section 4.2.1 — that carved out how imagining has become a social reality throughout modernity. As Arjun Appadurai (1996, p. 5) puts it: *"Imagination has become a collective, social fact."* While imagination as such has a long history in terms of mysticism and the like, throughout modernity it increasingly became *"a staging ground for action"* instead of traditional forms of *"escape"*. For Appadurai imagination represents a *"property of collectives."* By referring to them people are *"capable of moving from shared imagination to collective action"* (ibid., pp. 7–8). Charles Taylor (2004, p. 23) goes on an even more fundamental level with regard to human existence and action, when he describes social imaginaries as:

> *"[...] the ways in which people imagine their social existence, how they fit toegether with others, how things go on between them and their fellows, the expectations that are normally met, and the deeper normative notions and images that underlie these expectations."*

He contrasts imaginaries to the notion of theory in the sense that the term imaginary rather tries to grasp our everyday understanding of our social surroundings. In contrast to theories, which are mostly shared among a rather small and restricted number of people, imaginaries are shared by bigger social entities, meaning bigger groups or even whole societies. This way imaginaries are understood as a *"common understanding"* enabling *"common practices"* (ibid.). According to Taylor this common understanding has a factual and a normative dimension. In one sense they are factual because they express expectations in ordinary everyday settings, our sense of *"how things usually go."* However our understanding of how things usually go includes normative assumptions of *"how things ought to go"* (ibid. p. 24). In other words imaginaries always also include ideas, assumptions and judgements about how social order or social life as such should look like.

In contrast to this mundane dimension of the imaginary, Jasanoff and Kim also draw upon the notion of the technoscientific imaginary by George Marcus. As the term suggests this kind of imaginary is concerned with collectively shared understandings of actors in the fields of science and technology. As Marcus (1995, p. 4) puts it: *"we were* [...] *interested in the imaginaries of scientists tied* [...] *to their current positionings, practices, and ambiguous locations in which the varied kinds of science they do are possible in."* A more recent example of how imaginaries of the future were brought about in the context of the human genome project by biomedical and genome scientists was provided by Joan H. Fujimura (2003).

Consequently the notion of sociotechnical imaginaries brings together both strands, the focus on mundane everyday–life imaginaries as well as the more "esoteric" imaginaries in the realm of science and technology. This way the notion of the imaginary is transformed into a coproductionist framework. It does not only allow to trace how imaginations in the field of technoscience are shaped by and related to more common understandings of social reality. It also enables an understanding of everyday–life that is increasingly shaped by science and technology and associated imaginations.

Ulrike Felt's important contribution to this understanding of sociotechnical imaginaries could be summarized as an effort in historicizing the conceptual framework. She highlights the need for *"paying attention to the practices and continuous exercises needed to produce and maintain common imaginaries"* (Felt, 2015a). This already points us towards the fact that imaginaries are brought into existence in a continuous active process, meaning that they have historical forerunners and a history themselves. Furthermore practices of imagining are situated actions in a context with its own history.[2] But not only the historical

[2] This, among other aspects, also explains the importance of reflecting about technopolitical cultures (see section 4.1) in the context of imaginaries.

nature of social life as such is to be taken into account. Felt is also considering collective memory practices in the sense of Maurice Halbwachs (1991/1967) in order to trace how people actively and collectively relate to the past in imagining the present and the future. As (Felt, 2015a) says the aim is to trace *"[...] the making of a sociotechnical imaginary across different technological fields and episodes in history but also to point at the symbolic organization and impact of collective (technology–related) memory practices."*

In studying the three cases of nuclear energy, genetically modified organisms and nano technologies in Austria, Felt describes a sociotechnical imaginary of the absent, that developed since the controversy over nuclear power production in the 1970s. Analyzing imaginaries around three different technologies in three different historical settings she characterizes the development of sociotechnical imaginaries in a three stage process. At the very beginning imaginations are assembled.[3] Afterwards repeated rehearsals lead to processes of reassembling and over time result in the stabilization of the imaginary. This way imaginaries can not only survive longer periods of time, they can develop into stable points of reference, when it comes to sense making around other sociotechnical issues (ibid.).

These contributions to the conceptual framework of sociotechnical imaginaries originate from a common professional context. They will appear in a forthcoming volume edited by Sheila Jasanoff and Sang-Hyung Kim with over a dozen contributions building on and further developing the notion of sociotechnical imaginaries. Within the first chapter, Jasanoff (2015a) redefines the concept in the light of increasing complexity as:

> *"collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology."*

So beyond their collective nature imaginaries also tend to by stabilized in and through institutions (ibid.), as has been exemplified by Felt (2015a) in the case of anti–nuclear and anti–GMO legislations and policies in Austria.

As Jasanoff argues, the notion of sociotechnical imaginaries helps to overcome shortcomings in research on STS relations along four dimension. First it enables to account for differences in development, when it comes to implementation and appropriation of science and technology in various settings. I take up this dimension with special attention towards the production of national identity in section 4.2.1. Second the notion enables an analysis of temporal relations, making connections between past, present and future of science–technology–society relationships. I follow this dimension with a focus on the role of the future in S&T policy in section 4.2.2. Beyond that sociotechnical imaginaries also

[3] Prior imaginaries may be contested and broken up to even enable this moment of assembling first. Alternatively imaginaries might also develop simultaneously, completing each other as well as increasingly getting in conflict.

allow for new accounts on the role of space, as well as the relationship between collective formations and individual identity (ibid.).

In her concluding remarks Jasanoff (2015b) reads across the different contributions and identifies four different phases in the development of sociotechnical imaginaries that lie analogue to the stages identified by Felt: origins, embedding, resistance and extension.

In analyzing the appropriation of the "atomic age" in post–war Austria the focus will be on the one hand the phase of embedding. Tracing the imaginary at work means looking at how it *"get*[s] *embedded in the concrete artifact of industrial civilisation"* as a process of *"group reflections"* by *"publics and other non–state actors"* — as demonstrated in the case of Austria by Felt — and as a process of scientific and political elites as well (ibid.).

On the other hand looking at the appropriation of the nuclear imaginary in Austria already implies that its origins (from the Austrian perspective) lie elsewhere. So what is at stake is the extension of the nuclear imaginary, the *"global circulation of* an *already powerful sociotechical imaginar*[y]*"* (ibid.). In doing so another case opens up to study whether and how the nation state is invoked in the appropriation of an imaginary, that is at work on both, a global — more universal — and a national level.

4.2.1 National identity

The understanding of imagination as a social practice the notion scociotechnical imaginary builds upon, was very much shaped by Benedict Anderson (2006/1983) and his famous work on nations as "imagined communities". Anderson's conceptualization of nationalism from an anthropological perspective enabled a multiplicity of new accounts on the actual production of national identity in everyday practice.

Anderson defined the nation as *"an imagined political community* [...] *imagined as both inherently limited and sovereign."* (ibid., p. 6). The community is described as imagined because the members of the community do not have personal relationships, they neither know each other, nor do they actually or even expect to meet each other during their lifetime. In other words their experience of belonging to the national collective is based on their imagination. The nation is even brought into existence through their practice of imagining. As Anderson points out (ibid., pp. 6–7) the practice of imagining collectivity in the abstract form of nationality is a quite recent historic phenomenon, to put it differently: a phenomenon that is rooted in modernity. Anderson reflects on differences to older versions of imagined collectivity in the form of more direct, personal social relationships. E.g. Javanese villagers have a long tradition of imagining collectivity without direct relationships. In contrast to the abstract character of modern nationality this form of collectivity is imagined in a particularistic style of personal relationships that can be indefinitely expanded though (ibid.). The development of this new quality of social relations throughout modernity has been theorized in recent reconstructions of marxist theory in terms of a shift from pre–modern direct, immediate forms of social domination to abstract and mediated forms of socialisation (Postone, 2003). In other words we might say that imagining identity

and collectivity in the abstract forms Anderson describes, are entangled with the abstract forms of modern society.

Anderson defines the nation as a limited imagined collective though, because even though its borders are elastic and blurred, the realm beyond the borders belongs to other nations. So the abstract form of national collectivity comes along with its own, different form of particularity, because not a single nation is imagined in a universalistic style, forming a collective or society of humankind in all its heterogeneity. Furthermore they are imagined as sovereign, because of their origin in European enlightenment and its increasing entanglement with the sovereign state (ibid., p. 7).

Building on Ernest Gellner Anderson also speaks of the invention of nations, in the sense that they are created, brought into existence through imagination (ibid.). Throughout his book he scrutinizes several practices and institutions such as maps, the census or museums and the ways in which they take part in the imagination and construction of national identity. Similarly Hobsbawm and Ranger (1983) speak of the "invention of traditions" in the same year. Looking at a broader set of practices they investigate how different practices are symbolically framed in terms of (ancient) traditions, even though they are of recent (or at least modern) origin. In their own words:

> *"'Invented tradition' is taken to mean a set of practices, normally governed by overtly or tacitly accepted rules and of a ritual or symbolic nature, which seek to inculcate certain values and norms of behaviour by repetition, which automatically implies continuity with the past. In fact, where possible, they normally attempt to establish continuity with a suitable historic past."* (ibid., p. 1)

It is this understanding towards the notion of practice and its relationship towards history — or rather time in general as is reflected upon in section 4.2.2 — in combination with Anderson's understanding of imagination and its relationship with collectivity, that I consider essential with regard to sociotechnical imaginaries.

Early works in STS which can be seen in these traditions have been delivered by Jasanoff (1995), focussing on regulating biotechnology during its early years. Jasanoff explicated how different political cultures relate to different practices of regulation with regard to emergent technologies. Even though the overall expectations and aims of regulation did not differ too much in various countries, regulation processes resulted in distinct national styles of regulating and framing biotechnology. Furthermore the context of regulation and resistance is connected to collectively imagining the technology in question (ibid., p. 327). This is probably one of the main reasons why the earlier version of the notion of sociotechnical imaginaries grasped collectivity almost exclusively through national identity. Most considered case studies simply were situated on the national level, at least when it comes to regulation. Even though this exclusiveness has been opened up to accommodate to other collectives brought afore through imaginaries as well, most cases beg the question

why national identity appears to be so central. In other words, even though the nation state seems to be of relevance because of its role in regulating science and technology, practices of imagination seem closely entangled with national identity beyond this context of regulation as well. A decade later Jasanoff continued her comparative explorations in the field of biotechnology in the case of Germany, Britain and the United States. She argues that the nation as a regulatory instance is increasingly challenged and questioned. Again she stresses the need for broadening the view from national styles of regulation towards focussing on the role of political culture, framing and identity production within and beyond regulation. In that sense imaginaries help us to engage *"with active processes of meaning-creation that frame problems for collective action, build communal identities, and allow actors to mobilize"* (Jasanoff, 2005, p. 20).

Similarly Sunder Rajan (2006, p. 210) describes the nation as a *"structure of promisory imagination"* for technoscience. Analyzing narratives in Indian biotechnology he argues that the nation is a central form of articulation for biotechnologists in India. He analyzes how these narratives can take on quite distinctive forms, e.g. promises of national independence, human emancipation through national development, or specific ways of changing India's participation and role in global market structures. However *"the entire spectrum of scientist and policy positions is animated, quite explicitly, by nationalism"* (ibid., p. 221). Adhering to a coproductionist framework we also have to question the other side of the coin though. Nationalism and national identity are not only a structure of articulation and imagination for science. As Nadia Abu El-Haj argues, scientific practice also brings afore and produces national identity. In studying archaeological practice and its role within the construction of Israeli society El-Haj (2001, pp. 1–8) demonstrates how the production of national identity can be traced to the core of research practice. In doing so she takes a different turn and also goes way beyond earlier accounts on the entanglement of nationhood and archaeology and historic sciences as such. The focus on practice points out that nationality is also actively produced through science and technology, not only entangled with them and/or legitimizing national aspirations.

El-Haj draws upon the understanding of nationhood advanced by Rogers Brubaker. As Anderson drew upon Gellner to explicate how nations are invented, Brubaker demands the social theorist to reflect on processes of reification. He argues that the simple question "What is a nation?" already ontologizes the object of study. In that sense Brubaker (1996, p. 16) stresses: *"we should certainly try to account for this social process of reification — this process through which the political fiction of the nation becomes momentarily yet powerfully realized in practice."* In that sense the nation can be conceptualized as *"a category of practice, nationhood as an institutionalized cultural and political form, and nationness as a contingent event"* (ibid., p. 21). Because, as Brubaker puts it: *"Ours is not* [...] *'a world of nations.' It is a world in which nationhood is pervasively institutionalized"* (ibid.). Turning back to the idiom of co–production this brings us to the question how nationhood is so

pervasively institutionalized in science and technology. How it is brought into existence, how it is practiced in the field we are concerned with.

Gabrielle Hecht (1998, pp. 10–13) most prominently investigated relationships of science and technology and national identity. In her conceptualization she stresses that national identity is to be understood as a practice of imagining distinctiveness. At the core lies the question how science and technology contribute to performing a unique style of doing things. In the case of the French nuclear program Hecht traced, how different actors connected nuclear technologies to earlier technological artifacts and systems, that already were established as inherently French, e.g. the Eiffel Tower or the Arc de Triomphe. Consequently Hecht analyzed such moves as practices of making nuclear technology French and rendering France without nuclear capacities as undesirable. This way French national identity was not only imposed as a means of legitimation, it was also constructed, brought afore and practiced through science and technology. In her own words: *"If technological development is treated as a social, political, and cultural process, the history of technology can contribute to the hisoriography of national identity."* (ibid., p. 14).

To systematically realize this program Hecht suggests to trace these social, political and cultural processes through three different conceptual tools or approaches. First of all the beliefs of technologists themselves are to be investigated. Before we confront the object of study with our own understanding of national identity and the like, we should investigate how scientists and engineers imagined science–technology–society relationships themselves (Hecht, 1998, p. 15). Such an analysis then allows for systematization with the notion of technopolitics, which refers *"to the strategic practice of designing or using technology to constitute, embody, or enact political goals"* (ibid.). Finally the notion of technopolitical regimes allows for a description and analysis of the ways in which technopolitics are institutionalized within society (ibid., pp. 16–17).

As Hecht points out elsewhere, such an approach also furthers the analysis of the mutual production of science and technology and national identity. It enables the analyst to shift from questioning how *"national identity might justify large-scale technological development"* to question how they *"shape that development"* (Hecht, 2001, p. 254).

Last but not least Hecht brings the temporal dimension to our attention. I have drawn upon Hobsbawm and Ranger's notion of inventing traditions to highlight, how different practices need to establish specific symbolic relationships towards the past, to be able to make and maintain certain claims about the present and in doing so contribute to social cohesion. However Hobsbawm and Ranger already mentioned that this cannot be any kind of past, the connection has to be established to a suitable past. The examples of the Eiffel Tower and the Arc de Triomphe demonstrate that in case of the French nuclear program it was important to connect to a past focussing on French technological prowess. The connection however was made in order to influence decision making in the present, decision making in turn, that is inherently connected to a certain kind of future. In the words of Hecht:

> *"Discussions of national identity typically refer back to the past. But ultimately, national–identity discourse is not about the past per se or even about the present. It is about the future. National–identity discourse constructs a bridge between a mythologized past and a coveted future."* (ibid., p. 255)

4.2.2 The role of the future

Temporal aspects are to be understood as an important aspect of imagining as a social practice. Charles Taylor (2004, p. 24) for instance argued that imaginaries always have a normative dimension of *"how things ought to go"*. If imaginaries are a property of collectives that enable groups to act, we can assume that action very much relates to the actor's imaginations of how things are supposed to be in the future.

Even though there are numerous works on time in the social sciences, philosophy, history and other disciplines, Barbara Adam (1994) constituted a lack of studies when it comes to the relationship of time and social theory. While many accounts on the nature of time and its relation to the social are available, not too many theorists reflected upon the role of time within their writing and thinking. However, as Adam argues, such an undertaking is central, if we do not want to comprehend time as an *"inevitable fact of life, as a fact of history"* but as something that can be subject to change, something that we *"maintain by our daily actions"* (ibid., p. 5). Discussing the most important writings on time throughout the last two centuries Adam explores how different conceptualizations of time matter in dealing with the past, the present and the future. As Adam suggests, most of these conceptualizations are not able to sufficiently determine time as a social phenomenon. Quite similar to Jasanoff's take on the entanglement of social and natural orders, Adam argues for a similar understanding of time, that renders the dominant distinction between social and natural time in social theory obsolete. In her own words:

> *"Since the physical universe, living nature, human social groupings, written language and symbolic knowledge, social records, technology, artefacts, clocks and calendars, all form an integral part of our social life today, and since they are all implicated in a full understanding of time, it seems essential that they are explored in their own right"* (ibid., p. 46).

In that sense temporal aspects are more than just a further quality of sociotechnical imaginaries. Rather time as a social phenomenon is an essential part in the articulation of sociotechnical imaginaries. In asking about the role of time within the practice of imagining socio–technical orders, we ask the question of how the social and the technical, society and nature are co–produced through our understanding of time.

In that sense Adam's notion of time and its relation to social theory is in line with the works on time by Norbert Elias (1987). Elias argued, that social theorists quite often lost the ground when reasoning about time, because time seemed to be a problem of physics and metaphysics. Notions like social time were contrasted to notions of natural or physical

time. However, Elias suggested, not an understanding of human beings as opposed to the natural world is key to understanding time, but one of *"humans within nature"* (ibid., p. XV; translation FB). Even though time is based on physical phenomena and needs natural processes that exist without human beings, such processes also need to be synthesised by human beings, in order to account for time (ibid. p. XXI, XXXIX–XL). In other words, any time is to be understood as social time. In reference to his earlier works on the process of civilisation (Elias, 1997/1939), he conceptualized time through the notions of *Fremdzwang* and *Selbstzwang*. Through time society as such, the social relations formed by individuals pose an external form of coercion: via time individuals are subjected to social relations.

The functionalist understanding of time advanced by Sorokin and Merton (1937) focuses on the opposite dimension of this relationship. In this sense the basic function of time is one of organizing forms of collectivity. The bigger the groups, collectives or societies in question — also the higher the interconnectivity between different groups and collectives — the more abstract the temporal frame of reference has to be. While historical groups or societies based on hunting or agriculture mostly referred to natural processes in their everyday context and surroundings to divide time scales (e.g. tide, seasons, periods of seedings and harvest), highly differentiated societies needed a more empty and universal referent, hence the fixation on astronomical or physical time in modern societies. Even though this functionalist approach keeps up the boundary between social and natural time, its strength lies in the focus on the necessary role of time in forming groups, collectives or societies.

Helga Nowotny (1995) observes a certain "power of time", which can be described as an impersonal and inescapable form of social domination — what Elias had termed *Fremdzwang* — that is deeply entangled with social hierarchies, but also needs to be reproduced through individual practice. In other words: time is central in structuring society on the macro level, while it is also dependent upon our everyday practice, our participation in such structuring processes. Hence social time is always dependent upon different forms of institutionalization and different forms of construction. According to Nowotny the regime of past, present and future, would be a central example of changing but not arbitrary constructions of time in different societies.

Similarly Nowotny speaks of the development of so called machinery time. Throughout modernity machines and also the laboratory, were increasingly imagined to deal with and/or represent "natural time" (ibid., pp. 93–99). Nowotny describes, how this went hand in hand with the development of an abstract and empty understanding of time, that is rooted in industrial forms of production. This way she indicates towards what has systematically been described by Moishe Postone (2003), who characterized the predominant form of time in industrial societies as abstract time. For Postone the abstract form of time is both cause and result of the abstract form of socialisation in modern capitalism. Modern social institutions (e.g. the state, the economy, science and technology) not only play a role in the production of this abstract notion of time, in order to function properly they

depend upon a universal measure of time, stripped from concrete, historic, social context, so it can be added, divided, equated and so forth.

This understanding corresponds with research on the historic character of the future. Hölscher (1999) has shown how such an understanding of time, together with the regime of past, present and future as laid out by Nowotny, is of modern origin. Medieval societies in Europe lacked the means in terms of language and consciousness to think about the future as a period of time, where human action could be projected to. Only in course of the enlightenment, the increasing differentiation of societies and the development of modern institutions — among which science and technology played an essential role —, the future as an open period and space came into existence.

Throughout the history of industrial societies this relationship between the present and the future underwent further, significant changes. On the one hand Herman Lübbe speaks of a shrinking of the present, because we are no longer able to foresee the near nor the distant future. Due to constant change — in the sense of technological innovation — we have to expect social relations and everyday practices in the near future, that radically differ from the world we are used to live in (Lübbe, 1995, pp. 53–54). Against this understanding Nowotny (1995, pp. 90–93) argues that we are experiencing an extension of the present on the costs of the future. The future of industrial societies is increasingly imagined to be dominated by problems caused in our present. This way the present is extended into the future, and the future itself is narrowed down along certain characteristics, it loses its openness for projection.

Adam and Groves (2007) tell a similar story on how the role of the future changed within (Western) human history. While in ancient and medieval societies futures also mattered, they were tamed by different rituals. The future itself was however understood as pre–existing, a fixed destiny. Even though one could not really know what the future would bring, one had certainly no means of changing, organizing or building one's own or collective future. Only with the increasing importance of trade throughout early modern capitalism, the future was emptied, dis–embedded and de–contextualized. As trade demanded an empty future, open to promise, futures were commodified and took an abstract form and shape along with the abstract forms of clock time and exchange value. So also for Adam and Groves the open nature of modern futures is rooted in modern capitalism, which is dependent upon a

> *"realm of potentiality to be formed rather than transformed to human will. Emptied of content and meaning, the future is simply there, an empty space waiting to be filled with our desire, to be shaped, traded or formed according to rational plans and blueprints, holding out the promise that it can be what we want it to be"* (ibid., p. 11).

In accordance with Nowotny they diagnose substantial changes in the contemporary character of futures, when they acknowledge that the open nature of futures as a space for

projection is increasingly disintegrating. Throughout the 20th century they detect a rising awareness that ones own present is a tangible, embedded and contextualized version of earlier futures. Consequently we can either *"collude* [in order to secure that; comment FB] *the house of cards stays intact"* (ibid. p. 14), or we can question the role different versions, visions and imaginations of the future play in our present. Taking on historical perspectives on the matter allows for investigating such issues. The authors give several hints and examples of how such relations could be addressed. E.g. when discussing the development of the notion of progress during the enlightenment, they argue it has been naturalized. While on the one hand, the future was *"seen as the achievement, through human effort alone, of an entirely new condition"* (ibid., p. 65) the question of what kind of new condition that would be and how it might be obtained, was a) black boxed through naturalisation: *"*[...] *the choice of what future to create had to be based on knowledge of the principles of human nature"* (ibid., p. 67), and b) in doing so delegated to different sciences. Similarly we can ask what kind of understanding of progress different visions of the future are latently and tacitly imbued with. Even tough the final goal of progress is not so much understood as to be grounded in human nature anymore, the notion of progress as such is deeply inscribed into the modern understanding of the relations between past, present and future.

Furthermore, as Adam and Groves argue in reference to Karl Marx, modernity has to be understood as pervaded with contradictions. One such central contradiction they label *promethean* power: *"the power to act and transform is not matched by a capacity to know and be mindful of interconnections, implications and potential effects"* (ibid., p. 81). While technologists and technologies produce different promises, these processes of future making are intrinsically accompanied by processes of future taking. However the dis–embedded, dis–connected and de–contextualized form of modern future making renders the aspect of taking futures, which the authors ground in the sphere of specific, social and historic reality, invisible (ibid., pp. 81–93).

In discussing the merits and pitfalls of mobilization theory Arjun Appadurai coined the term *trajectorism*, in order to account for the *"meta-trap* [...] *of thinking through the optics of 'trajectories'"* in the history of Western thought (Appadurai, 2013, p. 223). In contrasting the notion to evolutionism, progress, growth and the like Appadurai defines trajectorism as

> *"the idea that time's arrow inevitably has a telos, and in that telos are to be found all the significant patterns of change, process, and history. Modern social science inherits this telos and turns it into a method for the study of humanity"* (ibid.).

Based on studies in the public perceptions of science and technology Felt (2015b, p. 8) speaks of an innovation trajectory. In doing so she accounts for most contemporary under-

standings of innovation, which are based upon the idea that *"societies gradually overcome natural limitations and impediments through technoscientific innovations."*

Beside temporal aspects trajectorism also has a spatial dimension and can be seen as an *"ideology of spatial expansion"* (Appadurai, 2013, p. 225). For Appadurai this points towards the central role of contradictions in European modernity: Not only are different trajectories contradicting each other, the contradicting trajectories were expanded to and exported all over the globe in an attempt to resolve the contradictory struggle within the development of Western societies themselves (Appaduari, 2012, p. 30).

In conclusion of these reflections on time I want to sum up the central lines of argumentation that have been advanced. Following Adam's call for reflecting on the role of time in social theory I traced the co–production of natural and social orders with regard to time from Elias, via the functionalist approach of Sorokin and Merton up to Nowotny, who pointed towards different forms of the social institutionalisation and construction of time, e.g. in the regime of past, present and future. A closer look on the future finally reveals that "our" very understanding of the future also underwent significant changes since the "advent of the enlightenment." With Adam and Groves I reached a preliminary characterization of what they called the open future and its multiple relations to the present. With Appadurai's notion of trajectorism I relate to the argument's point of origin: trajectorism has been a central trap in social theory, in the sense that theory has not systematically accounted for the ontological politics of time.

4.2.3 Aspects in investigating futures

Beyond such theoretical accounts there is a great number empirical case studies in STS, that help us to systematically investigate such temporal aspects with a focus on the future. Brown, Rappert, and Webster (2000) accounted for the rivalry among different futures in science and technology by editing a book called *Contested Futures*. In this collective volume they argue for shifting the focus *"from looking into the future, to looking at how the future as a temporal abstraction is constructed and managed, by whom and under what conditions"* (ibid., p. 4). Following their agenda a few properties of futures as an object of study that go beyond the aspects addressed above can be defined.

First we can ask to whom different narratives on and versions of certain futures attribute *agency* to, e.g. individuals, institutions or technologies. The authors also bring into play the notions of *path dependency* and *lock-in*. Even though Science and Technology Studies have long been challenging such understandings, they are still very powerful in the construction of futures.

This already brings in the next dimension of analysis: *practices* of future making such as modelling or crafting different scenarios. Cynthia Selin (2006) defined scenarios as a form of building consensus, in the sense that they are limiting the open future to a few versions of certain futures. From her analysis of the role of trust in building scenarios a few criteria can be borrowed. Even though future making involves a lot of disembedding and work of

eliminating context, the formation of a credible scenario is still very much depending on context in the present. In that sense crafting credible scenarios means creating a setting in which they are convincing based on trust in *sources, content, methods, narrative* and *dissemination.* These five characteristics form a basis for trust in future scenarios by providing answers to questions such as: Who is involved in crafting the scenarios? What do they look like, e.g. how are they able to claim credibility based on the authority of science? How do they establish credibility by relying upon clear cut methodology to appear repeatable? What discursive connections do the respective scenarios establish and what institutions are involved in disseminating them (Selin, 2006, pp. 5–12)?

Brown, Rappert, and Webster (2000) remind us to take limiting aspects into account as well. When it comes to the openness and uncertainty of futures, we can ask who is able to articulate and shape certain futures, who has the power to make arrangements in the present and who is marginalized in *"the orchestration of opportunity"* (ibid. pp. 5–16).

With Mike Michael (2000) we can define certain characteristics of the performativity of invoking futures. In contesting different versions of the future, the futures we invoke serve as resources within our argumentation. Most prominently futures are often either portrayed as relatively distant or relatively near to a certain position or point in time. In that sense *distance* offers room for contemplation, negotiation and action. Rendering expected events as located in a distant future can for instance create the necessary room for taking preparations, in case the future is grasped as bad or not desirable. Whereas proximity can create a certain need for *urgency.* The nearer future developments are, the faster preparations have to be — or even should have already been — taken. In that sense proximity can be a resource in mobilizing others to do something, or it can be a reason to stop approaching a certain future state of affairs (ibid., pp. 24–25). While Micheal differentiates between *good* and *bad* futures, Richard Tutton (2011) argues that most research on future scenarios, promises and expectations is not taking into account the role of futures to be avoided, and pessimistic futures being performed. In other words every articulation of a future to be obtained is an implicit reference to a future to be avoided. According to Tutton anticipatory work is therefore dependent upon both *"promising and pessimistic registers"* (ibid., p. 425).

The performativity of futures also imposes the question of the *subject* of the invoked future. The articulation of futures not only demands and delegates agency to the one enforcing it, it also refers to a subject affected by that future. This subject can be an individual of certain characteristics, as well as social collectives, such as nation states, scientists, publics or industry sectors (Michael, 2000, pp. 26–27).

Subsequently properties of futures also tie back into broader imaginaries of how things ought to be. As Michael puts it, futures are connected to different forms of rationality. A future can be *instrumental*, a means to reach a variety of goals, or it can be *substantive*, connected to more far reaching imaginaries and utopias. In turn this brings in the dimension of *realizabilty* as a rhetorical tool. Substantive imaginaries of the future can

therefore be a tool to argue for connected instrumental futures. On the other hand they can be pushed in the realm of dis–connected dreams and utopias, rendering the agent of the respective future as a mere illusionary (ibid., pp. 27–29).

Scholars questioning the role of expectations within science and technology policy carved out several essential aspects of how expected future results and applications of science and technology are made to matter, when it comes to organizing, arranging and regulating science and technology. Not only do expectations generate activities and provide a means of *legitimating* them, they also enable scientists and technologists to mobilize other actors, to connect their field of research to societal challenges, as well as inscribing themselves into broader processes of imagination (Borup et al., 2006). As Harro Van Lente (2006) argues, expectations guide scientists in their research, they help them in defending their activities by *promising relevance* with regard to final outcomes, e.g. in the light of momentary setbacks or at the very beginning of the research process. If scientists and policy makers are successful in *assembling* and *stabilzing* expectations, this in turn creates agendas, lists of priorities that demand action. What Van Lente describes as the *"promise requirement cycle"* in science and technology, can be grasped as one essential part in making more general futures: in technological development expectations are transformed into promises, which in turn lead to the articulation of requirements. Persuing these requirements feeds back into the formation and consolidation of further promises (Van Lente, cf. Geels & Smit, 2000, p. 881). Expectations are therefore rhetorical devices to generate action, similar to Michael's notion of performative futures.

Following Van Lente and Rip (1998, pp. 228–231) we can question how expectations relate to so called *funnels of interests* in literature on research and development. While in initial phases of research societal challenges receive wide attention in order to legitimate and stabilize emerging research fields and agendas, in the course of time they often transform into self–sustaining promises, that do not need further justification. As John Law (1986, p. 77) put it, the funnel represents a channelled shift from the general — the broad end of the funnel meant to *"suck in as wide an audience as possible"* — to the particular, *"preventing escapes"* on the way down and trying to secure that the audience reaches the right conclusion.

Ian Welsh (2000, pp. 6–8) takes the nuclear case as an example to study future oriented discursive strategies which are deployed in implementing science and technology. He argues they can be understood as a repertoire of strategies in science policy and implementation, which have been stabilized over time by repetition.

Freezing time by claiming the future: Nuclear projects typically involve long time scales and many uncertainties. Therefore claims usually are built on distant futures to render uncertainties negligible, while the subject benefiting in the distant future are huge collectives, such as humankind.

Locating the future on a new frontier: This set of discursive work evokes contingencies and uncertainties on the one hand, since it renders innovations as happening in the realm

of the yet unknown. On the other hand it *"translates risk into certainty"* by *"subordinating knowledge deficits to a future in which they have been resolved"* (ibid., pp. 6–7).

Asserting superior knowledge claims: As Welsh argues invoking scientific authority is central in arguing for future developments, which is mostly achieved by referring to past achievements. In that sense relating the present to a specific past helps to create the necessary symbolic capital for making claims about the future.

Asserting imperatives: If established properly imperatives can act as *"discursive trump card*[s] *capable of dismissing any counter–argument"* (ibid., p. 7). The most prominent version of such imperatives is known as TINA: there is no alternative.

Discounting residual difficultires into the future: In the case of nuclear research and development Welsh speaks of different forms of displacing unsolved problems into the future, that are invoked by reference to the distinction of basic and applied science. So difficulties are rendered as solved in the future, because by then basic science will have figured out the underlying processes of the problem. In the second case difficulties in application will be solved by then, because engineers and operators are already tinkering on solutions, while the basic process are already "discovered".

Asserting faith in progress: For Welsh scientific and technical progress is so deeply rooted in modern thinking that it becomes quite hard to challenge progress, once it is invoked in most circumstances. In the nuclear case he sees progress as very often invoked in a *"paradoxical manner"*: scientific elites rely on their authority and appeal to progress as being rational, while they *"call for the suspension of rational and economic doubt on the basis of 'faith'"* (ibid., p. 8).

At the beginning of this section I set out to provide a framework for the analysis of institutional and symbolic dimensions of appropriating science and technology, understood as a process of co–production of scientific, natural and social orders.

Discussing the conceptual history of the notion of technopolitical culture and giving some first hints on important aspects in the Austrian case, I provided a framework for the analysis of the institutionalization of the "atomic age" in post–war Austria.

In discussing the notion of sociotechnical imaginaries I then proposed a conceptual framework to account for the symbolic dimensions of appropriation processes. In doing so I focussed on two sets of interrelated social practices that deserve special attention within such an analysis: the role of national identity and the importance of temporal aspects, most prominently the role of the future. In the following I will lay out some methodological aspects, in order to operationalize the concepts outlined above for confrontation with empirical material.

5 Methodological Considerations

5.1 Corpus building

Departing from existing research the main two bodies of relevant archive material were considered the documents of the Austrian Commission on Atomic Energy at *Österreichisches Staatsarchiv*[4] and the documents of the *Institut für Radiumforschung* including the estate of Berta Karlik at *Archiv der Österreichischen Akademie der Wissenschaften*.[5]

Going through the documents in a process of *open* and *theoretical sampling* (Strauss & Corbin, 1998, pp. 201–207) the protocols of the Austrian Commission on Atomic Energy (see section 6.3), and drafts for official statements and memoranda along with correspondence between members and key actors were used to form the core of the corpus of materials. The notion of *open sampling* allowed for the search and inclusion of further materials, e.g. newspaper articles, scientific papers, pictures and newsreel reports as well as documents by the United Nations, which were made publicly available, until *saturation*. The *open* sampling process was backed up by *theoretical sampling*, which basically means that theoretical predispositions gained from reading and assessing existing literature were utilized to identify, find and evaluate different corpora of materials. Beyond existing literature I followed suggestions of the *Sociotechnical Imaginaries Platform* of the *Program on Science, Technology & Society* at *Harvard University's John F. Kennedy School of Government* (STS Research Platform: sociotechnical imaginaries, 2014).

5.2 Relational mapping

Next to going back and forth between identifying relevant materials and preliminary analysis I followed the suggestions of Adele Clarke (2005, pp. 86–109) to draw preliminary *messy maps* followed by *relational maps* in order to constitute a *situational map* of the phenomenon in question. For this mapping process I made use of the *network view* tool of *Atlas.ti, 6.2.28*, which allows the visualization of *codes* as network *nodes*. The nodes can be related to each other by a standard set of about a dozen relational forms, which can be easily extended with individual relational forms if needed. To begin with I started to relate the address of President Eisenhower in front of the UN General Assembly in 1953 (see section 6.1) with the national decision to form an Austrian Commission on Atomic

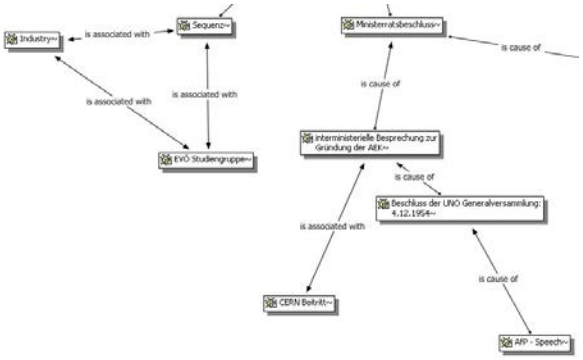

Figure 1: Part of early relational map

[4] Österreichisches Staatsarchiv, Archiv der Republik, Bundesministerium für Unterricht, 1. Hauptreihe, Stichwort Atom, Kartons 63–64. From now on ÖStA, AdR, BMU, Atom, K(Nr. of box).

[5] Archiv der Österreichischen Akademie der Wissenschaften, Bestandsgruppe 11: FE-Akten, Institut für Radiumforschung. From now on AÖAW, FE-Akten, IR, K(Nr. of box), F(Nr. of microfiche).

Energy by the national government (see figure 1). The network view of Atlas.ti allows for attaching memos and notes to the different nodes as well as the maps in general, which provided an excellent resource to assign (and constantly reassign) documents to items on the map during the processes of sampling and preliminary analysis. Furthermore the use of the memo function allowed for writing down assumptions on the relation between the different actors, institutions and events. During the process of corpus building and initial research the map could be easily reassembled and changed each time new insights and realizations demanded reconceptualization.

5.3 Mapping an unfolding situation

After early relational maps had become quite big in the sense of covering a large number of actors, issues and elements, I started to further shift the research process towards the end of preliminary analysis. Sorting, arranging and organizing all the different materials with relation to their specific contents allowed for the construction of a first blue print of the historical account/descriptive narrative that this process was aiming for.

Following the suggestions of the STS Research Platform as well as Clarke (2005, pp. 266–267) I focussed on documents of some sort of programmatic nature. Throughout the process of sampling and preliminary analysis it had become quite clear that the focus of the project would increasingly narrow down with regard to the period in question. At the beginning documents from directly after World War II up to the early 1960ies were gathered and taken into account. Focussing on the research questions described in section 3 an increasing number of documents dealt with the period from late 1953 up to early 1956. Taking into account the latest publications this was not very surprising. Recent historical analysis carved out the increase in public reception, institutionalization and economic development at this point in time.

Against this background I decided to come up with one situational mapping, trying to cover the appropriation phase between Eisenhower's Atoms for Peace speech in late 1953 and the UN Conference on the Peaceful Uses of Atomic Energy in 1955 including its immediate aftermath. This way the early phase of the appropriation process could be studied in detail, in order to account for the multiple dimensions carved out in the research question. Clarke (2005, p. 268) suggests to do multiple situational maps in order to cover the temporal structure of investigated phenomena. While doing so certainly suits the object of study in historical accounts over longer periods of time, it comes along with difficulties for the case in question. The period of interest are roughly two years, while most developments concentrate in the phase from late 1954 to August 1955. In a study aiming to cover the whole history of appropriating nuclear technologies in Austria, this time frame would most likely qualify for one situational map of many others. In this case it is singled out for in–depth analysis however. Providing several situational maps within this short period of time is not feasible, because records on the object of study are

limited. Therefore the necessary saturation for situational mappings in multiple points in time cannot be achieved within this short period.

Instead of doing several situational maps to cover the temporal structure I decided to do one mapping of an "unfolding" situation. Instead of reducing the period of two years to one situation in order to account for changes in a longer period that is investigated, I acknowledged that the single situation has a temporal dimension as well, and is as such emergent and unfolding. In contrast to Clarke's suggestions I accounted for time by arranging earlier moments and aspects on the bottom of the situational map, while later developments were positioned towards the top. Beyond that the relational forms defined to arrange the different nodes very often involved a temporal dimension, e.g. *"is result of"*. Of course positioning the different items on the map always involved a certain kind of reduction, sometimes to a rather crude extend. Nonetheless the mapping process itself was a very useful tool to order and structure all the materials by focussing on actors, events, developments etc. Even though the map itself was anything but a visual representation of the historical processes in question, it accounted for the unfolding character of the situation. The necessary reductions involved in the mapping process were reflexively accounted for in various memos and notes.

The last step of the mapping process was transforming this blue print into a written narrative of the unfolding situation, which reflexively describes the different historical developments (see section 6). This narrative is intended to be rather descriptive, in order to provide a substantive basis for in–depth analysis. By making extensive use of programmatic quotations, it lays the ground to answer the research questions focussing on the aspects of national identity and future making in the following section.

As the narrative account and the following analytical sections make use of archive records and other material, a few editorial remarks are important. In general references to archive material are given in footnotes. Since the material is almost exclusively in German, it is referenced by its original titles in German. If not explicitly noted otherwise, all direct quotations from records or materials referenced in German and quoted in English are my own translations.

In the public sphere terminology with regard to nuclear research does not seem to have stabilized until the mid 1950s, which results in an inconsistent usage of the words *"Atomenergie", "Kernenergie"* and the like. For matters of consistency I translated all combinations of *"Atom-"* with "atomic" (e.g. atomic energy) and all variations of "Kern-" as "nuclear" (e.g. *"Kernforschung"* as nuclear research). Explicit references to power production (e.g. *"Kraftstrom aus Atomenergie"*) have been translated to "nuclear power production". In sections 6 and 7 it will become clear that a certain shift occurred from general references to atomic energy to nuclear power production. In German language this shift benefits from a certain ambiguity, since the notion "Atomenergie" was increasingly equated with nuclear power production and lost the more general implications of the term.

5.4 Zooming in on national identity and futures

Based on the situational map as presented in section 6 I revisited the corpus of materials for a more detailed analysis with regard to national identity and practices of future making. As Jasanoff (2015a, p. 34) points out in reference to methodological approaches in the analysis of sociotechnical imaginaries, we should attend *"to the ways in which imaginaries frame and represent alternative futures, link past and future times, enable or restrict actions in space, and naturalize ways of thinking about possible worlds"* in our interpretative analysis.

Following this claim I reconsulted the archive material as it had been selected and pre-structured in the process of situational mapping and coded it with a focus on political culture, symbolic and discursive structures and practices that have been reflected upon in section 4. This way all parts and pieces flagged relevant in the coding process were transcribed and entered into a spread sheet, together with codings and identification numbers. Next the material was subjected to detailed analysis along the single codes and related to the situational mapping and existing literature for final depiction in sections 7.1, 7.2 and 7.3. Finally sections 6 and 7 formed the basis for a more general representation of the sociotechnical imaginary in question.

6 Mapping an unfolding situation: The "atomic age" in Austria

6.1 Early initiatives to form a commission on atomic energy

Investigating the appropriation of nuclear technologies in post–war Austria, US President Eisenhower's speech in front of the United Nations General Assembly is to be considered a decisive landmark. As Christian Forstner points out, the first decade after World War II was dominated by reconstruction efforts, also in the field of nuclear physics. Until Eisenhower's address the material conditions for establishing a program on the development of nuclear energy in Austria were simply not given. Atoms for Peace not only provided a foreign incentive in this direction, it also came along with the necessary resources to realize such an endeavour, e.g. financial support for purchasing US technology (Forstner, 2012, p. 165).

Two days after Eisenhower's speech in front of the UN General Assembly his remarks were extensively quoted on the front pages in Austrian newspapers. The *Arbeiter–Zeitung* opened with *"Atomic energy for peace, not for war. President Eisenhower in front of the United Nations — An appeal to Moscow to contribute to peace."* Overall the article stresses questions of international relations, including the Austrian State Treaty, and nuclear disarmament. Before reporting on the US initiative for an international organisation regarding atomic energy, the *Arbeiter–Zeitung* quotes the US president:

> *"The United States knows that peaceful power from atomic energy is no dream of the future.* [...] *To hasten the day when fear of the atom will begin to disappear from the minds the people and the governments of the East and West, there are certain steps that can be taken now."*[6]

In the follow–up article explaining the details of Eisenhower's proposal, he is once again quoted, explicating the peaceful applications of atomic energy: *"Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power–starved areas of the world."* (ibid.) Even though the future expectations with regard to atomic energy were prominently mentioned, the overall article and its tone were stressing conflicts between East and West as the central issues. The most important fact within the *Arbeiter–Zeitung*'s reception of the speech was the Austrian State Treaty. The next day's volume dedicated half the front page to the issue, stressing the open and welcoming nature of the US proposal as well as the invitation of the United Nations to the Soviet Union to react on it. Even

[6] Arbeiter–Zeitung, Atomkraft für den Frieden, nicht für den Krieg, 10.12.1953, S. 1. For the full-text of Eisenhower's address see: Atoms for Peace Speech, Address by Mr. Dwight D. Eisenhower, President of the United States of America, to the 470th Plenary Meeting of the United Nations General Assembly, http://www.iaea.org/About/atomsforpeace_speech.html, last visited: 27.10.2014.

more frankly than the day before the newspaper's reaction is aligning with the US proposal, accusing the Soviet Union of misjudging Eisenhower's speech and twisting its contents.[7]

At the lack of financial resources Austrian physicists were still lobbying for Austria's entry to the European Organisation for Nuclear Research (CERN) at this point. Already in 1951 Berta Karlik, head of the Department for Radiumresearch of the Austrian Academy of Sciences (*Institut für Radiumforschung, Österreichische Akademie der Wissenschaften, ÖAW*), demanded to be informed immediatly by the Department of Foreign Affairs of the Federal Chancellor's Office (*Bundeskanzlerat, Abteilung Auswärtige Angelegenheiten, BKA-AA*) with regard to further developments of such issues. Obviously neither her department nor any of her colleagues had been informed early enough to participate in the meetings in Paris on the creation of CERN.[8] At the end of June in 1953 the Federal Minister of Education Ernst Kolb reported to the Council of Ministers (*Ministerrat*) on the importance of Austria's CERN membership. According to this report Berta Karlik intervened by using her international contacts, which led to the assumption that Austria's annual fees could be negotiated down to 10.000 ATS (instead of 10.000 USD). The occasion was among the first to explicitly tie together national prestige and nuclear research and development:

> *"The scientific importance of this project as well as Austria's participation require no further explanation. Additionally one should mention that the contribution in preparatory work for the planned institution and the later participation in the work of the institute itself offer rich possibilities for Austrian sciences, that our country with its modest resources could never afford on its own. In view of the changed situation regarding the financial contributions it is imperative to the scientific prestige of Austria, not to exculde itself from participating in a scientific endeavor on such a large scale. Last but not least the rejection of participating could be interpreted as a lack of interest in European cooperation."*[9]

In March 1954, the Austrian Academy of Sciences adopted a position paper, which urged the Federal Ministry of Education (*Bundesministerium für Unterricht, BMU*) to take the first possible opportunity to apply as a full member to the newly founded CERN. When the Austrian Council of Ministers had finally decided that Austria should join the Council of CERN in July 1953, preparations had already been finished, which meant Austria could not easily join the Council of the founding members of CERN anymore, but had to apply to the newly founded institution. Among other things this meant further prolongation. The position paper closes with:

> *"What the contribution of Austria to the organisation would mean for its reputation in the scientific world, for our professionals in training and, in the distant*

[7] Arbeiter–Zeitung, Keine freundliche Aufnahme der Rede Eisenhowers in Moskau, 11.12.1953, S. 1.
[8] Karlik an BKA-AA, 27.12.1951, AÖAW, FE-Akten, IR, K50, F724.
[9] Vortrag von BM Ernst Kolb im Ministerrat, 30.06.1953. ÖStA, AdR, BMU, Atom, K63, GZ: 95.957/I.

future, once atomic energy is more extendedly used for peaceful purposes, also for Austria's economy, does not have to be elaborated."[10]

On the national level Hans Thirring was among the first to argue for the foundation of an Austrian atomic energy commission in order to strengthen the field of nuclear research. In a letter to Karlik he argued in August 1954 that he had approached her and Erich Schmid, since 1951 head of the II. physics department in Vienna, regarding this issue two or three years earlier. Thirring saw the creation of such an institutional body as *"the only way that raises the possibility to secure generous funding for nuclear research independent from the chronically insufficient budget of the Ministry of Education"*[11] and asked for her support. According to his account Karlik and Schmid had been reluctant to support the idea, because they feared the involvement of others.[12] Karlik responded that she wanted to discuss things with Schmid before she finally made up her mind. About a week later she informed Thirring that she, Schmid and Karl Lintner had decided to seek a conversation with him in person to clarify the issue.[13]

According to Thirring's explanations he had been approached by an engineer named W. Frank who wanted him among others to form the core of an Austrian atomic energy commission.[14] Consequently Thirring urged Karlik to support and join him by giving two reasons. First in 1956 the World Power Conference would be held in Vienna and as a member of the planning committee Thirring stressed the importance of taking steps. Second he wanted to make sure that he and his colleagues would be the ones in charge. He feared that they could be replaced by others, if they kept on waiting. Directly addressing Karlik's fears he further argued that she would *"not have to worry about Hardung joining the inner committee"*[15] because he was not involved in problems of power production and would not have a say with regard to the World Power Conference either (ibid.). So overall future scenarios of power production by nuclear power plants played a central role in his reasoning and argumentation.

Originally Thirring had opposed the idea of nuclear power production. Based on his reasoning that uranium was way to valuable to be burnt for energy production, he rejected the idea of nuclear power plants.[16] Based on estimations of global uranium and thorium deposits Thirring argued that global reserves would be completely burnt in a few hundred years, which he considered irresponsible in the light of them building the basic resource

[10] Österreichische Akademie der Wissenschaften, Stellungnahme, März 1954. AÖAW, FE-Akten, IR, K34, F477.

[11] Thirring an Karlik, 30.08.1954. AÖAW, FE-Akten, IR, K49, F706.

[12] "[...] *weil ihr Besorgnis hattet, daß sich dann Leute hineinmischen werden, die die Sache eigentlich nichts angeht."* (ibid.).

[13] Karlik an Thirring, 06.09.1954 und 16.09.1954. AÖAW, FE-Akten, IR, K49, F706.

[14] Unfortunately neither the estate of Thirring nor Karlik seems to contain the letter by Frank both refer to. Most likely Frank was a public official within the Federal Ministry of Commerce and Reconstruction (see below).

[15] Briefwechsel Thirring–Karlik. AÖAW, FE-Akten, IR, K49, F706.

[16] Hans Thirring, Dürfen wir Uran verheizen? Bau von Atomkraftwerken — unverantwortlicher Raubbau, in: Die Presse, Wochenzeitung, 12.07.1952.

for nuclear chemistry, the industrial potential of the future. Thirring explained that hydro power and solar energy could be further developed to meet global demands along with other alternatives. Just because nuclear power plants were profitable at the moment, the exhaustion of uranium deposits was not justified:

> *"I can well imagine that within a time that is infinitesimally short compared to the millions of years of future history of man, people will begin cursing the physicists and technologists of our own age for having erected, under the name of atomic power generators, Molochs destined to consume, year by year, ton after ton of irreplaceable uranium, until all economically worhtwhile ores have been exhausted."* (Thirring, 1952, p. 171)

Interestingly Thirring changed his mind even though he had been convinced enough in this scenario to agitate via national newspapers and the *Bulletin of Atomic Scientists*. However in a paper on energy production and consumption within the next century, he conceded that he had been wrong about the issue in 1954. Giving a brief introduction on the matter of global energy consumption throughout history and (modest as well as more optimistic) estimates on global fuel deposits he recommended the development of nuclear power production. Thirring argued that based on various combinations of the different estimations on fuel deposits, the development of the world population and the development of power consumption *"the cumulative total consumption will spike to an extent that even in the most modest case, existing fuel deposits will be decimated quickly"* (Thirring, 1954, p. 345). In his point of view covering energy needs with renewable energies was impossible in the light of this development, especially because the exploitation of solar energy was not competitive with fossil fuels and a problem in terms of global distribution. He continued:

> *"Most likely humanity would have had to try this solution within the 21st century, after the depletion of oil and coal reserves, if atomic energy had not — exactly at the right moment in time to make technical adjustments — appeared as a deus ex machina."* (ibid., p. 346.)

A detailed discussion of the different scenarios and the way Thirring was able to change his position in such a substantive manner within the practice of making such scenarios follows within the next section (7.3.2).

6.2 The Austrian Electrotechnical Association

At this rather early stage the Electrotechnical Association of Austria (*Elektrotechnischer Verein Österreichs, EVÖ*) provided a forum for promoting nuclear energy. On the occasion of its 70$^{\text{th}}$ anniversary in January 1953 the EVÖ published a small brochure. Recapitulating the last seven decades the self–understanding of the association was described as follows: *"The Electrotechnical Associtiation of Austria is on behalf of past and present destined to*

represent all Austrian electrotechnicians."[17] Besides the publication of the association's journal *Elektrotechnik und Maschinenbau (E und M)* one of the EVÖ's activities was the promotion of atomic energy by spreading knowledge on nuclear physics. In the first months of 1953 Karl Lintner gave a series of lectures within the association on the basics of nuclear physics for electrotechnicians. Dr. Saic from the EVÖ organized a visit at the Department of Radiumresearch in cooperation with Karlik at the end of March 1953 for a maximum of 50 people. According to their correspondence only a handful of people actually showed up, even though the visit was promoted in *E und M.*[18]

In the end of November 1954 the EVÖ had decided to form a research committee on atomic energy (*Studiengruppe für Atomenergie im EVÖ).* Again the focus was on communicating basic knowledge on nuclear physics for interested people within the engineering community.[19] The overall aim of the research committee was to facilitate exchange and coordination between basic science in the field of nuclear physics, technology and interested sectors of the economy. Beyond lectures and studying literature the research committee had limited resources for actual research. The Department of Radiumresearch was considered the only institution for experimental work. The key actors were predominantly from the Austrian Acadamy of Sciences, the University of Vienna and the Technical University of Vienna.[20] A memo on the activities of the research committe within the Federal Ministry of Education[21] notes the importance of president Koci himself, who was the main public official dealing with the electrification of the Austrian Federal Railways within the Federal Ministry of Traffic and Nationalized Enterprises (*Bundesministerium für Verkehr und verstaatlichte Betriebe*, BMVVB) as well as the chair of the executive committee of the World Power Conference. Together with his presidency within the EVÖ he was perceived to combine several spheres of interest within one person. Within the next few months the research committee was devided into three subgroups along the spheres of *research*, *technical aspects* and *economic aspects*.

The research group was formed by Berta Karlik, Hans Thirring, Ludwig Ebert, Georg Stetter, Erich Schmid and Karl Lintner. Karl Chiari was co–opted within the first session of the committee to represent the field of medicine. Heinz Sequenz, a specialist on heavy currents at the Technical University of Vienna, and his colleague Ernst Melan, who was specializing in heat technology, formed the technical subgroup of the committee within the EVÖ. The economic group was chaired by the director of the power plant corporation of upper Austria (*Oberösterreichische Kraftwerke AG)* Holzinger, who was also the chair of the Austrian National Committee of the World Power Conference (ibid.). Later on he

[17] Der Elektrotechnische Verein Österreichs, Jänner 1953. AÖAW, FE-Akten, IR, K50, F731.
[18] Briefwechsel Karlik–Saic, Jan–Mar 1953. AÖAW, FE-Akten, IR, K50, F750.
[19] Einladung von Saic an Karlik, 30.11.1954. AÖAW, FE-Akten, IR, K50, F750.
[20] Anwesenheitsliste Gründungssitzung: Min.Rat Dr. Koci (Vorsitz), Gen. Dir. Dipl. Ing. Holzinger, Prof. Dr. Ebert, Prof. Dr. Karlik, Doz. Dr. Lintner, Prof. Dr. Melan, Dr. Saic, Prof. DDDr. Sequenz, Prof. Dr. Stetter and Prof. Dr. Thirring.
[21] Aktennotiz zur Studiengruppe im EVÖ, 1955. ÖStA, BMU, Atom, K63, GZ: 26306/I/1,55.

was supported by W. Frank from the Federal Ministry of Commerce and Reconstruction (*Bundesministerium für Handel und Wiederaufbau*).[22]

Along with the formal foundation of the research committee dates and topics for another series of lectures were fixed. Other than that the meeting on December 16, 1954 served as an opportunity for mutual updating: The plans for the foundation of the research committee had been outpaced by bigger developments (ibid.). Within the first two weeks of December steps were taken to create an Austrian atomic energy commission (see section 6.3).

Within the following processes the EVÖ repeatedly served as a forum for different actors to coordinate or exchange ideas as well as a pool of experts, e.g. for expert reports.[23] In February the research committee fixed the rules of procedures, which once more sharpened the aim of the organisation: *"To* [...] *financially support scientific and industrial work on a higher level, which is able to contribute to the scientific and industrial and hereby also the economic progress of Austria in the shortest period of time."*[24] The focus within this framing was to support young researchers, in order to provide them with material grounds for *"a future in Austria"* (ibid.), which meant funding up to 1.000 ATS per month. Besides such funding opportunities, which were supported with money from the Austrian electric power industry as well as electric industries[25], the EVÖ offered further courses to distribute knowledge on nuclear physics throughout 1955.[26] In reference to Hecht (2001) we could say that these activities within the EVÖ can be seen as a first attempt, to strategically establish a technopolitical regime by connecting different actors through an institutional body.

6.3 The UN General Assembly and the creation of the Austrian Commission on Atomic Energy

The catalyzing event for Austrian nuclear physics was resolution A/RES/810(IX) on international cooperation in developing the peaceful uses of atomic energy by the United Nations General Assembly on December 4$^{\text{th}}$ in 1954. The resolution provided the grounds for the creation of the International Atomic Energy Agency (IAEA) and decided that an international conference would be held in order to facilitate the development of atomic energy among all member states of the United Nations or one of its organizations.[27]

Only two days later the Department of Foreign Affairs of the Federal Chancellor's Office in Austria sent out invitations for a meeting of public officials in relevant ministries and institutions to discuss the participation of Austrian officials in the UN Conference and

[22] Protokoll der 1. Sitzung der Studiengruppe, 10.01.1954. AÖAW, FE-Akten, IR, K50, F751. Koci an Hoyer/BMU, ÖStA, AdR, BMU, Atom, K63, GZ: 78418/I/1/55.
[23] Karlik an Hoyer/BMU, 22.01.1955. AÖAW, FE-Akten, IR, K50, F829.
[24] Geschäftsordnung der Studiengruppe im EVÖ, 07.02.1955. AÖAW, FE-Akten, IR, K50, F751.
[25] Protokoll der Studiengruppe vom 21.03.1955. AÖAW, FE-Akten, IR, K50, F752.
[26] Kursprogramm in der "E und M", Oktober 1955. AÖAW, FE-Akten, IR, K50, F752.
[27] UN General Assembly, Resolution No. A/RES/810(IX), 04.12.1954. Retrieved from: http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/810(IX).

related issues. Invitations were sent to the Federal Ministry of Education, the Department of Radiumresearch, the Federal Ministry of Social Care (*Bundesministerium für soziale Verwaltung, BMSV*), the Federal Ministry of Finance (*Bundesministerium für Finanzen, BMF*), the Federal Ministry of Traffic and Nationalized Enterprises (*Bundesministerium für Verkehr und Verstaatlichte Betriebe, BMVVB*), the Federal Ministry for Commerce and Reconstruction (*Bundesministerium für Handel und Wiederaufbau, BMHW*) as well as the Federal Ministry of Agriculture and Forestry (*Bundesministerium für Land- und Forstwirtschaft, BMLF*). Among others a central topic on the agenda was a proposal to the Council of Ministers to form a commission, consulting the Austrian government with regard to atomic energy, which would also be in charge of coordinating all issues of the peaceful uses of atomic energy in Austria, including the participation in the UN Conference on the Peaceful Uses of Atomic Energy. Beyond that the representatives were invited to discuss the offer by the US government to send an Austrian expert to the reactor training school at the Argonne National Laboratories in 1955, to have Austrian medical practitioners and surgeons visit US cancer hospitals using treatments based on atomic energy, the question of purchasing a research reactor for the production of radioactive isotopes for the application in medicine, agriculture and industry as well as the question of a contract between the Austrian and the US American government regarding the exchange of information, technical assistance and fissionable material for a research reactor. Finally the offer of the US to have foreign experts participate in training courses in various fields was up for discussion, next to possibilities for preparations of power production by utilizing atomic energy in Austria and once again, the Austrian membership in the European Organisation of Nuclear Research.[28]

Together with the agenda a few pages of additional attachments were provided, to inform the various representatives about recent developments. Regarding the foundation of the IAEA and the aforementioned UN resolution the report of the BKA-AA notes:

> *"With regard to Austria there are no regulations prohibiting the contribution of Austria to such actions for the peaceful uses of atomic energy, neither within the second agreement on the controll of Austria by the four allied forces of 1946* [Zweites Kontrollabkommen; comment FB] *nor within the draft of the Austrian State Treaty."*[29]

Keeping in mind the performative aspects of referring to the future and expectations also being argumentative resources in science policy, these documents provide very rich material. Regarding the problem of nuclear power production a report informed about the US initiative for five experimental power reactors and continues: *"In American opinion electricity produced by atomic energy is unlikely to be as cheap as elecriticity produced by*

[28] Einladung vom BKA-AA an das BMU, 06.12.1955. ÖStA, AdR, BMU, Atom, K63, GZ: 95.957/I.

[29] Einladung, Tagesordnung und Anhang zur interministeriellen Besprechung am 21.12.1954, ausgesendet vom BKA-AA, 11.12.1954. AÖAW, FE-Akten, IR, K50, F726.

contemporary methods for the time being. However there is justified hope for power production of that kind in the long run." (ibid.) According to the report the president of General Electric, A. Cardiner, had announced that until 1976 nuclear power reactors would amount to half of all power generators in operation and urged to be careful with plans for and the construction of traditional power plants. The report also mentioned activities by US industries and referred to ten research reactors under construction and the expectation that US private industry *"will use atomic energy within the next ten years."* (ibid.) Furthermore a request by the US Federation of Labor to the US Atomic Energy Commission was said to be demanding a report by the AEC to the US President explaining the *"economic, social and international effects of the use of atomic energy within the American private economy."* (ibid.) Besides a short technical introduction on nuclear power reactors the high efficiency of uranium was argued to be the main advantage of nuclear power production. Transportation costs would be almost zero, because 1kg of uranium could be utilized to produce the same amount of thermal effects as with 2,5t of coal, while natural uranium *"is anything but scarce."* (ibid.) Finally the USSR was reported to have a nuclear power reactor in operation since June 1954, which was almost competitive with traditional forms of power production, while the USSR was already building nuclear power plants on the scale of 50.000 to 100.000kw (ibid.).

In a preparatory meeting of the BMU that included various representatives of the Austrian Academy of Sciences, the University of Vienna and the Technical University of Vienna a public official stressed that the question on nuclear power production in Austria should be left to the respective experts, namely Prof. Sequenz and his associates. One of his associates underlined Sequenz' expertise, since Sequenz had dedicated his inaugural lecture to the problem of nuclear power production. Karlik on the other hand stressed that the EVÖ was interested in producing electric power by atomic energy for years and noted that engineers were already prepared and informed by talks and public lectures. Thirring was astonished that Austria's CERN membership was still not finalized, while the representative of the BMU noted that *"everything needed to be done, in order to realize Austria's membership."*[30]

The meeting between the different ministries itself took place on December 21st. All invited ministries sent public officials, while Berta Karlik as the representative of the Department of Radiumresearch was involved on behalf of the scientific community. All ministries expressed greatest interest in the questions at hand and supported the request for the Council of Ministers to form an Austrian commission on atomic energy: *"All departments endorsed the suggestions to have the Federal Minister of Foreign Affairs file the request, because of the importance of the matter."*[31]

[30] Vorbesprechung im BMU am 18.12.1954. ÖStA, AdR, BMU, Atom, K63, GZ: 95.957/I.

[31] Protokoll der interministeriellen Besprechung am 21.12.1954, 22.12.1954. AÖAW, FE-Akten, IR, K50, F726.

The tasks of the Austrian Commission on Atomic Energy were decided to be: taking preparations for the participation in the UN Conference, to ask for an expert's report on the suitability of purchasing a research reactor, calculating the costs of the acquisition and operation of a research reactor as well as to acquire funding, the realization of the aforementioned contract with the United States and the question of Austrian participation in various training courses as offered by the US. While the BMU expressed interest in participating in the reactor training school, both BMSV and BMU were in favour of sending Austrian medical practitioners and surgeons to the US. Regarding the acquisition of a research reactor several ministries expressed their support, especially the BMLF, because of *"the possibility to store foods for an unlimited period of time and the stimulation of growth within plants by using radioactive isotopes"* (ibid.).

While the procurement of funding was considered to be one of the main problems the need to address Austrian industries was already stressed within this first meeting. The BMSV expressed its interest in sending people to the US for training in the fields of industrial medicine, industrial hygiene and radiological physics, so that different sectors of Austrian industries could be prepared for the use of atomic energy.

As a result of these considerations first decisions were made. The protocol states that the expert's report should not only deal with the question if a research reactor should be purchased, but also when and preferable also what type:

> *"[...] in any case not a reactor for the production of radioactive isotopes, because those can already be imported cheaper from England, and also not an energy reactor (for experiments on the production of electricity), because the responsible officials are of the opinion that in this area the results of other states should be awaited first."* (ibid.)

With regard to nuclear power production the BMVVB expressed the opinion that taking experimental steps would be too early. More importantly foreign developments should be awaited, while Austrian activities on the sector should be coordinated. A representative of the BKA noted that a few months earlier the American expert Mr. Cisler gave a talk on the issue in Vienna and stressed the fact that nuclear power production would not enter competition with traditional forms of energy production, because energy consumption would be rising every year. Nuclear power plants would therefore only complement traditional methods of power production in the future. For the time being the costs of nuclear power production were perceived as extraordinary high, while profitability would vary in the different regions of the world, depending on the distance to reserves of coal. For now the representatives decided to continue collecting materials on the issue (ibid.).

Federal Minister Leopold Figl reported to the Council of Ministers on Jannuary 11$^{\text{th}}$. He stressed that the proposal was in line with Eisenhower's suggestions in late 1953 and the UN General Assembly's decision to hold a conference in December 1954. He refereed to the

prior meeting of the ministries as an *"informative talk"*[32] among affected officials. According to his report the ministries *"expressed serious interest"* and *"suggested the creation of an advisory commission to the federal government, in charge of the coordination of all concerns regarding the peaceful uses of atomic energy"* (ibid.). Finally he filed the request to create the commission based on representatives of ministries participating in the informal meeting and authorizing the commission to in case co–opt any Austrian representative. According to the minutes the request was accepted without further discussion, only the BMF stressed that the participation in the commission was on a voluntary basis and must not result in further costs.

6.4 The Geneva Conference and related activities in Austria

So the overall conditions for nuclear physics in Austria substantively changed between the end of 1953 and the beginning of 1955. Repeatedly the vision of nuclear power production was a central line of argumentation to support nuclear physics and its applications. In January 1955 the Austrian Commission on Atomic Energy had been formed and among its main tasks was the preparation of Austria's participation in the UN Conference on the Peaceful Uses of Atomic Energy in Geneva and preparing the acquisition of an Austrian research reactor in cooperation with the United States' Atomic Energy Commission. In the following section I want to investigate both of these developments with a focus on their contribution to the creation and consolidation of a future including the production and consumption of nuclear power. Especially the preparations for the Geneva Conference triggered a lot of activities within the ACAE, stimulating appropriation through future–oriented practices related to national identity.

6.4.1 Taking initial preparations for Geneva

As had been decided in December 1954 the newly founded Commission on Atomic Energy was appointed to coordinate Austria's participation at the Geneva Conference. In its second session the commission decided to prepare a memorandum on previous and present peaceful uses of atomic energy in Austria including present plans for the future, which would be submitted as part of Austria's conference documents. *"The aim of the memorandum [...]"* was *"[...] to show the world that Austria has been using atomic energy for peaceful purposes for years and is among the leading European nations in the field."*[33] Berta Karlik was authorized to coordinate the draft of the report in cooperation with the BMU. For a second memorandum on reactor plans another subcommittee was formed.

[32] Protokoll der 75. Sitzung des Ministerrates am 11.01.1955. BKA-AA, Vortrag an den Ministerrat, GZ: 329.020-INT/55. ÖstA, AdR, MRang MR 2. Rep. Mrp Kv 132.

[33] Protokoll der 2. Sitzung der Österreichischen Kommission für Atomenergie am 24.01.1955, ausgesendet am 27.01.1955. From now on: 2. Sitzung der ÖKAE am 24.01.1955, 27.01.1955. AÖAW, FE-Akten, IR, K50, F727.

6.4.2 *"Memorandum on the peaceful uses of atomic energy in Austria"*

The final memorandum seems to be mostly based on two other documents that have been circulating through the Federal Ministry of Education. On the one hand Traude Bernert, who was working at the distribution center at the Department of Radiumresearch, had published an article on the uses of radioisotopes in Austria in September 1954. Quite similar to Karlik's repeated argumentation within the commission on atomic energy Bernert stressed the importance of the distribution center:

> *"Today almost all European countries have a distribution center or are on the way of implementing such an institution. Austria was among the first countries, realizing a distribution center for radioisotopes."* (Bernert, 1954, p. 246)

On the other hand Ferdinand Cap, former assistant of Hans Thirring in Vienna and by now a young theoretical physicist at the University of Innsbruck, provided an exposé[34] of more than 40 pages, giving an introduction to key principles of nuclear reactors, nuclear power reactors and an overview on all contributions of Austrian physicists working in Austria and abroad. The paper is entitled *"On the peaceful uses of atomic energy"* and structured in three parts. After introductory remarks that are dealing with terminology around atomic energy, atomic power and nuclear energy the second section is dealing with the generation of power. After explaining fast and slow chain reactions Cap addresses the basic function of a fission reactor and lists four main purposes of nuclear reactors: a) the production of plutonium for nuclear weapons or nuclear reactors b) the generation of power c) research based on neutrons and d) the production of radioactive isotopes.

With regard to a) Cap highlighted the potential use of plutonium for power production and already existing breeder reactors in other countries. The problem of non–peaceful applications was simply not addressed. With regard to b) he expressed the expectation that energy costs per kilowatt–hour could be further reduced with nuclear power reactors *"since the energy content of one gramm of uranium is already equivalent to 2,5 tons of coal today"* (Cap, 1955, p. 6). Consequently Cap argued that very small reactors for power generation could also be used for research and the production of radioactive isotopes, which were both considered important for the material sciences and medicine. Other than that research on thermonuclear fusion was stated to be important as well: *"Currently there seem to be little expectations, that such reactions can be used for earthly purposes beyond the production of thermonuclear weapons, however everywhere work is in progress to also slow down these reactions and bring them under control"* (Cap, 1955, p. 7).

Over the next 15 pages Cap listed all applications of atomic energy known to him within different scientific fields and industry sectors in order to exemplify the enormous developments that could be expected from atomic energy. Overall he mentioned more than twenty different uses of tracing radioactive isotopes in organisms or materials, more

[34] Ferdinand Cap, Exposé über die friedliche Verwendung der Atomenergie. AÖAW, FE-Akten, IR, K50, F727–728; ÖStA, AdR, BMU, Atom, K63, GZ: 37772/I/1/55. From now on: Cap, 1955.

than ten versions of measuring density and thickness, eight cancer related treatments as well as several cases of determining age of different substances as well as using isotopes as a cheap substitute for traditional radiation emitters to treat materials and organisms. Every time Cap finished his reasoning on a promising field he either referred to Austrian applications in progress or to more universal benefits and expectations. E.g. the use of radioisotopes to measure the thickness of materials was exemplified by snow measurements with regard to power generation by hydro power in Austria — which was also picked up in Karlik's memorandum (see below) —, whereas the treatment of foods was exemplified with regard to humankind: *"Based on the knowledge gained on photosynthesis, it will be possible to synthetically produce foods in the future. In doing so the nutrition of humanity is no longer dependent on living plants."* (Cap, 1955, p. 17). In terms of Michael (2000, pp. 26–27) we can observe that the promised applications have a very different subject and time horizon. Measuring snow heights with nuclear technologies is staged as a near future that is already practiced on an experimental level, the profiting subject being the Austrian nation. Solving world hunger on the other hand seems to have a rather indefinite time horizon, at least this kind of future is not staged as very near. Equally vague the beneficiary seems to be unclear as well, so developments are staged in terms of a universal trajectory (see section 7.3.3).

The degree of optimism towards future applications can be captured by the way Cap addressed newly emerging radiation treatments: *"Nuclear energy is capable to provide antidotes also for the damaging effects of nuclearphysical radiation"* (Cap, 1955, p. 15). In other words, the potentials of nuclear physics were described as self–referentially able to solve the problems they cause in the first place. With regard to the effects on industrial production, the promoted vision was anything but modest either: *"With the help of radioactive isotopes and electric equippment the construction of automated factories is possible without a blink"* (Cap, 1955, p. 21). The potentials of nuclear physics could not be overestimated according to the final paragraph of this section: *"Today we can easily claim that there is hardly an aspect of human life, that could not benefit from nuclear physics. The respective specialists just have to approach a nuclear physicist with their worries and problems"* (Cap, 1955, p. 25.).

The last section of Cap's exposé was debating possibilities for Austria within the field of nuclear research. After a few pages of name dropping to foster the idea of a long tradition of Austrian nuclear physics[35] Cap dedicated himself to proposing measures to support the

[35] Cap referred to research and contributions of "Austrian" physicists all over the world. Beyond the work of Lintner, Urban (Graz) and March (Innsbruck) all other scientists — among them Erwin Schrödinger and Otto Frisch — are referenced with regard to their last Austrian University *", currently in ..."*. Cap did not mention that most of these people had been persecuted and therefore left Austria, nor was he differentiating with regard to those scientists who resided in the USSR, or in the case of Gustav Ortner, had to look for work in Kairo, because of denazification. Ignoring the recent past, everyone who had roots in Austria was incorporated to draft a great Austrian history of nuclear physics (Cap, 1955, 26–27). Reiter and Schurawitzki (2005, p. 252) describe a similar approach in dealing with the past with regard to the post–war depictions of Frederic de Hoffmann by his former colleagues in Viennese physics departments.

application of radioisotopes in Austria. In order to claim the necessary authority for his promises Cap invoked past achievements in science and technology (Welsh, 2000, p. 8). He equated the newly emerging technology with the introduction of electricity:

> *"The extension of possible applications of these substances seems absolutely necessary and the use of radioactive indicators respectively the renunciation of these is at least comparable with the introduction of electricity respectivly the decision not to have an electric power industry, with the only difference that the use of radioactive indicators bears almost no investment costs and the applications are far more versatile than those of electricity"* (Cap, 1955, p. 28).

His suggestions were quite straight forward: strengthening the distribution center at the Insitute of Radiumresearch, strengthening of transport infrastructure, appointing representatives for radioisotopes within industries as well as measures for popularizing the knowledge around applications and the education of people in the industrial sector.

Quite similarly Cap advanced propositions to strengthen nuclear research in Austria by listing several research areas and stressing the need to raise the effectiveness of nuclear power plants. *"Suitable measures to secure, that Austria is able to reengage in research in nuclear physics, or at least can keep or rather catch up with international developments"* would be joining CERN, sending Austrian researchers to foreign laboratories for training courses, an increase of scientific staff, more money for buying literature and reimbursement for lacks of funding since 1945, more administrative staff and rooms, reimbursement for costs researchers had been paying by themselves as well as raising the use of radioisotopes and the construction of a research reactor to stimulate nuclear research in general (Cap, 1955 p. 30–34).

With regard to the reactor question Cap argued against the construction of nuclear power reactors in Austria. He described them as slightly more expensive than hydro power plants or thermal power stations because of expensive radiation protection and intensive maintenance for the time being. Austria should rather invest in expanding the hydro power sector and probably think about nuclear district heating to save foreign currency, once reactors became competitive. Cap advised against investing in atomic cars, locomotives and airplanes, because these areas still demanded a lot of research that was to be considered a matter of the super powers that should be realized within the next ten years. Nonetheless Cap stressed the contributions of two Austrians who were involved in the development of nuclear airplanes in Germany and France.

The fact that Germany, the Netherlands, Switzerland, Norway, Sweden and Rumania were building middle sized reactors similar to the one in Brookhaven, MA did not necessarily urge Austria to construct a reactor of similar size according to Cap. A small research reactor could also be used to create needed radioisotopes of fast decay, while all others could still be imported. A small research reactor would suffice to meet the demands of

science and industry for the next ten years, and also enable Austria to engage in research with regard to middle sized and nuclear power reactors (Cap, 1955, p. 41–43).

By mid–March 1955 Karlik had already started a draft on the memorandum, which started to circulate in the second half of March 1955.[36] The first section of the draft entitled *"On the peaceful uses of atomic energy in Austria"* reported on the use of radioisotopes. Karlik debated the increasing use of radioactive isotopes in Austrian institutions ever since 1949, when the Department of Radiumresearch managed to reach an agreement with British authorities and established a distribution center for radioactive materials. The center had complete control over imported materials in Austria and was preparing to expand its connections towards Holland, Norway and especially the United States by 1955. While over 30 institutions were applying atomic energy for medical purposes, 15 institutions were working on *"scientific applications"*. On the industrial and technical sector the most valuable applications were considered *"testing new pipe lines for water power stations high up in the mountains"* density measurements within the Vienna city center for *"a large new underground passage"* [Opernpassage, comment FB] and *"an apparatus for snow measurements"*, which was considered "*of importance for the water supply of the power stations"* had been constructed and tested.[37] The draft continues: *"Future use. The demand for radioisotopes has been rapidly increasing in Austria during the past years so that a still much wider application is to be expected in the near future. Various plans are in preparation."* (ibid.) Interestingly the English version of the memorandum is not specifying these plans for the near future, while the German version is stressing planed applications in the field of agriculture.

At the beginning of 1955 the Federal Ministry of Agriculture and Forestry seems to have been reluctant when it comes to engaging atomic energy. Within the prior session the nominations by the different ministries had been up for debate and while most ministries wanted to send public officials and started considerations about including Austrian physicists as experts to the delegation, the BMLF had decided not to send a representative to Geneva. The ministry was also reluctant to send people to US training courses, which was endorsed by the other ministries.[38] Besides the initial excitement to store and grow foods by utilizing nuclear energy, the BMLF seems to have had a limited agenda with regard to the application of atomic energy. In January 1955 the issue was up for debate within the commission. According to the protocol Karlik offered literature to the public official in charge within the BMLF so the ministry could *"form an opinion on possible applications of atomic energy."*[39]

In section two of Karlik's report on the use of radioisotopes in Austria she formed a position with regard to building a research reactor and took the following prognosis:

[36] 3. Sitzung der ÖKAE am 11.03.1955, 12.03.1955. AÖAW, FE-Akten, IR, K50, F727.
[37] Anhang, 4. Sitzung der ÖKAE am 14.04.1955, 18.04.1955. AÖAW, FE-Akten, IR, K50, F728.
[38] 3. Sitzung der ÖKAE am 11.03.1955, 12.03.1955. AÖAW, FE-Akten, IR, K50, F727.
[39] 2. Sitzung der ÖKAE am 24.01.1955, 27.01.1955. AÖAW, FE-Akten, IR, K50, F727.

"It is expected that within a period of one year it will be possible to clear the major problems as there are: the juridical form of the collaboration of the partners [science and industry, comment FB] *in the project, the financial problem, the coordination of the research program as well as the reactor type, a time schedule etc. The construction of a power reactor is not considered advisable at the moment."*[40]

6.4.3 *"Report on the suitability of constructing a research reactor in Austria"*

The Austrian Commission on Atomic Energy also started to debate the question of acquiring a research reactor for Austria in January 1955. Prior to the 2nd session Karlik proposed to structure the process to evaluate the question at hand in three different subcommittees. The first, dealing with the question of radioactive isotope production, should be formed by the Department of Radiumresearch due to prior experiences. The second subcommittee should deal with basic science problems and be headed by the BMU in consultation with the Department of Radiumresearch. A small circle of people, qualified by their research experience in the field of nuclear physics, should come up with a draft on this section, which would be presented to all Austrian professors in the field of physics for comments and feedback. To formulate a section about research on power reactors, this committee could be expanded by representatives of the Federal Ministry on Commerce and Reconstruction, the Federal Ministry of Traffic and a section of the Federal Chancellor's Office. Last but not least this third committee should come up with a section on nuclear power production in cooperation with the electric power industry.[41] With regard to the nomination of experts Karlik also referred to the competences of the research group within the electrotechnical association.[42]

The Commission on Atomic Energy mostly followed Karlik's initiative. The three possible applications for a research reactor were seen as the production of radioactive isotopes, nuclear power production and *"purposes of research."*[43] Since purchasing radioactive isotopes via Harwell was considered cheaper than engaging in large scale production in Austria, the first application was excluded. Quite similarly the construction of an experimental power reactor was considered too expensive. Therefore the commission followed Karlik's suggestions to form subcommittees to draft a report *"on the suitability of constructing a research reactor."* A subcommittee on basic science problems was to be formed by nuclear physicists and expanded by representatives of the BMHW, BMVVB and BKA to clarify the question of research on nuclear power reactors (idid., pp. 2–3.).

Again Karlik took the lead in drafting the report and first versions were circled in late March 1955. At the beginning of April Karlik wrote to Thirring to ask for his consent

[40] Anhang, 4. Sitzung der ÖKAE am 14.04.1955, 18.04.1955. AÖAW, FE-Akten, IR, K50, F728.
[41] Karlik an BKA-AA/Matsch, Vorsitzender der ÖKAE, 22.01.1955. AÖAW, FE-Akten, IR, K50, F724.
[42] Karlik an BMU/Hoyer, 22.01.1955. AÖAW, FE-Akten, IR, K50, F829.
[43] 2. Sitzung der ÖKAE am 24.01.1955, 27.01.1955. AÖAW, FE-Akten, IR, K50, F727.

on the matter. According to Karlik the first sections of the report served to inform Austrian authorities, sections five and six were considered to be the most important ones.[44] The focus of section five was to evaluate preconditions regarding staff and finances for constructing a research reactor in Austria.

The financial situation within the BMU was not surprisingly perceived as insufficient. Even if respective adjustments were made, the financial situation within the Ministry of Education would be too tense. Steps in this direction were considered *"extremely unfavourable from the perspective of all Austrian sciences",* because other sectors would seriously lack funding.[45] Karlik argued in favour of a joint reactor project on a small scale. Since representatives of industry had shown interest, industries themselves and other ministries could cooperate together with the BMU within a joint reactor project, which was also in line with organizational forms in other European countries.

With regard to staff Karlik stressed the lack of funding since 1945. The way Karlik argued for more financial resources, is a nice example, how the creation of a suitable past relates to present phenomena in the sense of Hobsbawm and Ranger (1983). Even though Austria had

> *"a long tradition of nuclear research (the Department of Radiumresearch was the first department of the world exclusively working in this field, while modern nuclear physics was only practiced in Cambridge (Engl.) and Vienna in its first decade), financial resources had been very limited, especially since 1945."* (ibid.)

According to her account Austrian nuclear physics could hardly keep up with the developments in the field, which was exemplified by the number of staff, which was at the same level than in 1928. The number of people working in the field was described as very small, while young researchers mostly went abroad since 1945. Karlik estimated that it would take about five to six years to educate researchers in the field of nuclear physics, while Austrian universities were suffering a lack of students. The immediate needs within the realm of basic research would not suffice to guarantee a full time use of the reactor, hence the inclusion of more advanced professionals from industry would be convenient (ibid.).

Based on these reasons section six of the draft suggested a collective research reactor project between all involved ministries and industries. Within one year all interested actors should be consulted and participating actors fixed, the juridical form of cooperation should be decided, while the different research plans should be set, similar to financial contributions, reactor type and organisational structure and a time schedule (ibid.).

Hans Thirring approved of Karlik's draft, however he asked for some modifications. In case his remarks would reach her in time, he suggested to include a few lines to create more urgency and mobilize national identity to stress the importance of the matter:

[44] Karlik an Thirring, 05.04.1955. AÖAW, FE-Akten, IR, K49, F706.
[45] Entwurf von Berta Karlik, April 1955. AÖAW, FE-Akten, IR, K50, F706.

"At most I would critisize some aspects that seem to be a little too cautious and reserved. Reading between the lines it alsmost looks like we want to say 'If we are really constructing an Austrian reactor, at the utmost a rather small research reactor, and please do not hesitate.' At some point we should say that it is in accordance of Austria's status as a nation of culture, to of course participate in the field of nuclear physics like other countries of the same size and that the existence of a reactor could help to encounter the unfortunately shrinking numbers of young professionals of the last years."[46]

In his comment on the draft Heinz Sequenz underlined the importance of the dimension of power production. Regarding both, the memorandum for Geneva and the report on the suitability of constructing a reactor, he noted *"that out of consideration for the energy situation Austria has to be interested in nuclear power plants."*[47]

Beyond these reactions a number of physicists delivered statements to the BMU. At the end of May, before the report was delivered to the other ministries and the different experts and actors within the industry, Karlik responded to these statements. Overall she dismissed the statements of Urban and Leidinegg from Graz as being beyond the scope of the report or portrayed them as in line with her own position. The main difference of opinion were questions of staff. Urban and Leidinegg argued that there were several people who could immediately take up positions at the research reactor. Karlik dismissed the argument from a professional perspective: This *"could only refer to theoretical physics, while the construction and operation of a reactor is predominantly an experimental task requiring respective experiences, even though one is not able to spare theoretical physicists."*[48] Karlik suggested to ask her colleagues in Graz to name the respective people who would be competent and willing to participate in the construction and operation of the research reactor on a full–time basis. She reacted the same way on a proposal of Ferdinand Cap to reach out to Austrian physicists abroad and suggested to Hoyer to ask Cap to name the scientists, who were actually willing to come back to Austria. According to her, there were no more reasons not to forward the report to the other actors (ibid.).

While the overall report was forwarded to the other ministries, a short summary was added to the conference materials for Geneva entitled *"Status of the inquiry on the construction of a research reactor in Austira."* On half a page the report explicitly stated Austria was planning the construction of a research reactor and once more summarized the steps to be taken. Finally the reader was informed on the Austrian decision not to build a nuclear power reactor at the moment.[49]

[46] Thirring an Karlik, 15.04.1955. AÖAW, FE-Akten, IR, K49, F706.
[47] Stellungnahme von Sequenz, 25.04.1955. ÖStA, AdR, BMU, Atom, K63, GZ: 59.313/I/1/55.
[48] Karlik an BMU/Hoyer, 23.05.1955. AÖAW, FE-Akten, IR, K50, F830.
[49] Anhang 2, 1. Tätigkeitsbericht der ÖKAE, 05.07.1955. AÖAW, FE-Akten, IR, K50, F730.

6.4.4 *"Report on the expected needs of energy in Austria"* and *"report on uranium deposits in Austria"*

As outlined above, the memorandum on the peaceful uses of atomic energy in Austria and the report on the suitability of constructing a research reactor in Austria can be traced back to initiatives within Austrian ministries in cooperation with Austrian scientists and/or the Austrian government itself. Both reports served the purpose to inform Austrian officials and politicians on the status quo and to set the coordination of future plans in motion. With regard to Geneva these two reports served the purpose to demonstrate Austria's expertise and interest in the field of nuclear physics. They were added as conference materials and circled among the participating delegations.

The UN Secretariat on the other hand also demanded two reports along with the invitation to the conference. Only in its third session in March 1955 the head of the Austrian Commission on Atomic Energy reported that the official invitation to Geneva had arrived at BKA-AA at the end of February. According to Annex 1 of the invitation note *"Austria was requested to report on the roughly expected demand of electricity and fuels in Austria within the next 50 years."*[50] The commission decided to give this task to BMHW, BMVVB in cooperation with BKA, Sektion V. Other than that the protocol refers to a request of a report on uranium and thorium deposits in Austria by the United Nations, which was delegated to BMHW and BKA-AA. (ibid.)

The report on expected energy needs started with general remarks on forecasting development. Not only current trends were to be considered, but the overall status of development as well. According to the experts report the consumption of all sorts of energy had risen extraordinary vigorously since 1945, and in doing so *"had made possible the reestablishment of Austrian economy."*[51] The increase was perceived to be partly caused by the reconstruction effort as well as an *"expression of the normal development of the economy."* (ibid.)

Regarding electric energy, the consumption was identified to be increasing faster than in other countries *"of a similar stage in development"* (ibid.): While in 1954 the consumption had risen by 12.5% annually, an annual increase of 7% already meant that consumption would double within 10 years. Beyond the estimations and calculations these reports have several future–oriented dimensions: First of all they perform a reduction with regard to the open future and secondly, they include normative assumptions of how things are supposed to be. E.g. before the consumption patterns were extrapolated into the future (expected consumption in billion kwh: 1950: 6,365, 1960: 14,7, 1970: 25,6 and 1980: 30,5) the report stated:

> *"In the light of this increase it appears desirable that also Austria will have reached the high per capita consumption of electric energy of other highly in-*

[50] 3. Sitzung der ÖKAE am 11.03.1955, 12.03.1955. AÖAW, FE-Akten, IR, K50, F727.
[51] Anhang 3, 1. Tätigkeitsbericht der ÖKAE, 05.07.1955. AÖAW, FE-Akten, IR, K50, F730.

dustrialized states in a not all too distant future. We have to expect that further increases in electricity consumption will be occuring in a slower manner, after a certain standard of electrification will have been reached in a distant future." (ibid.)

With regard to fuels expectations were more moderate (expected consumption in kcal: 1950: $60x10^{12}$, 1960: $78x10^{12}$, 1970: $101x10^{12}$, 1980: $126x10^{12}$). The consumption of brown coal, which had been drastically increasing since 1946, was declining due to the electrification of the Austrian railways. The consumption of domestic fuel was considered stable, while the need for lignite was increasing in steam driven power stations (ibid.).

Based on these assumptions the report expressed the following expectations: In the field of electricity production caloric power production was expected to stabilize at about 25%, so the consumption of coal, oil and natural gas was expected to rise proportionally with increasing electricity consumption. Within thirty years national lignite production was expected to drastically decline due to shrinking deposits. The report concluded that even though there were potentials to expand its hydro power capacities and some coal as well as oil deposits were available, Austria would have an increasing demand of energy. *"Therefore Austria is interested in the development of new energy sources to a great extent, in order to cover its increasing needs of energy in the future."* (ibid.)

The report on the uranium and thorium deposits turned out completely negative. Together with a list of Austrian publications on the matter, the document reported on a few traces of radioactive materials that were of scientific interest, while *"no technically utilizable sources of uranium or thorium"*[52] were found in Austria. Over the years a number of wells were investigated focussing on radioactive traces. The fact that none of these examinations led to considerable results was seen as a confirmation of the initial findings (ibid.).

6.4.5 The effects of Geneva on Austrian nuclear physics

After the preparations for Geneva had been finished, the Austrian Commission on Atomic Energy reported to the Council of Ministers on its activities throughout the first half of 1955. In doing so the different documents discussed in and produced by the commission were distributed in larger circles. Overall the fact that Austria had an actively working commission on the matter had resulted in an increase in public attention.[53]

Other than that the activity report itself provided further room for making claims and expressing future scenarios:

"The effects of the peaceful application of atomic energy on Austrian economy, most of all for Austrian industry as well as the Austrian electric power industry, cannot be forseen today. To get to know the central problems and to educate specialists is imperative." (ibid. p. 4)

[52] Anhang 4, 1. Tätigkeitsbericht der ÖKAE, 05.07.1955. AÖAW, FE-Akten, IR, K50, F730.
[53] 1. Tätigkeitsbericht der ÖKAE, 05.07.1955, pp. 3–4. AÖAW, FE-Akten, IR, K50, F730.

Beyond such general remarks each ministry was allowed to place its central claim. The Federal Ministry of Commerce and Reconstruction noted its expected needs in heat stemming from nuclear energy, while the Federal Ministry of Traffic and Nationalized Enterprises expressed two further reasons, why nuclear power production would be important in the future:

> *"1) The development of nuclear power production will doubtlessly influence the future planning and constructing of hydro power plants. Getting to know the different aspects following from this development is exceptionally interesting for Austria for the near and distant future, independent of the fact, when the production of nuclear power is put into practice in Austria.*
>
> *2) Austria is a country where fuels are relatively scarce.* [...] *Considering the expected increase in electricity consumption it is likely, that Austria will be coerced in the near future, to produce an increasing part of electricity in caloric power plants. Depending on the development of the international coal market, it could then be necessary to engage in nuclear power production."* (ibid., pp. 5–6)

The rest of the report provided an overview on the role of the distribution center for radioactive isotopes, the legal situation on the use of radioactive substances as well as the nominations for the Geneva Conference by the different ministries.

Section two of the paper informed on the fact that the report on the suitability of constructing a research reactor was circling within industry at this point in time, and that most likely *"the results of the Geneva Conference will have to be awaited, before the report could be finalized"* (ibid., p. 10).

The preparations for Geneva, e.g. the invitation asking for specific expert reports for different panels, had also a framing effect within the Austrian Commission on Atomic Energy. The Geneva Conference itself increased and accelerated this effect. In June the BKA-AA circled a Background Paper on the Conference that informed the participating delegations about the structure of sessions and panels.[54] The opening plenary sessions A and B were titled *"The need for a new power source I + II."* The first session dealt with forecasting global power consumption and available power sources for the next 25 and 50 years. Possibilities of alternative power sources like solar energy, wind energy and energy production by making use of tides were also dealt with, next to the role of nuclear fusion as a potential power source (ibid., p. 8.) The second session focused on national energy needs by selecting various countries to present their reports on future needs.

After the establishment of future demands the role of nuclear energy was assessed in plenary session C. Countries were selectively invited to report on their surveys on occurrences of uranium and thorium before *"the maximum plausible role which nuclear power*

[54] United Nations, Department of Public Information and Press and Publications Divisions, NY: The International Conference on the Peaceful Uses of Atomic Energy, Background Paper. AÖAW, FE-Akten, IR, K50, F728–729.

can play as an energy source during the next 25 to 50 years" was at stake in panel C.2., followed by rough estimates on the economics of nuclear power in C.3. (ibid., pp. 9–10). The rest of the plenary sessions brought the issues down to the level of actual applications. Experiences in building nuclear energy enterprises were shared as well as experiences on reactor design, health and safety aspects, the production and use of isotopes, experiences with research reactors and power reactors, etc. etc.

In order to gather first insights on the immediate effects of the Conference on developments in Austria I suggest to look at internal reports on the Conference. One such report was provided by the BKA-AA. Most likely it has been drafted by the head of the Austrian Commission on Atomic Energy Matsch, who had also headed the Austrian delegation to Geneva. Initially the report was supposed to inform Austrian embassies and ambassadors, but the BKA-AA forwarded the document to Karlik at the beginning of September arguing it could *"provide a foundation for informing the Council of Ministers."*[55]

In tone the paper met the glorifying language of contemporary newspaper reports on nuclear matters. The Geneva Conference was once more exclaimed to mark the beginning of a new era in development, where nuclear energy was used in the interest of and for the progress of humanity: *"The conference is called the beginning of the nuclear age in the economy, because it proved that the energy released by nuclear fission can be devoted to the service of the economy."*[56] The consequences were considered to be unforeseeable: *"The economic effects of the conference are not yet to be foreseen, because so many suggestions were made for future uses of atomic energy."* (ibid., p. 2.) The dominant expectation towards future applications was quite clear and real though: *"The explanations at the conference made clear that nuclear energy will play an increasing role, predominantly in economy, within the next 10 years. The groundwork of this role had been laid at the conference."* (ibid.)

Besides these rather general perceptions the effects on the Austrian situation were perceived to be quite far reaching as well:

> *"For Austria this reveals the question, whether we should — encouraged by the electric power industry — set about building a reactor for the training of staff oriented towards aspects of energy production, besides the small research reactor constructed in cooperation with the United States."* (ibid., p. 4)

The report continues that Austria's electric power industry *"is coerced to deal with the production of energy by nuclear fission"* (ibid.) by the increasing demand in electric energy. This demand was described as way above the European average, while the mining and drilling for thermal fuels could not be increased in the recent past (ibid.). The power industry would therefore

[55] BKA-AA an Kalrik, 05.09.1955. AÖAW, FE-Akten, IR, K50, F729.

[56] BKA-AA, Runderlass an alle Botschaften: Internationale Konferenz für die friedliche Nutzung der Atomenergie; Information, 29.08.1955, GZ: 335.038-INT/55, S. 1. AÖAW, FE-Akten, IR, K50, F729.

> *"take nuclear possibilities into consideration with regard to the further construction of power plants. Regarding this issue it is to be noted that the use of hydro power, which still can be increased economically, will not loose its significance in the future and preseve its value for Austria and interested customers in neighboring countries."* (ibid., p. 5)

Even though contemporary reactor design was trying to cope with significant problems, the final breakthrough was expected soon, based on the enormous efforts taken. From an economic perspective the conference seemed to have proven that their were vast industrial potentials involved in the development of nuclear power plants: *"From an Austrian standpoint there are chances for an intensive industrial participation in the production of devices in the area of precision engineering and materials (such as graphite, sodium or probably even heavy water)"* (ibid.).

Regarding the use of radioactive isotopes the report noted that the Conference had proven the high level of research in Austria, especially in the field of medical applications. The report closed with a claim for upcoming decisions:

> *"Based on the experiences gathered at the Conference several decisions will have to be made in Austria: e.g. the foundation of an Austrian association for the application of atomic energy in the economy including preparations for the production of electric power by nuclear fission, the creation of a legal framework for radiation protection, the training of professionals in the area of atomic energy and the expansion of the foundations for nuclear research."* (ibid., p. 7).

Overall the Geneva Conference provided a forum for the formation of a new alliance between the electric power industry, politics and other industries. As Forstner (2012, pp. 169–170) has shown the conference can be seen as a catalyst for the Austrian nuclear program that lead to the foundation of the SGAE in cooperation between these actors, while the physicists had lost ground. In the long run this led to the decision to create the Seibersdorf Laboratories apart from university structures. While the physicists managed to keep positions within the structures and subgroups of the SGAE, they started to lobby for a research reactor for basic science, which could be realized by the foundation of the Austrian Atomic Institute (*Österreichisches Atominstitut*) in 1959.

6.5 An increase in public attention

In the realm of media and public spheres the increasing importance of the issue can be traced as an increase in attention and coverage. Although "the atom" enjoyed a lot of attention in the first place with regard to scientific developments as well as nuclear testing and international relations, by the end of 1953 the developments described above found an expression in an even stronger uptake and a focus on Austria and its future. Already in November 1953 *Neues Österreich* reported on the preparation of an exhibition at *Technisches Museum Wien*:

"In total silence Vienna is preparing to become a miniature atomic city. However, we cannot afford the oversized giant constructions for energy production [...] At least based on models also the Viennese will have the opportunity to convince themselves on the functionality of cyclotrons and atomic reactors."[57]

Figure 2: Model of a nuclear power plant

Throughout 1953 the TMW, headed by the physicist Josef Nagler, was preparing a 700m^2 exhibition on atomic energy. After an introduction to the history and main "discoveries" in nuclear physcis with an increasing focus on Austrian contributions the second part of the exhibition dealt with the latest developments and applications, e.g. a model to explain the basic construction plan and functionality of a nuclear power plant (see figure 2).[58] A detailed reproduction of a British reactor at the size of 4m x 2,5m (see figure 3)[59] was considered the highlight of the exhibition (Maschine + Energie, 1953).

As described in section 6.1 the address of President Eisenhower was well received in Austria's press, but did not have any immediate impacts on institutional developments. Besides the mentioned media reports some activities to increase public attention with regard to peaceful applications of atomic energy were taken up. In Vienna posters entitled *"Atom World Bank, The Eisenhower Plan"*[60] were distributed by the US Information Service (see figure 4).

Figure 3: Reconstruction of a reactor

The cube symbolizing the United Nations Atom World Bank has open front and back doors. A line of symbolic atoms departing from a warhead are entering the bank in the front and exiting through the back door, transforming into a flash directed towards a plough, an owl, a factory and a blue laurel wreath. While the latter is most likely intended to symbolize world peace under the aegis of the UN, the former represent electricity, agriculture, science and industrial production. Beyond the further increase in public attention towards the future uses of atomic energy, Eisenhower's speech does not seem to have had substantive imme-

[57] Neues Österreich, "Atomstadt Wien" im werden. Im Technischen Museum wird im kommenden Jahr ein Atommeiler zu sehen sein, 15.11.1953.

[58] Figure 2 by the courtesy of Archiv des Technischen Museums Wien, Abteilung Kernphysik 1961, from now on: ATMW, FA-01-01/FA-011044.

[59] Figure 3: ATMW, FA-01-01/FA-011047.

[60] US Information Service, Eisenhower, Dwight D., Atom Weltbank "Der Eisenhower Plan", 1953. Wienbibliothek im Rathaus, Teilkatalog Plakate. Retrieved from http://www.wienbibliothek.at

diate impacts in Austria. Bearing in mind that Eisenhower's address in New York did not come along with tangible offers for cooperation at this stage, this is not very surprising.

Throughout 1954 the controversy following the Lucky Dragon incident reached Austria. In April the weekly newsreels reported on the incident and follow–up procedures.[61] Similarly the *Arbeiter–Zeitung* printed an article on the increasing number of Japanese fishermen suffering from radiation sickness as well as an increase of radioactive particles in the air, measured in Chicago.[62] By the end of the year issues revolving around the consequences of nuclear testing seem to have reached a broader level, including public lectures in Vienna (see figure 5).[63] Overall reporting on atomic issues seems to match the ambivalent character that has been carved out for the German context (Stölken-Fitschen, 1993). Browsing through the weekly newspaper *Die Presse* for the years of 1953 and 1954 we can see that on the one hand the fear of atomic weapons, the case of Robert Oppenheimer and the consequences of nuclear testing structured the debate[64]. On the other hand nuclear hopes secured space in Austrian newspapers with regard to reporting and praising different applications.[65]

Figure 4: *"UN Atom World Bank"*

With the official decision to form the Austrian Commission on Atomic Energy in January 1955, a real uptake in reporting set in. Immediately national newspapers brought short pieces to disseminate the details on the Council of Minister's decision[66], as well as longer articles relating national activities to global developments. *Die Presse* reported on the use of radioactive isotopes in Austria, e.g. in medicine and heavy industries. According to the article the newspaper had contacted Berta Karlik, who gave details on Austrian activities in the field. Beyond these general remarks the newspaper also stressed the absence of allied restrictions on atomic matters in the case of Austria as well as the fact that the

[61] Filmarchiv Austria, Austria Wochenschau, 14/54, Beitrag 4.
[62] Arbeiter–Zeitung, Immer neue Fischerboote radioaktiv, 16.04.1954, S. 6.
[63] Figure 5: ATMW, BPA-014707-12.
[64] Die Presse, Im Zeichen der Atombombe, 03.04.1954; Die Presse, Ein Fall der ganz Amerika alarmiert, 01.05.1954; Die Presse, Robert Oppenheimers Schuld und Sühne, 07.08.1954; Die Presse, "Atomtechnik ist an allem Schuld", 09.10.1954.
[65] Die Presse, Das erste Atomschiff der Welt, 26.09.1953; Die Presse, Ein neues Zeitalter der Metalle, 17.10.1953; Die Presse, Nun auch: Atomkraft-Lokomotive?, 13.03.1954; Die Presse, Auf dem Umweg über Dampf?, 23.10.1954.
[66] Die Presse, Ein Atomreaktor für Österreich in Erwägung, 12.01.1955; Bildtelegraf, Österreich baut Atommeiler?, 12.01.1955.

Austrian *Verbundgesellschaft* had developed a device to measure snow levels in the high mountains.[67]

The *Neue Wiener Tageszeitung* focussed on connecting the dots and explained the origins of recent developments in Eisenhower's speech to the UN General Assembly and the UN decision to hold a conference on the peaceful uses of atomic energy in late 1955, before naming the different tasks the Council of Ministers defined for the commission.[68] On January 25th *Neuer Kurier* reported on the plans to hold the World Power Conference in Vienna in 1956. One cannot help but noticing that the article is entitled *"International Atomic Conference to Vienna. Austria activly participating in the development of atomic science"*, which most likely was supposed to create an allusion to the UN Conference, since time and place had not been set nor published. The article explained that Thirring, Karlik and Chiari were coordinating the World Power Conference together with the EVÖ, and that the main topic would be the application of atomic energy for purposes of the economy, continuing that *"Hereby Austria, which is currently forming a Commission on Atomic Energy, has moved up from an outsider to a nation activly participating in the development of atomic science."*[69]

Figure 5: *"Is our weather influenced by atomic explosions?"*

Only a few days earlier the *Wiener Kurier am Sonntag* started to publish a series in six parts entitled *"The atom as an energy source"*, which was to be published on the following weekends. Before a detailed discussion on the structure of "the atom" introduced the reader to the sphere of nuclear physics, the introduction explained why the Council of Ministers had decided to take steps in the first place. Again a heroic past is presented as opposed to the current state of affairs, which is characterized as lagging behind to create urgency:

> *"[...] Austria to catch up to international developments in atomic research. Even though especially Austria had excellently participated in nuclear research, Austria has slightly fallen behind in the field of science, due to the difficult situation of the post–war years."*[70]

[67] Die Presse, Österreich und das Atomzeitalter, 12.01.1955.
[68] Neue Wiener Tageszeitung, Atomreaktor für Österreich, 12.01.1955
[69] Neuer Kurier, Internationale Atomkonferenz nach Wien. Österreich aktiv an der Entwicklung der Atomwissenschaft beteiligt, 25.01.1955.
[70] Wiener Kurier am Sonntag, Energiequelle Atom, 1. Teil: Das ABC der Atome, 22.01.1955.

The second[71] and the third[72] part of the series introduced readers to the different particles forming an atom and to the nature of isotopes, already stressing the enormous energies that could be released and the peculiar characteristics of uranium and plutonium isotopes. The second half of the series focused on the application of nuclear research and introduced the topic by a brief history of nuclear fission and the development of the first reactors in the United States. World War II was described as a quasi external event that radically changed the circumstances for "free science", a sort of intermezzo to more general ambitions. Hence the article concluded that after the horrors of war *"we now almost face the realization of an older, original plan – the extraction of industrial electricity from uranium atoms."*[73] A week later the expectations towards the uses of radioactive isotopes were at the focus of the series. In the field of biology the article speaks of radical changes and expresses even more radical expectations: *"If scientists succeed in completely identifying all natural compounds and in constructing them synthetically, it will probably be possible to synthetically produce all foods and fuels we need one day."*[74] Most astonishing is the presentation of results in the field of agriculture. Isotopes are described to have brought about a revolution in the use of fertilizers and as reliable helpers when it comes to finding and fighting diseases of organisms. The last part of the series was dedicated to nuclear power production alone, which was stylized to the ultimate goal of nuclear research: *"With todays essay, which is dedicated to to the high point of all nuclear research, the utilization of the energy set free by atomic fission for peaceful purposes, we end our series on the atom as an energy source."*[75] After a detailed discussion on the construction of nuclear reactors and their functioning through producing heat, which was extensively used to frame the technology as mundane, the series concluded with a rather cautious forecast:

> *"However two of those* [all research and experimental reactors ever built, comment FB] *produced amounts of power on a pure experimental basis, that allows to draw the conclusion for economic utilization at least for the future. Hereby the development of atomic energy has reached its decisive phase: the search for ways and means to produce atomic power so cheap that it can compete with power obtained from coal, natural gas and oil"* (ibid.)

As has been pointed out by Andreas Kuchler (2012), the exhibition *"Atom. Atomkraft im Dienste der Menschheit"* in March 1955 was a central element in the "atomic age" reaching Austria. It has become clear within the sections above that proclaiming the beginning of the "atomic age" had become quite common by 1955 in very different arenas, spheres and media. When it comes to broadening and popularizing this claim the exhibition at the Viennese *Künstlerhaus* was nonetheless a very central catalyst. The US Information Service

[71] Wiener Kurier am Sonntag, Energiequelle Atom, 2. Teil: Bestandteile des Atoms, 29.01.1955.
[72] Wiener Kurier am Sonntag, Energiequelle Atom, 3. Teil: Atome und Isotope, 05.02.1955.
[73] Wiener Kurier am Sonntag, Energiequelle Atom, 4. Teil: Der Weg zum Atomreaktor, 12.02.1955.
[74] Wiener Kurier am Sonntag, Energiequelle Atom, 5. Teil: Isotope — Diener der Menschheit, 19.02.1955.
[75] Wiener Kurier am Sonntag, Energiequelle Atom, 6. Teil: Kraft — Das friedliche Ziel, 26.02.1955.

organized this travelling exhibition in cooperation with the Austrian League for the United Nations (*Österreichische Liga für die Vereinten Nationen*). On February 9$^{\text{th}}$ the League announced that the exhibition will be hosted in Vienna during the next month. Newspapers informed their readers that the exhibition will educate on the basics of nuclear research based on simple models and explanations, very much stressing the recent progresses in science and technology.[76] Eleven railway cars transported the installations — among them a model of a nuclear reactor and an isotope laboratory including the iconic *magic hands* (see figure 6)[77] — to Vienna under great public attention and follow up media reports.[78] The opening of the exhibition triggered euphoric reactions of a similar kind. Several newspapers brought half or full page articles, reporting on the different installations and the expectations towards the future.[79] Overall most media reports have a tendency in reporting on expected applications and fields of research in medicine, agriculture and industry/material sciences, by focussing on them as already being realized and used. In most cases they either do not address the fact that the mentioned technology is at most experimental, or they are overly optimistic, proclaiming results in the near future with absolute certainty.[80]

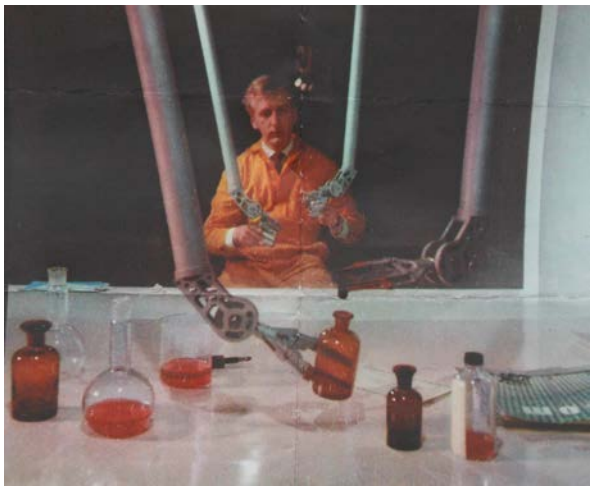

Figure 6: Model of "Magic Hands"

The expectations towards the exhibition itself give a good impression of the rather euphoric atmosphere. According to the *Arbeiter–Zeitung* the organizers expected about 10 000 people every day, who would be guided through the exhibition (about 1400m^2) in groups of 400 for 55 minutes. Visitors were handed out brochures summarizing the central applications of atomic energy with a lot of illustrations, while every 1000$^{\text{th}}$ visitor was offered a book of his or her choice.[81] When the exhibition left for Hamburg after March 23$^{\text{rd}}$, 99 216 people had been registered at *Künstlerhaus* (Aichelburg, 2014).

Even though the exhibition was organized by the US Information Service and travelled throughout Europe, it provided several opportunities for the national appropriation of

[76] Arbeiter–Zeitung, Die Atomausstellung kommt nach Wien, 10.02.1955; Wiener Zeitung, Atomkraft für den Frieden, 10.02.1955.

[77] Figure 6: Bilder der Woche, 10.03.1955.

[78] Neues Österreich, Elf Waggons "Atommaterial" rollen nach Wien, 10.02.1955; Neue Wiener Tageszeitung, Atomausstellung in Wien eingetroffen, 23.02.1955; Arbeiter–Zeitung, "Atomkraft" rollte zum Künstlerhaus, 23.02.1955; Die Presse, Atomkraftausstellung im Künstlerhaus, 23.02.1955; Das kleine Volksblatt, Das Material der Schau "Atomkraft im Dienste der Menschheit", 23.02.1955.

[79] Wiener Kurier, Ausstellung "Atom" heute eröffnet, 05.03.1955; Wiener Kurier, Sonderbeilage: Segenreiche Atomkraft. Zur Eröffnung der Ausstellung "Atomkraft im Dienste der Menschheit", 05.03.1955; Wiener Montag, Wien im "Atomtaumel", 07.03.1955.

[80] Die Presse, Aschermittwoch des Fortschritts, 26.02.1955; Neues Österreich, Atomenergie im Dienste der Menschheit. Im Künstlerhaus: Der Atomofen brennt, 05.03.1955.

[81] Arbeiter–Zeitung, Grandiose Vision des neuen Zeitalters, 05.03.1955.

nuclear matters. Together with US ambassador Thompson and the head of the Austrian League for the United Nations Heinl, Foreign Minister Leopold Figl opened the exhibition in a formal and festive event. He closed his opening speech with: *"I am convinced that also Austrian scientists, who have been and are ground–breaking in so many fields, will make their contribution in this collective effort of international scientists."*[82] The brochure mentioned above offered the Austrian Federal Chancellor Julius Raab an opening statement on the first page. After reflecting upon what he described as a collective historical effort in the field of nuclear physics he stated:

> *"For the development of atomic physics the groundwork of Austrian researchers was of crucial importance in many fields, and one can be sure that the Austrian people will be following the further development of atomic energy for peaceful purposes with great attention and is perfectly aware that this greatest achievement of humankind comes with the greatest responsibility."* (Österreichische Liga für die Vereinten Nationen, 1955, p. 2).

Austrian scientists on the other hand used the opportunity to stage and popularize their activities. Berta Karlik organized a section of the exhibition on the use of radioactive isotopes in Austria. After the exhibition a window display on the issue was placed on view at *Amerika–Haus* in the Vienna city center by the US Foreign Service. It seems that students at the Department of Radiumresearch were involved in performing the numerous on stage experiments and demonstrations at *Künstlerhaus*. Karl Lintner organized a visit for the Austrian Federal President Theodor Körner.[83] As the *Arbeiter–Zeitung* reports Körner was handed a bouquet of flowers by the *magic hands* during his visit: *"The atomic hand, normally used to grab radioactive substances, peacefully handed the federal president a bouquet of flowers, when he visited the atom–exhibition at Künstlerhaus on Friday."*[84] Josef Nagler, head of *Technisches Museum Wien*, used the opportunity to give public lectures at the exhibition. On two Saturday evenings and two Sunday mornings Nagler gave a talk entitled *"What should the lay person know about the atom?"* According to the invitation the talks included on stage experiments, however no specific information was provided on the matter.[85]

In the weeks after the Geneva Conference a series of articles appeared in the *Tiroler Tageszeitung*. The first full page article was dedicated to nuclear power production as the central application of nuclear research.[86] Two days later the newspaper extensively reported on debates about globally expected consumption and demand in energy, before the enormous potentials of nuclear power production in the form of a new markets were

[82] Neues Österreich, Ing. Figl: "Friedliche Atomnutzung eine Hoffnung", 06.03.1955.
[83] Henry F. Arnold (US Foreign Service) to Karlik, Letter of Thanks, 30.03.1955. AÖAW, FE-Akten, IR, K50, F721.
[84] Arbeiter–Zeitung, Illustration, 13.03.1955, S. 3.
[85] Einladung: "Was soll der Laie vom Atom wissen?, März 1955. Wiener Stadt und Landesarchiv, Ausstellungsakt des Künstlerhauses: Atom. Atomkraft im Dienste der Menschheit.
[86] Tiroler Tageszeitung, Bringt das Atomzeitalter eine weltweite Arbeitslosigkeit mit sich?, 01.09.1955.

staged.[87] While the third article of the series reported on the applications of radioactive isotopes that had been debated and demonstrated in Geneva[88], the fourth introduced the reader to applications in the field of curing cancer and agriculture.[89] The last two articles focussed on the role of Austria within these developments. Austria was staged as having a long tradition in nuclear research, but having lost its international position in the field. Nuclear research was framed as a key field of development, in which Austria had to catch up with the rest of the industrialized countries as soon as possible. In reference to developments in Switzerland the Austrian State Treaty was portrayed as the key step for Austria to participate in nuclear developments, as a small economy and neutral country.[90] In the final part of the series Austria's economy was portrayed as deeply entangled internationally. As a result participation was imperative, a fact that was highlighted by an overview of nuclear patents in Austria. While only three patents had been filed by then, all of them were granted to the French Commissariat á l'Energie atomiqué.[91]

About a year later Josef Nagler gave a lecture on Austrian radio, reflecting on the peaceful uses of atomic energy. Nagler's main focus was the question whether atomic energy would overall serve humankind or pose a danger. While he delegated all negative potentials to flawed political decision making, the exclusive focus on nuclear power production is astonishing. Nagler did not even mention other applications. While discussing different problems and difficulties in reactor development he stressed that it would still take about ten to twenty years for nuclear power production to become competitive with hydro power.[92]

[87] Tiroler Tageszeitung, Bringt das Atomzeitalter eine weltweite Arbeitslosigkeit mit sich?, 03.09.1955.
[88] Tiroler Tageszeitung, Bringt das Atomzeitalter eine weltweite Arbeitslosigkeit mit sich?, 10.09.1955.
[89] Tiroler Tageszeitung, Bringt das Atomzeitalter eine weltweite Arbeitslosigkeit mit sich?, 17.09.1955.
[90] Tiroler Tageszeitung, Bringt das Atomzeitalter eine weltweite Arbeitslosigkeit mit sich?, 24.09.1955.
[91] Tiroler Tageszeitung, Bringt das Atomzeitalter eine weltweite Arbeitslosigkeit mit sich?, 01.10.1955.
[92] Erwägungen zur Auswertung der Kernkraft, Radiovortrag am 28.11.1956 um 16:45 Uhr. ATMW, ÖFIT/BPA-009841.

7 Moments of appropriation and mobilization

Based on the narrative account I will revisit and analyze selected moments of appropriation and mobilization. I use the term appropriation in the co–productionist sense outlined in section 4 to stress that appropriating the nuclear in a specific historic context always also means re–inventing and re–shaping the nuclear. I also speak of mobilization to highlight the strategic, programmatic and visionary aspects in the appropriation process at hand.

First of all the situational map will be reinvestigated through the lens of technopolitical culture. Second the dimension of national identity will be investigated, before the future orientation in appropriating and mobilizing the nuclear will be the focus of analysis.

7.1 Establishing a technopolitical regime to coordinate nuclear activities

Following the approach of Hård and Jamison (2005) I will analyze the dimension of "implementation" in the appropriation of the "atomic age" in Austria. The mapping of the unfolding appropriation process provides us with ample material to reflect upon some characteristics of the technopolitical culture this process was situated in. For systematic analysis I draw upon Hecht's notion of technopolitical regime and ask, how a nuclear regime could be established within Austrian corporatist technopolitical culture. According to Hecht

> *"regimes are grounded in institutions, and they consist of linked sets of people, engineering and industrial practices, technological artifacts, political programs, and institutional ideologies, which act together to govern technological development and pursue technopolitics"* (Hecht, 2001, p. 257).

The notion of regimes allows us to reflect upon the relationships between institutions, people acting within those institutions and the ideologies they are upholding in doing so. Furthermore these institutions are designed to further certain visions and sociopolitical orders, which highlights the strategic aspect of such activities. Finally regimes also have a certain way of dealing with resistance, so by questioning their way of coping with opposition, we can learn about the nature of the regimes themselves.

7.1.1 The EVÖ as an early initiative

With regard to the later developments I want to take a moment and reflect upon the attempt to establish the Austrian Electrotechnical Association as an institution to promote, support and further institutionalize nuclear physics in Austria. While activities in 1953 focussed on lectures to popularize knowledge on nuclear physics among scientists and technicians, the association decided to take more substantive steps in order to facilitate exchange between science and industry throughout 1954 (see section 6.2). The EVÖ created an expert committee on the issue, bringing together different levels of expertise. While almost all scientists residing in Vienna and holding a professorship in a relevant field formed

the core of the research committee, the participants seem to have been well aware that connections to governmental and corporatist bodies would be essential, if the committee was to fulfill its designated role in bridging science and economy.

Consequently both Holzinger, the director of a nationalized power plant corporation, and Frank as a public official within the Federal Ministry of Commerce and Reconstruction were invited to form the economic subgroup of the committee. The president of the Electrotechnical Association, Alexander Koci, appears as a prototype of a public official within the Austrian corporatist system, bringing together a number of interests and positions in one person. Most importantly Koci was in charge of the electrification of the Austrian Railways in his position as a public official of the Federal Ministry of Traffic and Nationalized Enterprises. As such he had connections and access to high–rank government officials as well as the Austrian power industry sector and its corporatist structures. Furthermore his membership in the executive committee of the World Power Conference indicates that he must have been well connected with people such as Hans Thirring and Karl Chiari, which in turn enabled him to get the national nuclear physics community on board the EVÖ's research committee to facilitate exchanges between science and industry.

In this composition the research committee within the EVÖ can be seen as a forerunner of later constellations. As we have seen people like Frank and Thirring had been discussing the issue of establishing an Austrian Commission on Atomic Energy months before Austrian bureaucracy took initial steps. Nonetheless the EVÖ's research committee was outpaced by governmental processes a few weeks after its formation. Even though it continued to serve as a space of exchange for scientists from different institutions as well as a source of funding and support beyond usual channels, it did not reach importance as a coordinative factor when it comes to the institutionalization of nuclear research in Austria. Involved actors certainly knew who and what was necessary, to form a successful body to support science and technology in Austria's corporatist post–war culture. However a research committee of five to ten scientists holding a professorship and only three people from within Austria's bureaucracy was not enough to be recognized as an existing regime that one could build upon. In terms of political culture we could say, what the research committee in the EVÖ lacked most to be successful in the austro–corporatist environment, were authorization and instructions from above. After all the committee was formed by the actors involved themselves, because of a shared understanding of a certain need for concerted and coordinated action. The national government as such could not be mobilized so far.

7.1.2 A corporatist nuclear regime

Foreign incentives to create a national body of decision making were provided by the UN resolution on the Geneva Conference in late 1954 and offers by the United States to cooperate with regard to training and purchasing a research reactor (see section 6.3). Within the two and a half weeks before Christmas 1954 the Department of Foreign Affairs of the

Federal Chancelor's Office (BKA-AA) had assembled leading public officials of the Federal Ministry of Education (BMU), the Federal Ministry of Social Care (BMSV), the Federal Ministry of Finance (BMF), the Federal Ministry of Traffic and Nationalized Enterprises (BMVVB), the Federal Ministry of Commerce and Reconstruction (BMHW) and the Federal Ministry of Agriculture and Forestry (BMLF). The only scientist invited at this stage was Berta Karlik. Together with two public officials from the BMU she was to represent the Austrian sciences.

The composition of the commission, basically the perpetuation of the first meeting between all ministries considered relevant, seems to reflect several aspects: First of all the matter originates from Austria's activity in the sphere of international relations, hence the leading position of the BKA-AA and Matsch chairing the newly founded body. Secondly the composition most likely reflects the perception of the initiative in terms of an effort in strategic research and development. Since the Ministry of Finance was involved from the very beginning relevant actors seem to have been well aware that the activities of the newly founded commission would certainly lead to serious expenditures. We might also say the decision to bring the Ministry of Finance on board from the very beginning also reflects a certain commitment in that regard. This corresponds with Hans Thirring's position. He had been lobbying for the creation of an Austrian Commission on Atomic Energy for years, in order to gain funding beyond the limited budget of the BMU. The rest of the ministries basically corresponded to the areas President Eisenhower had prominently defined as "of importance" in dealing with atomic energy: the BMU representing scientists and scientific institutions, with Berta Karlik as a representative of the Austrian physics community, the BMSV representing the administrative and regulatory dimensions of medicine and health care and the BMLF representing national agriculture. Finally the Federal Ministry of Traffic and Nationalized Enterprises and the Federal Ministry of Commerce and Reconstruction represented the different sectors of Austrian industry. At a first glance, coordinating nuclear physics in Austria in the early years was almost exclusively in the hands of top level bureaucracy.

In contrast to the activities taken in the EVÖ, the Austrian Commission on Atomic Energy was formed quite quickly, once steps were authorized from within the national government. The BKA-AA assembled all relevant ministries and Berta Karlik to discuss the issues Austria was confronted with by the UN General Assembly and the United States. Even though the commission was officially formed as an advisory board to the national government it actually had extensive power and authority from the very beginning. The relevant ministries met in December 1954 and discussed the most important matters. Afterwards decisions had been handed over to the Council of Ministers, which formally created the commission and authorized the representatives to take the envisaged steps. In my opinion this is an indicator of two things: First of all members of the government were well aware of the steps taken, most likely the activities of Austrian bureaucracy in December 1954 had been discussed and induced behind the scenes among/with members

of the national government. Secondly the issue was considered important, but a matter of diplomatic, administrative and scientific expertise and as such delegated to the respective instances. There is no indication that the issue was controversial at this point. From then on the commission took decisions and articulated suggestions without reconsulting the Council of Ministers, because the members felt they had the authority to do so as part of the initial agenda.[93]

The increased need for scientific expertise within administrative structures also found an expression in the commission inviting the different ministries to provide lists of scientific experts, who would be capable of dealing with specific problems and questions.[94] Even though public officials were the dominant actors in numbers, science could claim enormous influence.

Berta Karlik took a leading position within the commission from the very beginning. Most decisions were delegated to "science" as questions that should be solved through expertise. As a result Karlik was authorized to build a number of subgroups on different issues, in order to draft position papers etc. Afterwards the BMU informed the wider scientific community, which mostly took affirmative positions towards Karlik's decisions. The few cases we observed where this was not the case, Karlik was granted the final word to defend her position nonetheless. Finally the suggestions were formally accepted and confirmed by the commission. In that sense we can observe science gaining increasing importance, authority and responsibilities within administrative and bureaucratic decision making.

The creation of commissions and research committees in order to further one's interests in bridging science and industry seems to have been quite promising to most actors at the beginning. In April the question arose, whether Austrian industry should be more actively invited to participate in the commission. For the time being, the commission decided, it would be enough that BKA, BMHW and BMVVB contacted relevant industry sectors to prepare for taking further steps of incorporating industry.[95] For now the austro–corporatist structures would do.

However a local committee formed at the Technical University of Vienna, seemingly because Sequenz, or at least some of his colleagues, had the impression they may be somehow out of the loop (Forstner, 2012, p. 168). Similarly local research committees were formed in Graz and Innsbruck. In both cases the institutions were formed by scientists and representatives of regional industries. The formation partly appears to have been driven by perceived rivalry between Vienna as the capital and urban center of Austria and others being located on the periphery. In the case of Graz the regional activities were presented as an extension and support to the national undertaking, and not as a matter of competition.

[93] E.g. the commission decided not to reconsult the Council of Ministers after official invitations for the Geneva Conference. The commission regarded decision making on the matter an implicit part of its agenda. 3. Sitzung der ÖKAE am 11.03.1955, 12.03.1955. AÖAW, FE-Akten, IR, K50, F727.

[94] 1. Tätigkeitsbericht der ÖKAE, 05.07.1955. AÖAW, FE-Akten, IR, K50, F730.

[95] 4. Sitzung der ÖKAE am 14.04.1955, 18.04.1955. AÖAW, FE-Akten, IR, K50, F728.

Such clear cut positioning work indicates that the cleavage between Vienna as the national capital and state capitals was perceived as very powerful and effective in the struggle over resources. Even though one was forming a new institutional body to strengthen one's position, it seemed important to stage the effort as nothing of that kind, in order not to actively offend somebody. The rising demands of industry regarding information on areas of application as well as educated professionals were given as the main reason to form a regional research committee. The national and regional commissions were in turn bridged by personal overlaps, as members of the regional committees were members in the national commission's subgroups.[96]

The question of public perceptions around atomic energy was not given much attention within the Austrian Commission on Atomeic Energy. In general decisions were taken and expected to be approved by the Council of Ministers, without further references. Only on a few occasions public concerns were debated within the commission. E.g. in the context of the first activity report the commission suggested that the Council of Ministers should *"carefully select"* parts of the report for publication, because publishing the entire document would lead to a huge number of inquiries in the different ministries.[97] This perception is in line with contemporary media reports on public reactions. Not only was the exhibition in March 1955 an enormous success in terms of visitor numbers, it also resulted in a lot of inquiries. An unexpected amount of people was reported to have been visiting the Viennese Department of Radiumresearch, asking questions and expressing enthusiasm as well as a doubts and fears.[98] Reports on the opening of the exhibition at the Künstlerhaus give further insights on how the public framing of the "atomic age" was affected by aspects of political culture as well. E.g. Foreign Minister Figl's opening speech was broadly reported on, while the minister himself was — beyond his official position as Minister of Foreign Affairs — also portrayed as an engineer. Federal Chancellor Raab used his opening statement in the brochure of the atom–exhibition to appeal to the Austrian's interest in the developments in science and technology. Federal President Körner — the national father figure serving as a substitute for the old emperor — in turn was among the first visitors of the exhibition and received flowers from *magic hands*. In other words the highest representatives of Austria actively engaged with the "atomic age" in an exemplary manner for the Austrian population.

The question of resistance was not an urgent problem for the emerging regime. E.g. publicly voiced criticism on nuclear matters led to occasional correspondence and position papers among members of the commission. In October 1955 Matsch forwarded a letter on the dangers of radioactivity by Heinz Hoffmann to the BMU. Hoffmann had written to the head of the regional government of Upper Austria (*Landeshauptmann*) Heinrich Gleißner, warning him on the dangers posed by radioactivity and radioactive wastes in particular.

[96] Bericht über die Gründung einer steirischen Studiengruppe für Atomenergie, 16.05.1956. ÖStA, AdR, BMU, Atom, K64.
[97] 4. Sitzung der ÖKAE am 14.04.1955, 18.04.1955. AÖAW, FE-Akten, IR, K50, F728.
[98] Die Presse, Die Wiener haben 'Atomfieber', 08.03.1955.

According to his evaluation of the situation, information on problems and dangers was systematically withheld by US scientists, as well as public officials. Similarly he accused the conference in Geneva to have downplayed the dangers and kept important information in secrecy. Hofmann's main concern was that Austrian politicians were kept unaware of these problems and issues, and hence would decide to build nuclear power plants in Austria based on wrong or flawed information. The file of the BMU contains a personal assessment of Heinz Hoffmann by the Ministry of Interior, labeled "confidential", giving details on his curriculum vitae and current occupation in the field of nuclear research. It opens with: *"Nothing disadvantageous could be found on his current moral and civic behaviour."* Since Hofmann had published articles in several newspapers, Matsch suggested experts should publish replies in the respective newspapers in due course.[99] To sum up we could say that resistance was processed by the regime without bigger frictions. The critic himself turned to public authorities and the media to voice his concerns and objections. His argument was forwarded internally, experts were granted the opportunity to "assess the criticism" and measures were taken.

The developments including the establishment of the Austrian Commission on Atomic Energy can be described as the installation of a new technopolitical regime to support research on nuclear issues in post–war Austria. It was a strategic effort in the sense that based on international incentives, national decision making resulted in the installation of an institution based on the cooperation of national bureaucracy as well as national scientific elites to coordinate nuclear research. Within this regime scientists could gain increasing influence. Hence we can understand the creation of the corporatist regime dealing with nuclear matters as a case of forming *"a new political contract between power and knowledge"* (Hård & Jamison, 2005, p. 252).

7.2 Mobilizing and practicing the Austrian nation state

President Eisenhower's Atoms for Peace speech in late 1953 was very much perceived in the context of the east–west conflict and Austria's strive for the State Treaty (see section 6.1). By then the Austrian physics community had been arguing for Austria joining the European Organization for Nuclear Research (CERN), while a few well positioned people like Thirring had started lobbying for the creation of an Austrian atomic energy commission. At the time steps were taken to form such a commission in late 1954, Austria was still not a member of CERN and the issue was somehow taken up in the newly founded commission in passing.

With regard to both issues the importance of any kind of nuclear matter for Austria as a country, was prominently articulated. When Minister of Education Kolb reported to the Council of Ministers, the highest collegial institution of the newly founded republic, he argued that the importance of Austria's participation in CERN was self explanatory.

[99] Matsch an das BMU, 15.10.1955, BKA-AA, GZ: 336.365. ÖStA, AdR, BMU, Atom, K63, GZ: 91.138-I.

He depicted Austria as a very small country with little resources, that had to participate in international cooperation in order to be competitive in the long run. Even worse, non–participation could be seen as a lack of interest in European cooperation by other nations. As has been demonstrated with a focus on Austrian debates about entering the European Union in the 1990s, this line of argumentation was to become a dominant aspect of Austrian national identity with regard to its relation to the rest of the world (Breuss, Liebhart, & Pribersky, 1995, pp. 166–169). At this early stage the importance of nuclear research for the Austrian nation was elaborated on by different actors. The Austrian Academy of Sciences stressed the importance for Austria's scientific reputation as well as for its young professionals, and in the long run also for the economy. Similarly the EVÖ saw great potentials in nuclear research and took steps to secure that the peaceful uses of atomic energy would strengthen the position of Austrian industry. In December 1954, when public officials from all concerned ministries first debated the issue, several expressed great interest again on behalf of Austrian sciences, agriculture and industry.[100]

Of course one might object here that public officials were acting as representatives of the Austrian state, and as such of course related to the Austrian nation in their positioning work. Still it is worth mentioning, that all of this occurred without frictions, without any further references towards more particular or other ends. Public officials and scientists both exclusively referred to the Austrian nation as the addressee of their claims and in doing so practiced Austrian nationhood and national identity as such. Keeping in mind that the Austrian state was founded in 1945 as a result of World War II, carried and fostered by political elites and mediated through the political parties, the importance of public institutions and public officials in the process of nation building as well as the development of an Austrian national identity and consciousness must not be underestimated. In the long run this is expressed by Austrian's referring to the nation state and its institutions, when being questioned about national identity (e.g. two thirds of the people being questioned in the 1990s, according to Breuss et al., 1995, p. 219).

On the other hand all of this very much structured the effort of coordinating nuclear research along national dimensions. As has been demonstrated this also resulted in reactions on a more regional level. We can safely assume that even though austro–corporatist structures were perceived to secure big industry and nationalized enterprises being "in the loop", while smaller enterprises, acting on a more regional or local basis, felt the necessity to make local arrangements to keep up.

Similarly Austrian physicists were involved in these processes within their role as scientific experts. Following Rogers Brubaker (1996), the practice of drafting reports and memoranda within this institutional setting as such already represents a reification of nationhood. Beyond that the Austrian Commission on Atomic Energy was quite open about this aspect, as members decided that the very purpose of the *Memorandum on the peaceful uses of atomic energy in Austria* was to demonstrate Austria's experience and expertise

[100] Interministerielle Besprechung am 21.12.1954, 22.12.1954. AÖAW, FE-Akten, IR, K50, F726.

in dealing with atomic energy. Physicists used these opportunities and actively engaged in the *"invention of tradition"* and the creation of suitable pasts in their work for the commission. Berta Karlik for instance repeatedly portrayed Austria as a nuclear pioneer in comparison to other European nations, because of the early institutionalization of a distribution center for radioactive isotopes, within the commission itself and within her reports. Even more so she stressed the long history of nuclear research in Vienna. While Vienna had been a leading center for nuclear research in the 1920s, it had drastically fallen behind throughout World War II and the first decade after the war. Karlik related a bright past of Austrian physics to a rather pitiful present. If Austria was to regain an important position in the world of nuclear research, investments were imperative. In course of 1955 Austria's role in nuclear research was increasingly described as a rather moderate one within the Commission on Atomic Energy. E.g. when reporting on developments in other countries, measures taken in Austria were framed as making sure and securing that Austria would not lose track, while taking risks or facing big challenges was explicitly avoided.[101]

Ferdinand Cap's internal report was similarly engaged in staging nuclear research as a national effort. Listing all possible fields of application of atomic energy in science and industry he referred to Austrian activities wherever possible. In doing so he fostered the impression of Austria already being well situated and having a long tradition in the field. Cap went even further, when listing Austrian contributions to nuclear research. Even though had the decency to remind the Austrian Commission on Atomic Energy on the large number of emigrés in the physics community and argued for approaching them to negotiate their return on another occasion, he was willing to attribute their contributions in physics to Austria. Thus he created a more recent history of great achievements in Austrian physics, a history completely ignorant of political persecution during national socialism and all its consequences. An outstanding performance of creating a version of post–war Austria, that is consciously disconnected from and ignorant of its own origins. In German this was referred to as *"die Stunde Null"*, which was supposed to imply that Austria and Germany were granted a fresh start after World War II. Needless to say that this has to be considered one of the foundational myths of post–war Austria, that enabled a whole society to deny its own involvement in National Socialism.

In contrast to the performance of national identity through institutions of the state as referred to above, Hans Thirring's suggestion to alter the *Memorandum on the suitabilty of a research reactor* in order to stress that constructing such a reactor would be *"in accordance with Austria as a nation of culture"* operates on a different level. It places nuclear research, or rather science and technology in general, in line with Austria as a nation of grand cultural achievements. Taking pride in such achievements is a key element in Austrian national identity, as Austria is repeatedly imagined as a cultural super power in contrast to its insignificant role in global politics. (Breuss et al., 1995, pp. 172–176).

[101] 1. Tätigkeitsbericht der ÖKAE, 05.07.1955. AÖAW, FE-Akten, IR, K50, F730. BKA-AA, Runderlass an alle Botschaften, 29.08.1955, GZ: 335.038-INT/55. AÖAW, FE-Akten, IR, K50, F729.

In general the Austrian Commission on Atomic Energy took efforts to and repeatedly stressed the importance of investing in national nuclear expertise. On the one hand this meant finding ways to cooperate with other European countries that were building or already running nuclear reactors, to have Austrian experts working and training with the technology.[102] Furthermore members of the commission expressed interest in having Austrian experts participate in the different training programs offered by the United States within the Atoms for Peace program.[103] On behalf of industry actors within the EVÖ, as well as members of the regional research committees on nuclear research in Innsbruck and Graz, stressed the importance of knowledge transfer to industry through educational measures. Within the Commission on Atomic Energy Karlik stressed the necessity of such efforts, when the invitation of an American "all-round expert on atomic energy" was debated. According to the protocol Karlik called such a move *"premature, because the Austrians posing the questions should be better oriented first."*[104] In short the demand for building national expertise in the nuclear field was on the one hand clearly articulated by various actors and on the other hand created by stressing national deficits.

While several ministries wanted to send Austrian experts to the United States, all of them tried to have the trips and stays funded by American sponsors. Most trips were sponsored by stipends of the Fulbright Program or other sponsors acquired through the American embassy.[105] On several occasions Berta Karlik and Hans Thirring were complaining about insufficient funding to keep young researchers either within science or in Austria at all.[106] As a result of this condition the commission decided to

> *"only send those experts to foreign countries for training courses, whom are expected to return and put their knowlege to use in Austria. In other words it might be best to pick people who already have permanent positions here."*[107]

Beyond that the commission expressed the opinion that educational efforts should be intensified at the Department of Radiumresearch.[108] The Geneva Conference in August 1955 fostered the idea that training and educating national experts would be necessary, mostly because such people were considered necessary staff and operators, in case Austria's energy production would include the use of atomic energy in the future. Apart from such demands and perceptions in national deficits the Geneva Conference seems to have con-

[102] Interministerielle Besprechung am 21.12.1954, 22.12.1954. AÖAW, FE-Akten, IR, K50, F726.
[103] 2. Sitzung der ÖKAE am 24.01.1955, 27.01.1955. AÖAW, FE-Akten, IR, K50, F727.
[104] 6. Sitzung der ÖKAE am 29.06.1955, 01.07.1955. AÖAW, FE-Akten, IR, K50, F729.
[105] 2. Sitzung der ÖKAE am 24.01.1955, 27.01.1955. AÖAW, FE-Akten, IR, K50, F727. 4. Sitzung der ÖKAE am 14.04.1955, 18.04.1955. AÖAW, FE-Akten, IR, K50, F728. 5. Sitzung der ÖKAE am 06.05.1955, 09.05.1955. AÖAW, FE-Akten, IR, K50, F728.
[106] Anhang 6, 1. Tätigkeitsbericht der ÖKAE, 05.07.1955, p. 14. AÖAW, FE-Akten, IR, K50, F730. Thirring an Meznik/BMU, 21.09.1956. AÖAW, FE-Akten, IR, K49, F707.
[107] 6. Sitzung der ÖKAE am 29.06.1955, 01.07.1955. AÖAW, FE-Akten, IR, K50, F729.
[108] 5. Sitzung der ÖKAE am 06.05.1955, 09.05.1955. AÖAW, FE-Akten, IR, K50, F728.

vinced the members of the delegation that in medicine Austrian expertise was top–notch and internationally competitive.[109]

Overall the participation of the Austrian delegation in the Geneva Conference as well as Austria's negotiations on joining CERN are to be understood as further examples of practices attached to the production of national identity themselves. In contrast to Germany, Austrian nuclear research was not limited by any kinds of regulations, so envisaged activities did not pose any problems while Austria was still under allied administration (see section 6.3). Both cases provided an environment for Austrian officials to participate in international relations, to internationally appear as representatives of the new state of Austria, that was currently negotiating the conditions of its future independence. Between 1953 and 1955 the Austrian State Treaty was of course the most important aspect of Austria's foreign relations. However international cooperation in science and technology provided an opportunity to participate in international developments, to take (even only a small) part on the global stage, while Austria was neither a full member of the United Nations, nor a sovereign country. Then, only a few months after the Austrian State Treaty had been signed, the Geneva Conference was staged and celebrated as one of the biggest breakthroughs in international cooperation and in research and development. The participation of an Austrian delegation can therefore also be seen as a form of normalisation with regard to Austria's situation in the post–war era.

As already addressed in section 2, cooperation in the field of nuclear research and development also served as a playing field for the integration of Austria into the western block, that lay offside the negotiations of the Austrian State Treaty. On several occasions the tensions between such an alignment with the West and an emerging neutrality found an expression in the Austrian Commission on Atomic Energy. While it must have been abundantly clear for everyone involved that Austria was planning on purchasing a research reactor from the United States, steps for international cooperation in nuclear research were also taken towards Yugoslavia and the USSR. In January 1955 the commission expressed that

> *"in Austrian opinion it would be favourable to cooperate with US institutions without a contract between the two governments, because one can expect that in case such a contract would be signed, political objections could be filed from another side."*[110]

In November, after the Austrian State Treaty had been signed, the commission recommended that Austria should not restrict itself to only one country with regard to uranium purchases, even though it was *"self–evident that regarding a research reactor delivered and paid for in half by the United States, the delivery of uranium would have to occur from the*

[109] BKA-AA, Runderlass an alle Botschaften über die Genfer Konferenz, 29.08.1955, GZ: 335.038-INT/55. AÖAW, FE-Akten, IR, K50, F729.

[110] 2. Sitzung der ÖKAE am 24.01.1955, 27.01.1955. AÖAW, FE-Akten, IR, K50, F727.

US."[111] Again this indicates two things. First of all Austria was planning on purchasing a US reactor from the very beginning, and was actively seeking the integration into the Western block. Thus we can speak of Austria actively participating in what Krige called the co–production of hegemony. Second Austrian officials were also looking for wiggle room in international relations and tried to use the tensions in international relations to their advantage, which can be interpreted in terms of increasing self–confidence in the international arena (see also Rößner, 2013, p. 32; Rathkolb, 2005, p. 31).

In section 6.4.5 we have seen how the expected role of the peaceful uses of atomic energy in Austria increasingly revolved around Austria's economy profiting from and participating in the emerging sector of nuclear industry. Repeatedly the Austrian Commission on Atomic Energy stressed the importance of atomic energy for national economy. Thus the participation of Austrian industires in the nuclear sector was related to the reconstruction effort and economic prosperity. Especially in the mid 1950s national survival in terms of economic prosperity was a central theme in the construction of Austrian national identity. As Breuss, Liebhart, and Pribersky (2004, p. 506 and p. 507, translation FB) put it:

> *"Austrian reconstruction efforts after 1945 — besides economic goals — also served the aim of creating an ideology of a national community. After 1945 reconstruction was not only a necessary consequence of defeat and distruction in World War II, but simultaneously a political program beyond actual reconstruction"* [...] *"'The trust of Austrians in their nation state's ability to live' should be expressed in the collective efforts of reconstruction."*

As the authors argue, belief in national independence and progress was increasingly built on the reconstruction effort, economic accomplishments and technological capabilities. Throughout the 1950s such accomplishments were most of all symbolized through national hydro power projects like Kaprun and increasing electrification in general (ibid., pp. 507–518; see also Rathkolb, 2012). As we have seen Karlik prominently referred to applications of nuclear technology useful in the context of Austrian hydro power plants in the *Memorandum on the peaceful uses of atomic energy*. How important this linkage was can be grasped in Austrian media reports, explicitly referring to these national accomplishments as well.[112] In other words atomic energy was actively contextualized as supporting Austrian hydro power production, establishing a symbolic link between atmoic energy and Austrian national identity. Equally the reference of future power production through atomic energy was carefully related to developments in hydro power, avoiding conflict between the two. At best nuclear power production would accompany existing and future hydro power installations. Furthermore the future role of nuclear power production was increasingly stressed, especially after the Geneva Conference in August 1955. Thus the connection was established to another theme of national identification in the post–war era: the electrification of Austrian society.

[111] 10. Sitzung der ÖKAE am 23.11.1955, 24.11.1955. AÖAW, FE-Akten, IR, K50, F730.
[112] Die Presse, Österreich und das Atomzeitalter. Radioaktive Isotopen bereits in Verwendung, 12.01.1955.

This collective belief in national progress was accompanied by the postulation of a new era. As we have seen in section 6.5 Austrian newspapers made use of many opportunities to stage the Austrian nation as actively involved in international developments in the nuclear realm. Furthermore the participation in the new era — the "atomic age" — was a dominant figure. Thus the appropriation of the "atomic age" in Austria not only enabled the identification with the Austrian nation, it did so in terms of an awakening or departure into an unknown, yet bright future. Again this future orientation in imagining collectivity enabled the construction of an Austrian national identity, that was very much disconnected from its past. Even though the "atomic age" was related to a long Austrian tradition in nuclear research, it was part of a new phase in history, not related to the distressing recent past one was involved in. Much like Hecht (2001, p. 253) demonstrated how science and technology provided a stage to renegotiate what was French in the light of *"decolonization and fears of Americanization"*, in the Austrian context science and technology provided a stage for the reinvention of Austrian national identity after World War II.

7.3 Practices of future making: On promises, scenarios and trajectories

In the following section I trace, how different visions of the future were staged in the appropriation of the "atomic age" in Austria. First of all I deal with promises and expectations within the Austrian Commission on Atomic Energy. Then I will focus on the role of scenarios in negotiating futures, before I take a look on how these aspects relate to trajectories in making futures. While I address these different sets of practices separately for analytical purposes, they have to be understood as interrelated registers. Much like (Tutton, 2011) stressed that invoking certain kinds of positive futures always involves invoking negative ones that are to be avoided, promises and expectations, scenarios and trajectories are linked registers, situated on different levels. E.g. we will see how trajectories are quite substantive imaginations. However they also provide necessary context for small scale promises. Small scale promises in turn are important bits and pieces in the construction of "bigger" trajectories.

7.3.1 Expectations and promises

In late 1953, when US President Eisenhower gave his speech on the future of atomic energy in New York, he prominently staged a number of promises attached to nuclear research. While innovations in agriculture were to solve the problem of world hunger, developments in medicine would cure diseases, numerous applications in industry would revolutionize production and finally, nuclear power production would provide relief to the *"power–starved areas of the world."* At this stage the discursive structures of these claims towards the future nicely fit the characterization of Welsh: E.g. temporal structures are relatively long and promises are directed towards humankind. Physicists in Austria, most prominently Hans Thirring, as well as actors in the EVÖ welcomed the US initiative and

aimed for national institutionalization. Throughout this process of institutionalization the promises for humankind expressed by Eisenhower, were appropriated and reshaped in Austria.

In the first few months of the Austrian Commission on Atomic Energy's activities, the general understanding of atomic energy seems to have been a very broad one. The term atomic energy referred to all fields of nuclear research that dealt with the energies of the atom that had been discovered and released by nuclear research in the first half of the 20^{th} century. As such the field of nuclear research was represented through the different promises that set the agenda of the commission.

Training courses and education programs were explicit fields of interest within Austrian bureaucracy, because medical treatments promised new strategies of dealing with, or maybe even curing cancer. Nuclear research was considered relevant in the BMLF, because it promised unlimited preservation of foods as well as the stimulation of growth in plants. Expected developments in industry seemed to afford preparation, which already implied the application of nuclear research in industry, in terms of industrial hygiene or industrial medicine. But how, we have to ask, were these promises made to matter within the Austrian setting?

As far as the commission goes, documents suggest that the promises were articulated by the different representatives of Austrian bureaucracy to legitimize their interests in sending Austrian experts abroad. Since we do not have any word–for–word documentation of the sessions, it is not that easy to track however, who initially articulated such promises in the commission and how they were debated and negotiated. At least we can make an educated guess and attribute a leading role to the scientific experts involved. The case of the BMLF provides a good example: In the first meeting on December 21^{st}, the BMLF reportedly expressed interest in sending an expert to the United States, based on explicit promises (food preservation and growth stimulation).[113] However in the following sessions the respective ministry was repeatedly reported to be rather clueless, when asked to place demands and interests. Commission members on behalf of the BMLF seemed to have little knowledge on possible applications in their field. Eventually Berta Karlik assured to provide literature, so the BMLF could make up it's mind on relevant future possibilities. The commission itself also served as a space of exchange between the different ministries in this regard. While the BMLF had seemingly no knowledge on relevant activities by universities in Austria at the very beginning, the University of Natural Resources of Vienna (*Universität für Bodenkultur*) was conducting research focussing on the relationship of metabolism and life-stock breeding since the beginning of the 1950s. After the creation of the commission the respective expert urged the BMU to acknowledge the importance of such research in further plans in the light of expected future applications in agriculture.[114]

[113] Interministerielle Besprechung am 21.12.1954, 22.12.1954. AÖAW, FE-Akten, IR, K50, F726.

[114] J. W. Amschler an das BMU, 04.03.1955. ÖStA, AdR, BMU, Atom, K63, GZ: 46.554/I/1/55. J. W. Amschler an das BMU, 04.04.1955. ÖStA, AdR, BMU, Atom, K63, GZ: 49.838/I-1/55.

Beyond such early exchanges on promises and expectations within the commission the preparation of the memoranda for Geneva provided ample room for staging promises. Ferdinand Cap's exposé on the uses of atomic energy in Austria provides a good example here. Cap listed an extensive number of applications, from age determination of materials, the measurements of snow heights, radioactive diagnostics and research on metabolisms in animals and plants that would lead to developments of new breeding techniques and fertilizers (see section 6.4.2). What makes Cap's report so interesting with regard to promises is the mix of general developments in the field of nuclear research with national activities. In doing so all the different applications and promises appear to be of direct and immediate relevance. Some aspects are framed as basic science that is going on either abroad or in Austria, others are applications already developed in the United States, others already in use by Austrian industry, while some are to be developed in the near future. As such all of these activities, whether they are already practiced or at least soon–to-be-practiced, provide the necessary context for more future oriented promises, that are way more open and lack contextualization and concreteness. In other words age determination of bible texts on parchment and measuring snow heights in the Austrian alps help in creating trust for promising synthetic food production and fully automated factories in the long run. Similarly the staged progress in medicine paves the way for putting nuclear research on a self–referential trajectory: Eventually nuclear research can be reasonably expected to provide a cure for diseases caused by radioactivity as well.

An example of missing institutional backup in order to participate in the orchestration of opportunity are the activities of Erich Bandl, to bring the commission's attention to the possibilities of using radioactive tracers in alpine rescue services. Bandl suggested to equip alpinists with radiation emitters, so they could be traced in avalanche accidents. In a similar fashion he suggested to mark alpine tracks with radiation emitters, so alpinists in emergency could seek orientation by using Geiger counters.[115] Even though these suggestions appear extraordinarily strange from today's perspective, it is interesting that Bandl tried to realize such a project through the Austrian Commission on Atomic Energy. Probably Bandl expected to be listened to because of his own background in the BMLF in the interwar period. However Bandl was a trained jurist and engaged in nuclear matters as a self–trained geologist, who was associated with the Federal Institute of Geology in Vienna (*Geologische Bundesanstalt*) (Salzer, 1960). As such he had no connections to the physics community at all and could hardly claim scientific authority within the commission. There are no indications that Bandl's suggestions received any attention by any member of the ACAE.

Focussing on expressed promises and expectations the first eight months of the Austrian Commission on Atomic Energy's activity can be described as a phase of channelling interests in the form of promissory practices. While the first four months a very general idea of atomic energy was prevailing, expectations became increasingly attached to promises

[115]Bandl an das BMU am 04.05.1955. ÖStA, AdR, BMU, Atom, K63, GZ: 51.032/I-1/55.

of nuclear power production as the conference in Geneva approached in 1955. It seems that atomic energy and nuclear research were staged as very broad and general developments in the early phase of appropriating the "atomic age", to suck in as many interests as possible, as we might say in reference to John Law (1986, p. 77). Once all the interested actors had been assembled through a broad set of expectations, these were narrowed down into promises through the process of institutionalisation and stabilisation. The more the futures revolving around atomic energy were embedded in actual institutional practices, the more they revolved around the promise of nuclear power production. The issue was present from the very beginning, but consciously put aside on several occasions. Instead Austrian sciences and bureaucracy decided to purchase a research reactor to mainly serve the interests of education and training in basic and applied experimental physics, to secure that Austria had the necessary level of expertise at its disposal, to catch up with international processes and be prepared for future developments. In course of the summer of 1955 the debates increasingly evolved around nuclear power production as the promissory industry sector, while expectations and respective agenda setting narrowed down in this direction. For instance the report on Geneva to the Council of Ministers that suggested the foundation of the SGAE explicitly listed preparations for the production of electric power by nuclear fission as part of the new institution's agenda. Promising developments for Austrian industry, were now attached to experimental power production in foreign countries:

> *"Even though the experimental stage is not yet overcome in these countries, in the light of the enormous efforts taken to persue experiments on such a great scale, there can be no doubt that technically satisfying solutions will be found shortly. From an economic perspective, the Geneva Conference has proven the great industrial potentials on this sector. The production of reactor material, control units and measuring instruments, equipment and necessary administrative installations can stimulate wide circles of industry to an unforeseeable extent."*[116]

In reference to Van Lente and Rip's notion of the funnel of interest, I suggest to describe this development of staging general expectations, and their subsequent reshaping towards more embedded, contextualized and situated promises as a *funnel of expectations.* In the early phase of the appropriation process expectations were located on a very universal layer, which is most prominently expressed in humanity being the beneficiary subject of the expected developments . In the further course these expectations were reshaped to actual promises in the process of their appropriation in Austrian institutions in terms of embedding and contextualizing. Consequently these promises were not only related to e.g. Austrian industry instead of humankind, they were also boiled down to very specific

[116] BKA-AA, Runderlass an alle Botschaften, 29.08.1955, GZ: 335.038-INT/55. AÖAW, FE-Akten, IR, K50, F729.

perspectives for value accumulation. The UN Conference n the Peaceful Uses of Atomic Energy in Geneva, its structure and conceptualisation, together with the preparatory work demanded from participating countries, acted as a structuring factor in this process. Again in reference to Van Lente, Rip and Law we can say, it was designed to prevent escape in the process of contextualizing and embedding expectations, ensuring that participating countries ended up on the right pathway. Throughout this development articulated expectations turned into ever more specific promises that also lead to the formulation of situation–specific requirements, e.g. organizational structures in the SGAE and the decision on the type of the research reactor that was to be purchased. Consequently all of this strengthened the initial expectations, after all a lot of efforts were taken, so one could expect respective outcomes.

7.3.2 Drafting scenarios: making futures path–dependent

Hans Thirring's changing positions on nuclear power production have been addressed in section 6.1. Initially he opposed nuclear power production because he objected the destruction of uranium deposits. In his view uranium was one of the key resources of future economic developments in nuclear chemistry. Since Thirring was a scientist who explicitly exposed himself in public life with regard to political decision making, he left written traces that can be subjected to closer analysis.

In reference to the work of Cynthia Selin (2006) Thirring's accounts on the future role of nuclear power production can be described as drafting scenarios. Thirring depicted certain versions of the future in order to bring others in line behind him. He used the open space of projection to narrow it down to specific scenarios, different versions of how today's actions might relate to future states of affairs. As we have seen, in 1952 his main argument was that burning uranium was simply irresponsible in the light of other possibilities.

Asking how Thirring's scenarios were claiming credibility, we are tempted to quickly judge them as crude simplifications, extrapolating a certain state of affairs hundreds of years into the future, only by relating three or four different factors. On a closer look however, we could argue that instead of hiding behind esoteric knowledge claims Thirring staged the problem in question as simple, open to be contested or repeated, tempting the reader to do the calculations: He argued that the world energy consumption divided by the amount of energy produced from one kilogram uranium equals 1000 tons of uranium to be burnt within a year. Assuming nuclear power production amounted to 10 per cent of all industrial power production, this would imply 100 tons of burnt uranium per year. In relation to estimated deposits this implied all uranium would be consumed within a millennium. In case the percentage rises probably only five hundred years. My argument here is that even though the reduction of complexity that is at work in creating such a scenario is obvious, it creates trust because it allows the reader to repeat the simplified calculations. Thirring provided the reader with a comprehensible methodology on how his scenarios were constructed and in doing so enabled trust in the respective scenario. Besides

Thirring's publications such calculation oriented scenario making was also published in the *Tiroler Tageszeitung* after the Geneva Conference.[117]

Furthermore the wild speculations on future states of affairs were contextualized in the present, e.g. by drawing upon path–dependency. Thirring argued against the construction of nuclear power plants, because the simple decision to build the plants would lead to enormous investments, which in turn would demand the plants be in operation until investments amortized. At least until then however, they would be burning uranium and therefore actively engage in the creation of the future Thirring wanted to avoid.

Thirring was also projecting past experiences of human history into the future. He stressed that the Phoenicians cutting cedars in Lebanon, and the Venetians deforesting Dalmatia, could have well been doing so based on sound decision making in order to further their cause, *"yet, two thousand years later, they stand condemned before history for having irresponsibly and selfishly robbed future generations"* (Thirring, 1952, p. 170). The sociology of expectations termed such activities *"prospecting retrospects"*, suggesting that scenarios of the future are very often projections of past experiences (Brown & Michael, 2003, pp. 9–11). In this case these prospects very much expressed the increasing awareness of ones own present being the open future of earlier generations. Besides Thirring also Cap engaged in this kind of future making, when he compared research and development in the nuclear field with the enormous changes the general introduction of electricity meant for economic and societal developments. While Thirring's retrospecting was supposed to be a warning, Cap was trying to assert his claims by referring to past achievements of science and technology, in the typology of Welsh (2000, p. 8).

Overall the scenarios that were contrasted by Thirring in 1952, in order to convince his readers on the irresponsibility of using uranium ore as a fuel for power production, very much relied on pessimistic registers. It was not so much a good future that was opposed to a bad one, it was rather an open future that was contrasted with a narrow one. We could say that Thirring's objections on nuclear power production in the early 1950s were moral ones. He labeled the use of uranium ore as a fuel for power production as irresponsible, because it was an act of taking futures, it limited the possibilities of future generations, even though there were other options. When new research by the US Atomic Energy Commission suggested that estimates on fossil fuel deposits had to be scaled back Thirring adapted his scenarios. Based on the new estimates, and by adding the factors of growth in world population and expected rises in electricity consumption, the considered alternatives appeared unfeasible. Because of increasing demand and fading fossil fuels, Thirring staged the burning of uranium ore as imperative now: There was no other option. In the light of necessity earlier objections were subjected to the faith in technological progress: *"there is justified hope that the relatively small amounts of uranium necessary to produce radioactive isotopes, could be gathered from globally dispersed uranium"* (Thirring, 1954, p. 343).

[117] Tiroler Tageszeitung, Bringt die Atomenergie weltweite Arbeitslosigkeit mit sich?, 03.09.1955.

Scenarios also played an important role within the Austrian Commission on Atomic Energy in 1955. In sections 6.4.4 and 6.4.5 we could observe how the Geneva Conference framed the work of the commission by seeking the participating countries to deliver reports on expected energy demands in the next 50 years. The respective report in Austria stressed the increasing degree of electrification. While recent increases could not directly be extrapolated into the future because of the reconstruction effort, the electrification of Austrian households and the Austrian railways, together with a continuing rise in demand from industry, fostered the idea that a new power source would also be wishful for Austria in the long run. Not only did the commission bring afore this understanding of expected increases in demand, it also circled it among relevant actors. Within a few months between spring and summer 1955 relevant actors were provided with a scenario on energy consumption in Austria for the next 50 years, that suggested measures taken so far were not able to secure Austria's needs.

Besides the scenario on future energy consumption, the Geneva Conference also served as a space to exchange national scenarios on the future role of nuclear power production. Before the Geneva Conference nuclear power production was imagined to be relevant in a rather distant future in Austria. As we have seen this understanding was superseded by scenarios of nuclear power production within the next decades. The time frame until nuclear energy would play a central role in economy was expected to be 10 years, the plans for nuclear power production within the next 25 years in England, France and the United States had been openly debated in Geneva. Consequently they contributed to the perception that preparations were to be taken as soon as possible, after all nuclear power production seemed to move up into the near future. Immediately after the Geneva Conference the *Tiroler Tageszeitung* took up these scenarios and estimated that nuclear power production could be competitive with traditional forms of power production within two decades.[118] About a year later, Josef Nagler popularized the same scenario in reference to competition with hydro power in his radio lecture.[119]

Questioning how these scenarios could be established in a credible way, we can again investigate the way they have been contextualized in the appropriation process in Austria. At the very beginning of the commission's activity, nuclear power production was staged as a frontier endeavour: An experimental power reactor was mentioned to be already running in the USSR since June 27$^{\text{th}}$ 1954. However electricity costs were estimated higher than electricity produced from hydro power.[120] Meanwhile the US were reported to have decided on the construction of five different experimental power reactors. While nuclear power production still seemed to be quite expensive, there were *"justified hopes"* for sinking prices. The justification of these hopes was argued with falling stock prices on the US market, the warning of the president of General Electric in planning conventional power plants and the

[118] Tiroler Tageszeitung, Bringt die Atomenergie weltweite Arbeitslosigkeit mit sich?, 03.09.1955.

[119] Erwägungen zur Auswertung der Kernkraft, Radiovortrag am 28.11.1956 um 16:45 Uhr. ATMW, ÖFIT/BPA-009841.

[120] Interministerielle Besprechung am 21.12.1954, 22.12.1954. AÖAW, FE-Akten, IR, K50, F726.

reported intention of US electric power companies to use the technology within the next decade. All of these claims qualify as examples of *"discounting residual difficulties into the future"* (Welsh, 2000, p. 8). While the basic problem, the scientific laws on which nuclear power production is based, were framed as already discovered, technologists and private enterprises were already tinkering on the realization of the project. Given the enormous efforts taken — efforts which were repeatedly stressed — the scenario was staged as modest, rather than the result of technoscientific hubris. However, while others were taking the risks in tinkering on the application of nuclear power production, Austria took a "wait and see" position.

In the months before the Geneva Conference, the scenario on expected power demands contributed to the fostering of the nuclear power production scenario. In the first activity report the BMVVB already placed that

> *"in the light of expected increase in energy consumption it is likely that Austria will be forced to produce an increasing amount of its energy by caloric power stations. Based on the development of the international coal market, it could be advisable or necessary to switch to nuclear power production then."*[121]

Immediately after the Geneva Conference most of these reservations seem to have disappeared. What was important now was the framing of the scenario of nuclear power plants in Austria, as not conflicting with the development of Austrian hydro power, the industry sector the nation took so much pride in. As Breuss et al. (2004, p. 515) have observed, after the nationalisation of Austrian power production future scenarios for Austria's energy production included the vision of Austria becoming a power exporting country in the center of Europe. A first attempt to actively reframe the role of nuclear power production of Austria in that sense in the aftermath of the Geneva Conference, can be found in the series edited by the *Tiroler Tageszeitung.*[122]

Beyond that the commission asserted belief in progress and engaged in frontier–speech, when reporting on developments in other countries. While the theme of Austria lagging behind in development was otherwise used to create urgency, it was reversed in this case. All Austria had to do was investing in the education of national experts and creating the structures to secure that Austrian industry could benefit from this expertise, to secure participation once the industrial possibilities of nuclear power were to be realized.

A common feature of all these scenarios is their invoking of path–dependency. While some scenarios quite explicitly stage the respective future as path–dependent, they all do so to some extent. Scenarios are contextualizing different steps and stages of future states of affairs in the present, and in doing so they allude to the notion of path–dependency. After all it is hard to imagine a scenario that is not projecting the idea of certain causes leading to specific results into the future. Consequently we could interpret this transformation of futures into path–dependent futures through the practice of making scenarios, as one further aspect of how such scenarios claim credibility and establish trust.

[121] 1. Tätigkeitsbericht der ÖKAE, 05.07.1955. AÖAW, FE-Akten, IR, K50, F730.
[122] Tiroler Tageszeitung, Bringt die Atomenergie eine weltweite Arbeitslosigkeit mit sich?, 01.09.1955.

7.3.3 Conceptualizing developments as trajectories

Throughout this section the predominant focus has been on how the "atomic age" was appropriated on different occasions and in various forms. First with regard to national identity, afterwords in focussing on how different expectations, promises and futures were contextualized throughout the increasing institutionalisation of science and technology policy in 1955. On several occasions though, we also could observe how coordinating nuclear research in Austria was connected to practices of imagination in the different direction: Repeatedly local or national developments were imagined to be part of global and universal developments of humankind.

Within the Austrian Commission on Atomic Energy it was Ferdinand Cap, who explicitly established such links in his exposé. As described in section 6.4.2 Cap located research on photosynthesis to the synthetic production of foods and implied that, once the underlying processes of photosynthesis were discovered, *"nutrition of humanity"* would be *"no longer dependent on living plants."* Similarly the use of radioactive isotopes would enable automated production, and many other aspects of human life could be expected to be eased through the application of nuclear technologies, if only nuclear physicists were granted their earned position within society.

Similarly the production of nuclear power was staged to be connected to a bigger project of providing humanity with energy from the very beginning. Technological explanations on nuclear fission stressed the importance of developing breeder reactors, in order to secure that consuming uranium simultaneously resulted in the production of further nuclear fuels.[123] On the other hand Ferdinand Cap stressed efforts taken in nuclear research to "discover" thermonuclear fusion. As the report of the delegation concluded in this regard after the Geneva Conference: *"If the control of this process could be discoverd by science, any energy demand of the world could be covered, because of the availability of unlimited hydrogen resources."*[124] Thirring went even further in defending the open future against nuclear power production:

> *"It can easily happen that at some future time when our civilization will first have reached the advanced stage enabling it to start really going places with uranium and thorium, it will find left to it none but miserably poor deposits of these metals."* (Thirring, 1952, p. 171)

In a complementary manner electricity consumption was understood as an indicator for welfare and therefore on an ever increasing pathway. Not only Eisenhower equated these two factors, when he imagined nuclear power production as a technology enabling humanity to provide energy to the power–starved areas of the world. In Austria Hans Thirring included continuing rises in energy consumption on a global scale in his scenarios for future energy production. Austrian scenarios on future power consumption and demands

[123] Anhang, Interministerielle Besprechung am 21.12.1954, 22.12.1954. AÖAW, FE-Akten, IR, K50, F726.
[124] BKA-AA, Runderlass an alle Botschaften: Internationale Konferenz für die friedliche Nutzung der Atomenergie; Information, 29.08.1955, GZ: 335.038-INT/55. AÖAW, FE-Akten, IR, K50, F729.

articulated the desire, to reach the same per capita consumption as other highly industrialized countries. These three examples show that the consumption of electricity was seen as an indicator for social welfare, progress and prosperity. After electricity consumption was strictly regulated in the immediate post–war years, by the mid 1950s measures were taken in Austria, to encourage the use of electricity. The so called *"Elektrogeräte–Aktion"* should enable Austrian consumers to modernize households. National efforts as Kaprun were in the end supposed to further economic prosperity on an individual level. In these terms technological utopias increasingly superseded sociopolitical utopias in the first two decades after World War II (Breuss et al., 2004, pp. 515–517). The use of electric energy in everyday life was seen as one central form of this technological modernisation project, as expressed in contemporary advertisement: *"Electricity makes life more comfortable and the economy more efficient."*; *"Living electric means living better."*; *"Electricity: a yardstick for the standard of living."* (translation FB; cited from Breuss et al., 2004, p. 517).

Referring to Appadurai's notion of trajectorism we can identify the underlying telos in all these different narratives. The first one creates a trajectory of human development based on the aim of solving world hunger. The nutrition of all human beings of the world is imagined to be achieved in the future, by relieving natural constraints through technology. In the end it will be achieved by freeing the human being from its metabolism with nature. The telos of the second trajectory is the unlimited production of energy. Through discovering and mastering natural processes humanity would in the end be able to produce indefinite amounts of energy for all kinds of purposes, and in doing so be free of energy constraints in the process of further modernization. The final trajectory is a more contextualized, maybe a more mundane one. It suggests that the development of civilisation is a process of making human life more comfortable, a process of overcoming difficulties and troubles to secure one's existence.

As I tried to demonstrate, the mastering of atomic energy and nuclear power production were imagined to be technical accomplishments in reference to a bigger project of civilisation and modernisation. As such these imaginations formed a constitutive part of an innovation trajectory that Felt described as the idea of societies gradually overcoming *"natural limitations and impediments through technoscientific innovations"* (Felt, 2015b, p. 8). If we ask what aspects of the human existence are black boxed and naturalized in such an understanding, we cannot help but notice what Breuss et. al. described in reference to the trajectory of electricity consumption in post–war Austria. The innovation trajectory nuclear research was associated with, framed societal challenges as purely technoscientific issues. World hunger, economic prosperity and social welfare were attributed to science and technology, completely separate from social relations or orders. In terms of Michael we could say the imagination of a future substantively different from the current state of affairs, was imagined to be based on technological development alone. This way the utopia of a different future for humankind was also depoliticised and disconnected from an openly articulated sociopolitical one.

8 The post–war nuclear imaginary

In their first take on sociotechnical imaginaries Jasanoff and Kim stressed the heuristic benefit of cross–national comparison in order to identify and illuminate imaginaries (Jasanoff & Kim, 2009, p. 120). Even though the analysis within this thesis focuses on one single case study on the national level, I intend to discuss the associated sociotechnical imaginary in a comparative effort. In contrast to Jasanoff and Kim the nature of the comparison is not cross–national by first order, but rather across different historical moments and contexts. Within this section the post–war nuclear imaginary in Austria will be compared to and delineated from the sociotechnical imaginary of the absent, the anti–nuclear imaginary that established since the late 1970s (Felt, 2015a). The heuristic benefit of having an object of comparison that is essentially different from the one under scrutiny, is effective in this historic comparison as well, because of the substantive break and shift in dealing with the nuclear in Austria. Beyond this inner–national comparison I will also relate the results of my analysis to case studies of South Korea (Jasanoff & Kim, 2009), to shed more light on the specific aspects of the Austrian case.

The anti–nuclear imaginary that established in Austria throughout the last quarter of the 20th century has been scrutinized by Felt as the essential aspect of the formation and stabilization of a new kind of technopolitical identity. Ever since the anti–nuclear imaginary could be successfully assembled and stabilized, it was repeatedly reassembled and rehearsed, mostly with regard to the nuclear itself, but it was also invoked and rehearsed in the context of the anti–GMO debate and appears to be a central point of reference in dealing with nano technologies as well (Felt, 2015a). In that sense I advance a reading of Ulrike Felt's work here that stresses the centrality of opposing the nuclear in Austrian technopolitical identity. In every case this technopolitical identity is actively invoked and at work — so on every occasion some kind of technology is singled out and resisted by invoking national identity, which in contrast to common sense impressions only took place with regard to a few exceptional technologies — the sociotechnical imaginary revolves around the anti–nuclear moment as the crucial point of reference. Imaginations, hopes, fears and futures are constructed in relation to a specific reading of Austria's anti–nuclear history, including the idea of public/collective learning: In Austria "the people" have spoken out against the nuclear and hence put an end to nuclear prowess. As a result technopolitical imaginations gain a certain relevance because of and in relation to specific interpretations of the nuclear.

In contrast to the current imaginary the pro–nuclear imaginary in the post–war era does not revolve around the nuclear in that sense. The unique feature in the production of technopolitical identity does not seem to be the nuclear itself. Even though the nuclear is an important element, where numerous imaginations are entangled, it is lacking this kind of centrality. The point in question becomes clearer in reference to the works of Gabrielle Hecht (1998, p. 10): *"The ways in which people* [in contemporary Austria; comment FB]

imagine the distinctiveness of their country and define uniquely national ways of doing things" is defined by referring to the nuclear. In immediate post–war Austria the nuclear was rather something that was appropriated in the sense of incorporation, much like in the case of South Korea (Jasanoff & Kim, 2009, p. 132): The nuclear was increasingly made Austrian, rather than referring to the nuclear as a means to make something else Austrian. To be clear, this does not refute a co–productionist point of view. Incorporating something and appropriating it by making it Austrian also involves the dimension of simultaneously constructing, producing and reshaping nationhood.

My analysis of how the nuclear was entangled with national identity throughout the 1950s highlighted the importance of relating nuclear research — and in course of time increasingly nuclear power production — to Austrian hydro power throughout the 1950s. The nuclear imaginary was assembled around hydro power on several levels: First of all nuclear research was related to power production in the alps, the use of radioactive isotopes contextualized as a promising field of research and development for the electric power industry. As the use of radioactive isotopes was generally perceived and staged as carrying the potentials for revolutionizing industrial production, it was also imagined to contribute to hydro power production in Austria by measuring snow heights, checking pipe installations and more subtle also by promising revolutions in the material sciences in general.

Secondly imagining the nuclear increasingly revolved around nuclear power production and was as such also related to hydro power production. This linkage connected the nuclear to hydro power projects like Kaprun and Ybbs–Persenbeug, which have been mythologized in terms of national prowess and technological progress (Rathkolb, 2012). Much like Welsh (2000) argued that developing nuclear capacities was a crucial moment of self–assertion in the Cold War era, the capacity to master technological progress in terms of giant projects in hydro power was a symbol of the ability to live for the newly founded state of Austria (Breuss et al., 2004). I have demonstrated how the nuclear was carefully related to these issues, while possible conflicts were ruled out from the very beginning. Decisively and carefully nuclear power production was portrayed as only one element in power production — what is labeled one dimension of the so–called power mix nowadays — that was rather contributing to Austria gaining a possible position as an electricity exporting country in Europe, instead of soon–to–be–cheap nuclear power penetrating hydro power markets.

This way the nuclear could be incorporated as part of the reconstruction effort. We could also observe how demonstrating technological prowess formed an essential part of reconstructing Austria, which was staged and performed as a collective effort to prove Austria's ability to survive in economic terms in the context of the strive for Austrian independence. The nuclear imaginary hence also included the technopolitical dimension of strategically pressing for technological development for overt political goals. The powerful rhetorics of the necessity "to catch up" was equally invoked as the imagination of Austria still being a cultural super–power, while it had lost this status in the arena of international politics. Investing in nuclear research and development was framed to be important because

Austria was staged as a small country with little natural resources in central Europe. Much like later in the context of Austria joining the European Union, this understanding of the Austrian nation state was performed in the debate of Austria joining CERN already by 1954. The post–war nuclear imaginary in Austria seems to be of a similar kind than the one accounted for in South Korea, which also revolves around imaginations of *"'atoms for development,' which South Korea has incorporated into its functioning as an effective and credible state"* (Jasanoff & Kim, 2009, p. 121). In the Austrian context this imagination of development included the idea of turning the nation into a power exporting country in central Europe based on the combination of hydro power and nuclear power production.

All of these dimensions were connected to different versions of the so called innovation trajectory identified by Felt (2015b). Radioactive isotopes were imagined to contribute to automated forms of production and the relief of natural constraints in nutrition. Humanity was imagined to enter a new (or probably also the last) phase of modernization as a project of dominating nature. Electricity played a central role in the Austrian innovation trajectory in the 1950s, as it was understood as an essential technical relief in everyday life. One prominent example demonstrating this aspect was the *Elektrogeräte–Aktion*, next to the officially expressed understanding that a rise in energy consumption was an indicator for social welfare. While hydro power was the already established proof of Austrian capabilities in mastering technology in the name of progress, nuclear power was imagined to be the next step on the way to freeing the human condition from energy constraints.

We have seen how different practices of future making tied into each other, to establish such imaginations and visions of the future as credible ones. While expectations and more specific promises formed a so called "funnel of expectations" that was effective and important in the implementation of science and technology policy, energy scenarios seem to have played a crucial role in fostering the idea that nuclear power production was inevitable. The publicly staged turn in position by Hans Thirring can be interpreted as an exemplary case in this regard, as it represents the change of an expert position that was framed to be without alternatives. Incorporating the nuclear as part of the dominant sociotechnical imaginary was perceived and staged as a necessity, rather than deliberate choice. This also found an expression in the ways Austrian nuclear history was mobilized and staged on multiple occasions. The equation of nuclear and Austrian prowess for instance demanded to stage Austria as some kind of nuclear pioneer, by referring to past scientific achievements and traditions. Even though such moves were most prominently taken by scientific experts like Berta Karlik and Ferdinand Cap within bureaucratic institutions, also Austrian media increasingly took up such portrayals. In 1960, when the Department of Radiumresearch celebrated its 50^{th} anniversary, Austrian newspapers similarly drew upon the register of the Austrian nuclear pioneer.[125] This long tradition in nuclear research could not be easily connected to contemporay developments though, as Austria had lost its position in internationl nuclear science. Historic glory was hence used as an introductory reference,

[125]Kurier, Heute vor 50 Jahren: Die Radiumforschung begann in Wien, 21.10.1960.

before the necessity "to catch up" or to build national capacities was stressed. So even though Austria was occasionally staged as a nuclear pioneer of the past, it was hardly conceptualized in terms of frontier–speech, as participating and practicing "science on the edge". The Austrian take on the issue was rather moderate, suggesting to wait, see and take necessary preparations in the light of foreign developments. Beyond that we could also observe how the discontinuity of the imagined future with the immediate history of National Socialism was performed in reference to the myth of *"die Stunde Null"*.

Overall the "atomic age" was very much staged as a new phase in history, a phase Austria was about to enter and incorporate. In these terms the nuclear imaginary in the immediate post–war era also reflects a more general understanding of history. In relation to the Moscow Declaration of 1943 the Austrian nation state was founded on the myth of having been the first victim of expanding National Socialist Germany. In the context of this *Opfermythos* history was conceptualized as external, something Austrians are passively confronted with (Breuss et al., 1995, p. 238). Today's sociotechnical imaginary of keeping certain technologies out is on the contrary occasionally invoked to stage Austria as making history. Mobilizing the nation state in the anti–nuclear struggle offers a stage for a performance of resistance against such foreign, external and intrusive developments, as could be observed in the ways Austrian representatives acted in the aftermath of the nuclear accident in Fukushima.[126]

Finally reflecting the relationship of the sociotechnical imaginary and the technopolitical culture it is situated in provides interesting insights. While assembling and stabilizing the anti–nuclear imaginary in the context of the nuclear controversy also included aspects of renegotiating and reestablishing the relationship between political leaders, public authorities, scientific experts and different publics, incorporating the nuclear in the post–war era offered the opportunity to perform and practice the newly established austro–corporatist culture. Appropriating the "atomic age" provided opportunities for politicians, bureaucrats and scientific experts to participate in the international arena just like representatives of any other country. This normalization also included a certain kind of increasing self–consciousness in the strive for national independence and it fostered the belief in the newly founded Austrian nation state. Consequently the sociotechnical imaginary was everything but critical towards the state and corporatist structures. On the contrary the state and its institutions were imagined to be the central vehicle with regard to the innovation trajectory. In the late 1970s this role of the state was contested for several years, as the role of public officials and institutions of the austro–corporatist system were challenged in the struggle over the nuclear power plant in Zwentendorf. Throughout the 1980s and most prominently after Chernobyl, the anti–nuclear position could be stabilized through public institutions and authorities though. In that sense the austro–corporatist element persisted in the ongoing renegotiations of the nuclear.

[126] Bundeskanzler Werner Faymann bei der Abschlusskundgebung der Wiener Sozialdemokratie am 01.05.2011: http://www.youtube.com/watch?v=7Bbba0LTOQE, last visited: 12.03.2015.

9 Conclusion

The analysis of the appropriation of the "atomic age" in Austria in the mid 1950s shows that what was perceived and understood as the nuclear was immensely shaped and re–shaped in the context of its increasing institutionalization. Even though the period under investigation is more or less confined to the two years from late 1953 to the end of 1955, we have seen how imaginations, hopes and futures around nuclear technologies took a great variety of forms.

It is exactly with regard to this aspect that investigating nuclear enthusiasm in post–war Austria in terms of a sociotechnical imaginary proved especially fruitful. Analyzing and contrasting the pro–nuclear imaginary as a predecessor of the contemporary anti–nuclear imaginary shows that basic processes in dealing with science and technology do not seem to have changed in the late 20^{th} century, even though Austria's nuclear position was completely reversed.

Taking a closer look we could observe, how the post–war nuclear imaginary was assembled in form of a trajectory of growth regarding energy production and consumption. In addition to large scale hydro power projects nuclear reactors were increasingly framed as a central element of a future power mix, while Austria was increasingly imagined to turn into a highly industrialized country, which would probably be also able to position itself as an active player on an European energy market. As we have seen the understanding that the nuclear would be an essential part in this energy mix was staged as inevitable. The scenarios disseminated by the Austrian physicist Hans Thirring very nicely demonstrate, how the imagination of a power mix of traditional and alternative energies was replaced by a nuclear power production scenario, based on the demonstration that it was without alternatives. While the scenarios themselves, were built around a limited number of parameters, they most of all did not ask questions about the interwoven character of technoscientific development and various forms of social organisation. In that sense the scenarios and trajectories crafted depoliticized technological futures. Electricity and energy trajectories rather seem to be changing and varying imaginations of continuing growth. They do not question the necessity of growth in energy consumption or economic growth in general and how this is inextricably entangled with different forms of organization and institutionalisation in relation to modern capitalism. Quite on the contrary the sociotechnical imaginary in the post–war era black–boxed such aspects, e.g. by equating energy consumption with social welfare. After this trajectory of growth was contested in the context of the nuclear controversy in Austria — also initiatives in reducing energy consumption have been taken since the repeated crises on global energy markets — we have seen the stabilization of the sociotechnical imaginary of keeping nuclear power production out of Austria. In a rehearsal of this imaginary in the post–Fukushima phase, we could even observe measures to keep electricity from foreign nuclear reactors out of Austrian

networks.[127] In relation to the anti–nuclear imaginary a power mix without nuclear power production is often rendered to be without alternatives. What is absent are discussions on how "sustainable energy production" could look like, beyond the prominent praising of solar, wind and hydro power production. Rather than questioning how the capitalist form of production and the multiple ways it shapes science–technology–society relationships is preventing a fundamental move towards "sustainability", the anti–nuclear imaginary seems to attract our attention towards the Brits and the French, who are framed as choosing the wrong power mix in order to reach substantive reductions in CO_2 emissions.

This brings me to the second persistent aspect in dealing with the nuclear, its entanglement with national identity. Focussing on the specific ways the nuclear was appropriated in post–war Austria, we have seen that the nuclear was incorporated through nationhood in the context of the reconstruction effort. Mastering nuclear technology was staged as essentially Austrian in connection to the completion of large scale hydro power projects such as Kaprun and the reconstruction of Austrian economy as well as the recreation of the Austrian nation state. Furthermore we could observe, how the Austrian nation was brought into existence, how it was practiced in relation to the nuclear. Negotiations about Austria joining CERN, drafting position papers to argue for the acquisition of a research reactor, the opening of the "atom exhibition" in Vienna as well as the participation of an Austrian delegation in the UN Conference on the Peaceful Uses of Atomic Energy and many others were scrutinized as occasions where the Austrian nation was invented and practiced. These occasions were on the one hand moments of mobilization, rehearsals ensuring consent through the identification with the national collective. On the other hand these were the occasions were the Austrian nation as such was produced and brought into existence in the first place. This way the nuclear was part of a sociotechnical imaginary of development that very much revolved around mastering large scale technologies in general and different forms of producing electricity in particular. Austria was preparing to participate in the global nuclear industry, to be able to compete and participate in this sector. As we have seen this sociotechnical imaginary, which stabilized in form of a national trajectory of growth, was challenged in the late 1970s and consequently reassembled as an imaginary of keeping the nuclear out of the national territory. Meanwhile the nuclear seemed to have lost most of its capacity to mobilize the national collective, its capacity for identification with and production of national identity. In the post Chernobyl era however, the nuclear returned in this function in an even more prominent position. Ever since we can observe continuous rehearsals of the various entanglements of the nuclear and nationhood that have stabilized in reverse. Since Chernobyl the occasions to mobilize and produce the Austrian nation are moments were the rejection of nuclear power production can be staged in the context of the anti–nuclear imaginary. In a polemic version of the point

[127] DerStandard.at, Österreich soll bis 2015 Atomstrom-frei sein, 23.03.2011, 14:39. http://derstandard.at/1297821246502/Neues-Oekostromgesetz-Oesterreich-soll-bis-2015-Atomstrom-frei-sein, last visited: 12.03.2015.

in question we could say, what changed at most throughout the last 70 years in dealing with the nuclear in Austria, is how Austrians like to see themselves through the nuclear. What once was a source of techno–national prowess transformed into a source for prowess through its absence.

I suggest to interpret both of these developments as changes in "content" rather than "form". While the nuclear imaginary was reversed from being pro–nuclear to being anti–nuclear, nationhood and trajectorism persisted as central practices and forms of imagination. The comparison of sociotechnical imaginaries not only enabled me to describe the pro–nuclear imaginary as a predecessor of the anti–nuclear imaginary, it also highlights that both of these imaginaries act as machineries of black–boxing and naturalizing national collectivity as well as various hopes, expectations, scenarios and visions of the future. The benefit of analyzing aspects of nuclear history in these terms became clear throughout this analysis. Since hopes and expectations towards the nuclear are detached from contemporary innovation trajectories in Austria, an investigation in nuclear enthusiasm allowed for scrutinizing it within a relatively confined historic context and contrasting it with later developments in Austria. This also allowed for the partial transcendence of the current anti–nuclear imaginary. Hence we can observe how narratives of public reason and collective learning of the Austrian society in relation to the nuclear, would have to be challenged and analyzed as ideological narratives as well, if one aims at criticizing science–technology–society relations towards the nuclear, rather than rehearsing the anti–nuclear imaginary.

From this perspective future research will have to further scrutinize not only how science and technology are entangled with nationhood and various forms of imagining the future, but also why this is the case. Investigating what functions the coproduction of nationhood, trajectorism and science and technology serve could provide hints for substantive criticism on the ways science, technology and society are entangled and institutionalized. Accounting for the ways in which these aspects are historically specific forms and how they are related to historic specifc froms and dynamics of modern capitalism could consequently provide further insights for criticizing more recent developments. E.g. what is black–boxed and naturalized in how contemporary societies deal with hopes, expectations and imagine futures in relation to Alzheimer's disease. Or how conflicts over nuclear power production in the light of climate change and struggles over nuclear waste disposal sites serve as rehearsals to perform national collectivity and turn into occasions to produce and practice undemocratic practices and ideologies like xenophobia, rather than criticizing the underlying dynamics driving such large scale sociotechnical problems.

References

Adam, B. (1994). *Time and Social Theory.* Cambridge: Polity Press.

Adam, B., & Groves, C. (2007). *Future Matters. Action, Knwoledge, Ethics.* Leiden and Boston: Brill.

Aichelburg, W. (n.d.). 150 Jahre Künstlerhaus Wien 1861–2011. Verzeichnis der Ausstellungen 1868 bis 2010. Retrieved May 15, 2014, from http://www.wladimir-aichelburg.at/kuenstlerhaus/ausstellungen/verzeichnis/

Almond, G. A. (1956). 'Comparative Political Systems'. *The journal of Politics*, *18*, 391–409.

Almond, G. A. (1987). Politische Kultur-Forschung – Rückblick und Ausblick. In D. Berg-Schlosser & J. Schissler (Eds.), *Politische Kultur in Deutschland. Bilanz und Perspektiven der Forschung* (pp. 27–39). Opladen.

Almond, G. A., & Verba, S. (1989/1963). *The Civic Culture: Political Attitudes and Democracy in Five Nations.* Newbury Park, London, and New Delhi: Sage Publications.

Anderson, B. (2006/1983). *Imagined communities.* London and New York: Verso.

Appaduari, A. (2012). Thinking beyond Trajectorism. In M. Heinlein, C. Kropp, J. Neumer, A. Poferl & R. Römhild (Eds.), *Futures of Modernity. Challenges for Cosmopolitical thought and Practice* (pp. 25–32). Bielefeld: transcript Verlag.

Appadurai, A. (1996). *Modernity at Large: Cultural Dimensions of Globalization* (D. Gaonkar & B. Lee, Eds.). Public Worlds. Minneapolis and London: University of Minnesota Press.

Appadurai, A. (2013). *The Future as Cultural Fact. Essays on the Global Condition.* London and New York: Verso.

Bernert, T. (1954). Verwendung von Radioisotopen in Österreich. *Österreichische Chemiker-Zeitung*, *55*(17/18), 246–254.

Borup, M., Brown, N., Konrad, K., & Van Lente, H. (2006, July). The Sociology of Expectations in Science and Technology. *Technology Analysis & Strategic Management*, *18*(3-4), 285–298.

Breuss, S., Liebhart, K., & Pribersky, A. (1995). *Inszenierungen: Stichwörter zu Österreich.* Wien.

Breuss, S., Liebhart, K., & Pribersky, A. (2004). Land des Stroms. 'Heimische Energie' für den österreichischen Wiederaufbau. In E. Brix, E. Bruckmüller & H. Stekl (Eds.), *Memoria Austriae I. Menschen, Mythen, Zeiten* (pp. 505–529). Wien.

Brown, N., & Michael, M. (2003). A Sociology of Expectations: Retrospecting Prospects and Prospecting Retrospects. *Technology Analysis & Strategic Management*, *15*(1), 3–18.

Brown, N., Rappert, B., & Webster, A. (2000). Introducing Contested Futures: From *Looking into* the Future to *Looking at* the Future. In N. Brown, B. Rappert & A. Web-

ster (Eds.), *Contested Futures. A sociology of prospective techno-science* (pp. 3–20). Burlington: Ashgate.

Brubaker, R. (1996). *Nationalism reframed. Nationhood and the national question in the New Europe*. Cambridge: Cambridge Univ. Press.

Clarke, A. (2005). *Situational Analysis. Grounded Theory After the Postmodern Turn*. Thousand Oaks, London, and New Delhi: Sage Publications.

Cooke, S. (2011). *Atom. Die Geschichte des nuklearen Irrtums*. Köln: Kiepenheuer & Witsch.

Elias, N. (1987). *Über die Zeit. Arbeiten zur Wissenssoziologie II*. Frankfurt am Main: Suhrkamp Verlag.

Elias, N. (1997/1939). *Über den Prozess der Zivilisation. Soziogenetische und psychogenetische Untersuchungen*. Frankfurt am Main.

Elzinga, A., & Jamison, A. (1995). Changing Policy Agendas in Science and Technology. In S. Jasanoff, G. E. Markle, J. C. Petersen & T. Pinch (Eds.), *Handbook of Science and Technology Studies* (pp. 572–597). London: Sage.

Felt, U. (2007). Zukunftsszenarien als wissenschaftliche Ressource: Begegnungen zwischen Wissenschaft, Politik und Medien. In R. Egloff, G. Folkers & M. Michel (Eds.), *Archäologie der Zukunft* (pp. 287–302). Zürich.

Felt, U. (2015a). Keeping Technologies Out: Sociotechnical imaginaries and formation of a national technopolitical identity. In S. Jasanoff & S.-H. Kim (Eds.), *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. Chicago: Chicago University Press.

Felt, U. (2015b). The temporal choreographies of participation: Thinking innovation and society from a time-sensitive perspective. Pre-print; Published by the Department of Science and Technology Studies, University of Vienna, January 2015. Retrieved from http://sts.univie.ac.at/publications

Felt, U., Fochler, M., & Winkler, P. (2010). Coming to Terms with Biomedical Technologies in Different Techno-Political Cultures: A Comparative Analysis of Focus Groups on Organ Transplantation and Genetic Testing in Austria, France and the Netherlands. *Science, Technology & Human Values*, *35*(4), 525–553.

Fengler, S. (2014). *Kerne, Kooperation und Konkurrenz. Kernforschung in Österreich* (M. Ash & C. Sachse, Eds.). Wien, Köln, and Weimar: Böhlau.

Forstner, C. (2012). Zur Geschichte der österreichischen Kernenergieprogramme. In S. Fengler & C. Sachse (Eds.), *Kernforschung in Österreich. Wandlungen eines inderdisziplinären Forschungsfeldes 1900-1978* (pp. 159–180). Wien, Köln, and Weimar: Böhlau.

Fujimura, J. H. (2003). Future imaginaries: Genome scientists as sociocultural entrepreneurs. In A. H. Goodman, D. Heath & M. S. Lindee (Eds.), *Genetic nature/culture: Anthropology and science between the two-culture divide* (pp. 176–199). Berkeley.

Geels, F. W., & Smit, W. A. (2000). Failed technology futures: pitfalls and lessons from a historical survery. *Futures*, *32*, 867–885.

Greiffenhagen, S. (2009). Theorie(n) der Politischen Kultur. In S. Salzborn (Ed.), *Politische Kultur. Forschungsstand und Forschungsperspektiven* (Vol. 1, pp. 11–31). Frankfurt am Main.

El-Haj, N. A. (2001). *Facts on the ground. Archaeological Practice and Territorial Self-Fashioning in Israeli Society.* Chicago and London: Univ. of Chicago Press.

Halbwachs, M. (1991/1967). *Das kollektive Gedächtnis.* Frankfurt am Main: Fischer Taschenbuch Verlag.

Hanisch, E. (1984). Historische Überhänge in der österreichischen politischen Kultur. *Österreichische Zeitschrift für Politikwissenschaft*, *13*(1), 15–19.

Hård, M., & Jamison, A. (2005). *Hubris and Hybrids: A Cultural History of Technology and Science.* New York and London: Routledge.

Hecht, G. (1998). *The radiance of France. Nuclear power and national identity after World War II.* Cambridge, MA: MIT Press.

Hecht, G. (2001). Technology, Politics and National Identity in France. In M. T. Allen & G. Hecht (Eds.), *Technologies of Power. Essays in Honor of Thomas Parke Hughes and Agatha Chipley Hughes* (pp. 253–294). Cambridge, MA.

Hobsbawm, E., & Ranger, T. (Eds.). (1983). *The invention of tradition.* Cambridge: Cambridge Univ. Press.

Holloway, D. (1996/1994). *Stalin and the Bomb. The Soviet Union and Atomic Energy 1939–1956.* New Haven and London: Yale Univ. Press.

Hölscher, L. (1999). *Die Entdeckung der Zukunft.* Frankfurt am Main.

Jasanoff, S. (1995). Product, process, or programme: three cultures and the regulation of biotechnology. In M. Bauer (Ed.), *Resistance to new technology* (pp. 311–334). Cambridge: Cambridge Univ. Press.

Jasanoff, S. (2005). *Designs on Nature. Science and Democracy in Europe and the United States.* Princeton and Oxford: Princeton University Press.

Jasanoff, S. (2006). Ordering science, ordering society. In S. Jasanoff (Ed.), *States of Knowledge. The co-production of science and social order* (pp. 13–45). New York: Routledge.

Jasanoff, S. (2015a). Future Imperfect: Science, Technology, and the Imaginations of Modernity. In S. Jasanoff & S.-H. Kim (Eds.), *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power.* Chicago: Chicago University Press.

Jasanoff, S. (2015b). Imagined and Invented Worlds. In S. Jasanoff & S.-H. Kim (Eds.), *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power.* Chicago: Chicago University Press.

Jasanoff, S., & Kim, S.-H. (2009). Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea. *Minerva*, *47*(2), 119–146.

Kaase, M. (1983). Sinn oder Unsinn des Konzeptes 'Politische Kultur' für die vergleichende Politikforschug, oder auch: der Versuch, einen Pudding an die Wand zu nageln. In

M. Kaase & H.-D. Klingemann (Eds.), *Wahlen und politisches System. Analsysen aus Anlaß der Bundestagswahl 1980.* Opladen.

Karlhofer, F. (2001). Österreich. Zwischen Korporatismus und Zivilgesellschaft. In W. Reutter & P. Rütters (Eds.), *Verbände und Verbandssysteme in Westeuropa* (pp. 335–354). Opladen.

Kolb, F. (2007). *Protest and opportunities; the political outcomes of social movements.* Zugl.: Berlin, FU, Diss., 2006. Frankfurt am Main [u.a.]: Campus Verl.

Kriechbaumer, R. (2001). *Die großen Erzählungen der Politik. Politische Kultur und Parteien in Österreich von der Jahrhundertwende bis 1945.* Wien, Köln, and Weimar: Böhlau.

Krige, J. (2006a). *American Hegemony and the Postwar Reconstruction of Science in Europe.* Cambridge, MA/London: MIT Press.

Krige, J. (2006b). Atoms for Peace, Scientific Internationalism, and Scientific Intelligence. In J. Krige & K.-H. Barth (Eds.), *Global Power Knowledge. Science and Technology in International Affairs* (pp. 161–181). Chicago: Univ. of Chicago Press.

Kuchler, A. (2012). Das Atomzeitalter erreicht Österreich (1950-1970). In O. Rathkolb, R. Hufschmied, A. Kuchler & H. Leidinger (Eds.), *Wasserkraft – Elektrizität – Gesellschaft. Kraftwerksprojekte ab 1880 im Spannungsfeld* (pp. 218–225). Wien: Kremayr & Scheriau.

Lackner, H. (2000). Von Seibersdorf bis Zwentendorf. Die 'friedliche Nutzung der Atomenergie' als Leitbild der Energiepolitik in Österreich. *Blätter für Technikgeschichte*, *62*, 201–226.

Law, J. (1986). The Heterogeneity of Texts. In M. Callon, J. Law & A. Rip (Eds.), *Mapping the dynamics of science and technology* (pp. 67–83). Basingstoke and London: The Macmillan Press.

Lehmbruch, G. (1967). Proporzdemokratie. Politisches System und politische Kultur in der Schweiz und in Österreich. In *Recht und Staat in Geschichte und Gegenwart* (Vol. 335/336). Tübingen: Mohr.

Lübbe, H. (1995). Schrumpft die Zeit? Zivilisationsdynamik und Zeitumgangsmoral: Verkürzter Aufenthalt in der Gegenwart. In K. Weis (Ed.), *Was ist Zeit? Zeit und Verantwortung in Wissenschaft, Technik und Religion* (pp. 53–79). München: Deutscher Taschenbuch Verlag.

Marcus, G. E. (Ed.). (1995). *Technoscientific Imaginaries. Conversations, Profiles, and Memoirs.* Late Editions. Cultural Studies for the End of the Century. Chicago and London: University of Chicago Press.

Maschine + Energie. (1953). Eine Atomkraftausstellung im Technischen Museum in Vorbereitung. *Maschine + Energie. Fachblatt für Maschinenbau, Elektrotechnik, Energiewirtschaft*, (2), 32–33.

Medhurst, M. J. (1997). Atoms for Peace and Nuclear Hegemony: The Thetorical Structure of a Cold War Campaign. *Armed Forces and Society*, *24* (4), 571–593.

Michael, M. (2000). Futures of the Present: From Performativity to Prehension. In N. Brown, B. Rappert & A. Webster (Eds.), *Contested Futures: a sociology of prospective techno-science* (pp. 21–39). Aldershot: Ashgate.

Morone, J. G., & Woodhouse, E. J. (1989). *The Demise of Nuclear Energy? Lessons for Democratic Control of Technology*. New Haven and London: Yale Univ. Press.

Nowotny, H. (1979). *Kernenergie: Anatomie eines Konflikts*. Frankfurt am Main: Suhrkamp.

Nowotny, H. (1980). The Role of the Experts in Developing Public Policy: The Austrian Debate on Nuclear Power. *Science, Technology, & Human Values*, *5*(32), pp. 10–18.

Nowotny, H. (1995). Wer bestimmt die Zeit? Zeitkonflikte in der technologischen Gesellschaft zwischen industrialisiterter und individualisierter Zeit. In K. Weis (Ed.), *Was ist Zeit? Zeit und Verantwortung in Wissenschaft, Technik und Religion* (pp. 81–99). München.

Österreichische Liga für die Vereinten Nationen (Ed.). (1955). *Atom. Die Auswertung der Atomkraft für friedliche Zwecke*. Wien.

Paine, R. (1992). 'Chernobyl' reaches Norway: the accident, science, and the threat to cultural knowledge. *Public Understanding of Science*, *1*(3), 261–280.

Pelinka, A., & Rosenberger, S. (2007). *Österreichische Politik. Grundlagen – Strukturen – Trends*. Wien.

Postone, M. (2003). *Zeit, Arbeit und gesellschaftliche Herrschaft*. Freiburg: ca ira Verlag.

Rathkolb, O. (1997). *Washington ruft Wien: US-Großmachtpolitik und Österreich, 1953-1963*. Wien: Böhlau.

Rathkolb, O. (2005). *Die Paradoxe Republik: Österreich 1945 bis 2005*. Wien: Zsolnay.

Rathkolb, O. (2012). NS-Erbe, Wiederaufbau, Mashallplan und das 'weiße Gold' in den europäischen Netzwerken. In O. Rathkolb, R. Hufschmied, A. Kuchler & H. Leidinger (Eds.), *Wasserkraft – Elektrizität – Gesellschaft. Kraftwerksprojekte ab 1880 im Spannungsfeld* (pp. 187–206). Wien: Kremayr & Scheriau.

Rathkolb, O., & Ogris, G. (Eds.). (2010). *Authoritarianism, history and democratic dispositions in Austria, Poland, Hungary and the Czech Republic*. Innsbruck, Wien, and Bozen: Studien-Verl.

Reiter, W. L., & Schurawitzki, M. (2005). Über Brüche hinweg Kontinuität. Physik und Chemie an der Universität Wien nach 1945 – eine erste Annäherung. In M. Grandner, G. Heiss & O. Rathkolb (Eds.), *Zukunft mit Altlasten. Die Universität Wien 1945–1945* (pp. 236–259). Innsbruck et al.: Studien-Verl.

Rhodes, R. (1988). *Die Atombombe oder Die Geschichte des 8. Schöpfungstages*. Nördlingen: Greno.

Rohe, K. (1994). Politische Kultur: Zum Verständnis eines theoretischen Konzepts. In O. Niedermayer & K. von Beyme (Eds.), *Politische Kultur in West- und Ostdeutschland* (pp. 1–21). Berlin.

Rößner, M. (2013). *Von der österreichischen Studiengesellschaft für Atomenergie zum Reaktorzentrum Seibersdorf*. (Diplomarbeit, Universität Wien).

Salzer, H. (1960). Nachruf: Erich Bandl. *Mitteilungen der Österreichischen Geologischen Gesellschaft*, *53*, 283–284.

Schmid, S. D. (2006). Celebrating Tomorrow Today: The Peaceful Atom on Display in the Soviet Union. *Social Studies of Science*, *36*(3), 331–365.

Selin, C. (2006). Trust and the illusive force of scenarios. *Futures*, *38*, 1–14.

Sorokin, P. A., & Merton, R. K. (1937). Social Time: A Methodological and Functional Analysis. *American Journal of Sociology*, *42*(5), 615–629.

Sovacool, B. K., & Ramana, M. V. (2014). Back to the Future: Small Modular Reactors, Nuclear Fantasies, and Symbolic Convergence. *Science, Technology & Human Values*, *40*(1), 96–125.

Stölken-Fitschen, I. (1993). Bombe und Kultur. In M. Salewski (Ed.), *Das Zeitalter der Bombe. Die Geschichte der atomaren Bedrohung von Hiroshima bis heute* (pp. 258–281). München: Beck.

Strauss, A., & Corbin, J. (1998). *Basics of Qualititaive Research*. Thousand Oaks, London, and New Delhi: SAGE Publications.

STS Research Platform: sociotechnical imaginaries. (n.d.). Methodological Pointers. Retrieved 2014, from http://sts.hks.harvard.edu/research/platforms/imaginaries/ii.methods/methodological-pointers/

Sunder Rajan, K. (2006). *Biocapital. the Constitution of Postgenomic LIfe*. Durham and London: Duke University Press.

Tálos, E. (2006). Sozialparnterschaft. Austrokorporatismus am Ende? In H. Dachs, P. Gerlich, H. Gottweis, H. Kramer, V. Lauber, W. C. Müller & E. Tálos (Eds.), *Politik in Österreich. Das Handbuch* (pp. 425–442). Wien.

Tálos, E., & Kittel, B. (1995). Sozialparnterschaft – Zur Konstituierung einer Grundsäule der Zweiten Republik. In R. Sieder, H. Steinert & E. Tálos (Eds.), *Österreich 1945 – 1995. Gesellschaft - Politik - Kultur* (pp. 537–551). Wien.

Taylor, C. (2004). *Modern Social Imaginaries*. Durham and London: Duke University Press.

Thirring, H. (1952). Is It Wise To Use Uranium for Power. *Bulletin of the Atomic Scientists*, *8*(6), 171, 205.

Thirring, H. (1954). Ausblick auf die Energiewirtschaft der nächsten hundert Jahre. *Österreichische Zeitschrift für Elektrizitätswirtschaft*, *7*(9), 343–347.

Tutton, R. (2011). Promising pessimism: Reading the futures to be avoided in biotech. *Social Studies of Science*, *41*(3), 411–429. doi:10.1177/0306312710397398. eprint: http://sss.sagepub.com/content/41/3/411.full.pdf+html

Van Lente, H. (2006). Prospective Strucutres of Science and Science Policy. In J. Hage & M. Meeus (Eds.), *Innovation, change, and Insititutional Change. A Research Handbook* (pp. 369–390). Oxford: Oxford Univ. Press.

Van Lente, H., & Rip, A. (1998). The Rise of Membrane Technology. From Rhetorics to Social Reality. *Social Studies of Science*, *28*(2), 221–254.

von Schwerin, A. (2012). Österreich im Atomzeitalter: Anschluss an die Ökonomie der Radioisotope. In S. Fengler & C. Sachse (Eds.), *Kernforschung in Österreich. Wandlungen eines inderdisziplinären Forschungsfeldes 1900-1978* (pp. 159–180). Wien, Köln, and Weimar: Böhlau.

Wang, J. (1999). *American Science in an Age of Anxiety: Scientists, Anticommunism, and the Cold War*. Chapel Hill and London.

Weart, S. R. (2012/1988). *The Rise of Nuclear Fear*. Cambridge, MA: Harvard Univ. Press.

Welsh, I. (2000). *Mobilising Modernity. The nuclear moment*. London and New York: Routledge.

Wynne, B. (1992). Misunderstood misunderstanding: social identities and public uptake of science. *Public Understanding of Science*, *1* (3), 281–304.

Online resources

Atoms for Peace Speech, Address by Mr. Dwight D. Eisenhower, President of the United States of America, to the 470th Plenary Meeting of the United Nations General Assembly, http://www.iaea.org/About/atomsforpeace_speech.html, last visited: 27.10.2014.

Bundeskanzler Werner Faymann bei der Abschlusskundgebung der Wiener Sozialdemokratie am 01.05.2011. http://www.youtube.com/watch?v=7Bbba0LTOQE, last visited: 12.03.2015.

DerStandard.at, Österreich soll bis 2015 Atomstrom-frei sein, 23.03.2011, 14:39. http://derstandard.at/1297821246502/Neues-Oekostromgesetz-Oesterreich-soll-bis-2015-Atomstrom-frei-sein, last visited: 12.03.2015.

DerStandard.at, Österreich will gegen britisches AKW Klagen, 08.10.2014, 17:17. http://derstandard.at/2000006572568/Gruenes-Licht-aus-Bruessel-fuer-Staatsgeld-fuer-britisches-AKW, last visited: 25.02.2015.

UN General Assembly, Resolution No. A/RES/810(IX), 04.12.1954. http://www.un.org/en/ga/search/view_doc.asp?symbol=A/RES/810(IX) last visited: 25.03.2015.

US Information Service, Eisenhower, Dwight D., Atom Weltbank "Der Eisenhower Plan", 1953. Wienbibliothek im Rathaus, Teilkatalog Plakate. http://www.wienbibliothek.at.

Quoted materials

Arbeiter–Zeitung, Atomkraft für den Frieden, nicht für den Krieg, 10.12.1953.

Arbeiter–Zeitung, Keine freundliche Aufnahme der Rede Eisenhowers in Moskau, 11.12.1953.

Arbeiter–Zeitung, Immer neue Fischerboote radioaktiv, 16.04.1954.

Arbeiter–Zeitung, Die Atomausstellung kommt nach Wien, 10.02.1955.

Arbeiter–Zeitung, "Atomkraft" rollte zum Künstlerhaus, 23.02.1955.

Arbeiter–Zeitung, Grandiose Vision des neuen Zeitalters, 05.03.1955.

Arbeiter–Zeitung, Illustration, 13.03.1955.

Bilder der Woche, 10.03.1955.

Bildtelegraf, Österreich baut Atommeiler?, 12.01.1955.

Das kleine Volksblatt, Das Material der Schau "Atomkraft im Dienste der Menschheit", 23.02.1955.

Die Presse, Das erste Atomschiff der Welt, 26.09.1953.

Die Presse, Ein neues Zeitalter der Metalle, 17.10.1953.

Die Presse, Nun auch: Atomkraft-Lokomotive?, 13.03.1954.

Die Presse, Im Zeichen der Atombombe, 03.04.1954.

Die Presse, Ein Fall der ganz Amerika alarmiert, 01.05.1954.

Die Presse, Robert Oppenheimers Schuld und Sühne, 07.08.1954.

Die Presse, "Atomtechnik ist an allem Schuld", 09.10.1954.

Die Presse, Auf dem Umweg über Dampf?, 23.10.1954.

Die Presse, Die Wiener haben 'Atomfieber', 08.03.1955.

Die Presse, Österreich und das Atomzeitalter. Radioaktive Isotopen bereits in Verwendung, 12.01.1955.

Die Presse, Ein Atomreaktor für Österreich in Erwägung, 12.01.1955.

Die Presse, Atomkraftausstellung im Künstlerhaus, 23.02.1955.

Die Presse, Aschermittwoch des Fortschritts, 26.02.1955.

Hans Thirring, Dürfen wir Uran verheizen? Bau von Atomkraftwerken — unverantwortlicher Raubbau, in: Die Presse, Wochenzeitung, 12.07.1952.

Kurier, Heute vor 50 Jahren: Die Radiumforschung begann in Wien, 21.10.1960.

Neuer Kurier, Internationale Atomkonferenz nach Wien. Österreich aktiv an der Entwicklung der Atomwissenschaft beteiligt, 25.01.1955.

Neues Österreich, "Atomstadt Wien" im werden. Im Technischen Museum wird im kommenden Jahr ein Atommeiler zu sehen sein, 15.11.1953.

Neues Österreich, Elf Waggons "Atommaterial" rollen nach Wien, 10.02.1955.

Neue Wiener Tageszeitung, Atomausstellung in Wien eingetroffen, 23.02.1955.

Neues Österreich, Atomenergie im Dienste der Menschheit. Im Künstlerhaus: Der Atomofen brennt, 05.03.1955.

Neues Österreich, Ing. Figl: "Friedliche Atomnutzung eine Hoffnung", 06.03.1955.

Neue Wiener Tageszeitung, Atomreaktor für Österreich, 12.01.1955.

Tiroler Tageszeitung, Bringt das Atomzeitalter eine weltweite Arbeitslosigkeit mit sich?, 01.09.1955, 03.09.1955, 10.09.1955, 17.09.1955, 24.09.1955, 01.10.1955.

Wiener Kurier am Sonntag, Energiequelle Atom, 1. Teil: Das ABC der Atome, 22.01.1955.

Wiener Kurier am Sonntag, Energiequelle Atom, 2. Teil: Bestandteile des Atoms, 29.01.1955.

Wiener Kurier am Sonntag, Energiequelle Atom, 3. Teil: Atome und Isotope, 05.02.1955.

Wiener Kurier am Sonntag, Energiequelle Atom, 4. Teil: Der Weg zum Atomreaktor, 12.02.1955.

Wiener Kurier am Sonntag, Energiequelle Atom, 5. Teil: Isotope — Diener der Menschheit, 19.02.1955.

Wiener Kurier am Sonntag, Energiequelle Atom, 6. Teil: Kraft — Das friedliche Ziel, 26.02.1955.

Wiener Kurier, Ausstellung "Atom" heute eröffnet, 05.03.1955.

Wiener Kurier, Sonderbeilage: Segenreiche Atomkraft. Zur Eröffnung der Ausstellung "Atomkraft im Dienste der Menschheit", 05.03.1955.

Wiener Montag, Wien im "Atomtaumel", 07.03.1955.

Wiener Zeitung, Atomkraft für den Frieden, 10.02.1955.

Archiv der Österreichischen Akademie der Wissenschaften, Bestandsgruppe 11: FE-Akten, Institut für Radiumforschung. Karton 34: Fiche 477. Karton 49: Fiche 706, 707. Karton 50: Fiche 721, 724 726, 727, 728, 729, 730, 731, 750, 751, 752, 829, 839.

Archiv im Technisches Museum Wien

Josef Nagler Erwägungen zur Auswertung der Kernkraft, Radiovortrag am 28.11.1956 um 16:45 Uhr. ÖFIT/BPA-009841.

Abbildungen: FA-01-01/FA-011044, FA-01-01/FA-011047, BPA-014707-12.

Österreichisches Staatsarchiv, Archiv der Republik

Bundesministerium für Unterricht, 1. Hauptreihe, Stichwort Atom, Kartons 63–64.

MRang MR 2. Rep. Mrp Kv 132, 11.01.1955.

Filmarchiv Austria, Austria Wochenschau, 14/54, Beitrag 4 (Datenbankauszug).

Wiener Stadt und Landesarchiv, Ausstellungsakt des Künstlerhauses: Atom. Atomkraft im Dienste der Menschheit.

Abstract (english)

While recent scholarship in Science and Technology Studies and Science and Technology Policy carved out that techno–scientific developments take distinct national styles and shapes, less attention has been payed to such differences in the scholarship on nuclear history in Austria. In the context of the struggles over the non–commissioning of the already completed nuclear power plant at Zwentendorf (1978) and in the aftermath of the reactor explosion in Chernobyl (1986) the formation of a specific technopolitical identity, revolving around the sociotechnical imaginary of keeping nuclear technologies out of Austrian territory, has been observed. At the backdrop of this imaginary the history of nuclear enthusiasm in Austria is only present in narratives about how "the people" have resisted and rejected the implementation of nuclear technologies in Austria and thus overcome "unreasonable promises of the so called atomic age". On the other hand historical scholarship shows that Austria has a long history of nuclear research and nuclear (power) policy that was hardly questioned until the early 1970s.

Departing from this discrepancy this master thesis investigates the appropriation of the "atomic age" in Austria in the mid 1950s. When US President Dwight D. Eisenhower gave his famous *Atoms for Peace* address in front of the UN General Assembly in late 1953 global nuclear enthusiasm in the immediate post–war era reached a new highpoint. Analyzing the following developments in Austria until late 1955 — of which the formation of an Austrian Commission on Atomic Energy and the participation in the UN Conference on the Peaceful Uses of Atomic Energy are to be considered milestones — thus enables me to observe how the appropriation of the "atomic age" was deeply entangled with imaginations of national collectivity and different forms of imagining the future.

In reference to the broader frameworks of "appropriating" science and technology in society as well as the coproduction of scientific/natural and social orders I ask the question of how hopes and expectations towards the "atomic age" were perceived and shaped in post–war Austria. Drawing upon the notions of *technopolitical culture* and *sociotechnical imaginaries* I scrutinize imaginations around nuclear research and nuclear technologies in the mid 1950s by investigating archival records of the Austrian Commission on Atomic Energy and related materials in an adoption of *situational analysis*. The analytic focus lies on the coproduction and mobilization of national identity and various forms of imagining *the future* — such as expectations, promises, scenarios and more general trajectories — in the appropriation process. Consequently the analysis carves out how strategic technopolitical efforts were situated in the austro–corporatist setting, how "being pro–nuclear" was entangled with Austrian national identity on various levels, while *the future* was a central resource of argumentation and imagination in multiple ways.

This allows for the description of the pot–war sociotechnical imaginary that the nuclear was part of, which very much revolved around mastering large scale technological systems such as hydro power installations (e.g. Kaprun), the reconstruction effort and an innovation trajectory of producing and consuming electricity. Finally implications for further research in the context of the contemporary anti–nuclear imaginary in Austria are discussed.

Abstract (deutsch)

Studien im Bereich der Science and Technology Studies haben herausgearbeitet, inwiefern technowissenschaftliche Entwicklungen und Politiken spezifisch nationale Formen annehmen können, ein Umstand, der in Bezug auf die Geschichte der Atomenergie in Österreich eher vernachlässigt worden ist. Diesbezüglich wurde herausgearbeitet, dass in Österreich als Resultat der Auseinandersetzungen um die Nichtinbetriebnahme des AKW Zwentendorf (1978) und die Reaktorkatastrophe von Tschernobyl (1986) eine technopolitische Identität herausgebildet wurde, die sich weitestgehend rund um die Ablehnung von Nukleartechnologien konstituiert. Vor diesem Hintergrund wird die Phase der Begeisterung rund um Atomenergie in Österreich oft nur aus Blickwinkeln thematisiert, die sich vorrangig um die "Auflehnung der ÖsterreicherInnen" gegen die Atomenergie drehen, durch welche die heute als unvernünftig bewerteten Versprechen und Zukunftsvorstellungen rund um die Atomenergie zurückgewiesen wurden. Auf der anderen Seite verweisen historische Forschungen klar auf eine lange Tradition der Nuklearforschung und Nuklearpolitik in Österreich, die erst im Laufe der 1970er Jahre in Frage gestellt wurden.

Ausgehend von dieser Diskrepanz untersucht die vorliegende Masterarbeit die gesellschaftliche Aneignung des "Atomzeitalters" in Österreich Mitte der 1950er Jahre. Die *Atoms for Peace* Rede des US Präsident Dwight D. Eisenhower vor der UN Generalversammlung markierte einen neuen Höhepunkt in der globalen Euphorie rund um die Atomenergie. Die Arbeit untersucht die anschließenden Entwicklungen in Österreich bis Ende 1955, insbesondere die Gründung der beratenden Regierungskommission für Atomenergie und die Teilnahme Österreichs an der UN Konferenz über die friedliche Auswertung der Atomenergie in Genf, und ermöglicht eine genauere Betrachtung der Verwicklungen von nationaler Identität/Kollektivität und unterschiedlicher Zukunftsvorstellungen rund um die Atomenergie in Österreich.

Unter Bezugnahme auf die Konzepte "appropriation" und "coproduction of scientific/ natural and social orders" stellt die Arbeit die Frage, wie Hoffnungen und Erwartungen rund um die Atomenergie im Österreich der 1950er Jahre wahrgenommen, produziert und geformt wurden. Mit Hilfe der Begriffe "technopolitical cultures" und "sociotechnical imaginaries" werden Imaginationen rund um Atomenergie und Nukleartechnologien in den Blick genommen, indem Archivmaterial der Österreichischen Atomenergiekommission und weitere Quellen im Rahmen einer "situational analysis" beleuchtet werden. Der Fokus liegt hierbei auf der Koproduktion und Mobilisierung von nationaler Identität sowie von unterschiedlichen Zukunftsvorstellungen, wie etwa Versprechen, Erwartungshaltungen, Szenarien und so genannten "trajectories". Anschließend wird festgemacht inwiefern diese technopolitischen Anstrengungen innerhalb des austrokorporatischen Rahmens situiert waren, wie eine positive Einstellung zur Nukleartechnologie auf unterschiedlichen Ebenen mit "österreichisch sein" verschränkt war, während die Zukunft als zentrale Argumentationsresource und wichtiger Imaginationsraum herausgearbeitet und analysiert wird.

Dies ermöglicht schließlich eine genauere Charakterisierung des "sociotechnical imaginary" in welchem die Atomenergie in der unmittelbaren Nachkriegszeit eine wichtige Rolle spielte. Dieses drehte sich maßgeblich um die Beherrschung von Großtechnologien wie der Wasserkraft (z.B. Kaprun), den Wiederaufbau und ein "innovation trajectory" rund um Elektrizitätserzeugung und -konsumption. Abschließend werden einige Schlussfolgerungen in Bezug auf weitere Forschungen zur gegenwärtige Ablehnung der Atomenergie in Österreich diskutiert.

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