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The case of nuclear phase-out postponement in Belgium: atomic habits?

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ABSTRACT

By mapping the political debate on nuclear phase-out postponement in Belgium between 1999 and 2022, this research aims to better understand the role of nuclear techno-optimism in climate and energy policy-making processes. In 2003, Belgium imposed a law to deactivate nuclear power plants after 40 years of service and to phase them out entirely by 2025. After 2003, the lifespan of several nuclear power plants has however been extended with 10 years, resulting in a postponement of the phase-out deadline to 2035 in 2022. Through the Advocacy Coalition Framework, this research attempts to understand the policy subsystem of Belgian nuclear energy and the role of nuclear techno-optimism in it. Through multiple methods - discourse network analysis, policy document analysis and semi-structured interviews - a multitude of data is analyzed to test the hypothesis that in the case of Belgian nuclear phase-out, techno-optimism would have led to outcomes of climate delay. In sum, this research aims to answer the research question: *How has the discourse of nuclear techno-optimism impacted policy-output of nuclear phase-out postponement in Belgium between 1999 and 2022?* The policy-output was found to have been impacted by nuclear techno-optimist discourse indeed, as a resourceful and strategic advocacy coalition against phase-out succeeded in organizing itself based on the discourse throughout the years. Nuclear techno-optimism however was not the only driving force observed behind the policy-changes. Stable parameters in place combined with global external shocks have enabled this advocacy coalition to institutionalize its stances.

Key words: nuclear energy, techno-optimism, climate delay, discourse coalitions, ecological modernization

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1. Introduction

1.1. Research problem

As empirical evidence on the causes and consequences of climate change grew, so has the general consensus in climate science. The latest IPCC report synthesized it clearly: human activity has led to global warming, threatening the planet's ecosystems (IPCC, 2023). The question that follows of what human activity to change and how to approach that, has appeared to be more contested (Brulle, 2013; Roper et al., 2016; Shue, 2022). In modernized societies, human activity is structured in industries and economies that compete with each other. Some societal actors are convinced of the beliefs of ecological modernization, that continuation on this path will lead to higher efficiency and eventual reduction in emissions (York et al., 2010). Others see a need to transform these societal structures, based on growing proof that precisely these modernized human activities would be at the source of climate and environmental distress (York et al., 2010).

To be able to reduce the risks of a changing climate, urgent action would be needed (IPCC, 2023). The lack of decisive climate policy-making due to a lack of consensus can however lead to delays in climate action (Roper et al., 2016). The problem of lacking consensus and accompanied slowed-down decision-making are examined in this thesis research. More specifically, this research focuses on the role of techno-optimism in these processes, a discourse overestimating unproven or inefficient technological solutions to act on the climate crisis, while underestimating societal ones (Danaher, 2022; Lamb et al., 2020). As will be explained in further detail in the literature review, this discourse could be used as a strategy of climate delay by actors that benefit from business-as-usual (Lamb et al., 2020).

Given the urgency of the climate crisis and the gravity of delayed climate action, this problem needs to be researched to be properly understood. In this research specifically, the contested policy-making process in Belgium on nuclear energy production and its phase-out is examined. This way, the presence of techno-optimist discourse and the consequences for energy and climate policy are explored in the local context of Belgium.

1.2. Research aim

The broader aim of this research is to better understand the phenomenon of climate delay as a consequence of techno-optimist discourse in climate and energy policy-making processes. By testing the mechanism hypothesized from the literature, the validity of the established discourse of techno-optimism can be questioned (Yin, 2009; Gustafsson, 2017). By doing so in the local context of Belgian politics, this specific political debate, that has been contested for years, can be mapped and better understood. Furthermore, this research aims to gain insights into identity protecting tendencies of policy participants, occurring in the modernized world threatened by climate change (Hultman, 2016; Kahan et al., 2007). Resonance of policy participants with certain assumptions can lead them to identify with a discourse (Roper et al., 2016). In this research, the causal link between nuclear techno-optimism and

climate delay is researched by examining the advocacy coalitions in the policy subsystem of Belgian nuclear energy policy.

Building on one descriptive and two explanatory subquestions, this research attempts to answer the following explanatory **research question**:

How has the discourse of nuclear techno-optimism impacted policy-output of nuclear phase-out postponement in Belgium between 1999 and 2022?

SQ 1: What policy participants have been prominent in the development of nuclear techno-optimist discourse in the Belgian political debate on nuclear phase-out between 1999 and 2022?

SQ 2: How have the advocacy coalitions organized themselves around their shared policy core beliefs in the Belgian political debate on nuclear phase-out between 1999 and 2022?

SQ 3: How have the advocacy coalitions influenced policy-output of nuclear phase-out postponement?

1.3. Methodology

These research questions will be answered throughout this research by conducting a single-case study on the policy-processes of nuclear phase-out in Belgium, over the time span of 1999 until 2022. Through the Advocacy Coalition Framework, changing policy on a wicked problem can be analyzed over a longer period of time, and this way be better understood (Weible & Sabatier, 2006; Sabatier & Weible, 2007). In this case, this framework can shine a light on the advocacy coalitions that organized around the discourse of nuclear techno-optimism in the local context of Belgium. To test the hypothesized causal mechanism, various data will be analyzed through a multitude of methods; discourse network analysis, policy document analysis and semi-structured interviews, as will be explained in further detail in the methodology chapter.

1.4. Scientific relevance

Roper et al. (2016) warn that commonly accepted discourses hold the most power, as they are not considered political, but rather 'common sense'. Discourses of ecological modernization have been widely normalized in the political venues of modernized societies, making the examination of these underlying beliefs a relevant scientific study (Hajer, 1995 in Buttel, 2000). Furthermore, there is a need for more research on the role of collective and cultural values and beliefs in climate governance (Hultman, 2016; Patterson, 2022). Although gender imbalances have been studied in the light of climate change, the embeddedness and influence of constructed hegemonic masculinities has remained understudied (Connell & Pearse, 2014 in Hultman, 2016). To understand the role of shared ideas and discourses, the actors and coalitions that subscribe to them need to be carefully

examined and understood in their own context (Pflieger & De Pryck, 2023). Due to the involvement of powerful actors, the opposition to climate action has been able to make its way into climate policy-making (Brulle & Aronczyk, 2019). For this reason, Pflieger and De Pryck (2023) encourage researchers to not only examine the discourse of climate delay, but also what actors and coalitions are involved in the discourse and advocacy coalitions. To transcend from a narrow techno-economic approach to climate governance, more qualitative research is needed in this research area (Abreu et al., 2023). The results retrieved from this research can specify in which steps the hypothesized causal mechanism might appear less valid and robust, which can spark new research questions for later research on the researched mechanism.

1.5. Societal relevance

For policy-makers to develop just and sustainable energy policies, Dallenés et al. (2023) recommend other researchers to conduct more qualitative research into the cultural power dynamics of resistance against renewable energy. Hess and Renner (2019) argue there is a correlation between conservative politics and opposition to the energy transition. Yet, this correlation differs in every political context, and thus alleged causal relations should be examined within their specific context (Hess & Renner, 2019). With the rise of right wing politics in Europe and in Belgium, their role in shaping climate and energy policy-making and its effects carries a growing societal relevance. Although this single case-study will not result in generalizable conclusions on the theoretical causal link between techno-optimism and climate delay, it can provide more clarity on that causal mechanism in the context of Belgian nuclear phase-out.

As will be elaborated on in the section describing the case selection, Belgium is an interesting case to test the hypothesized mechanism of this research. 2020 statistics show how the country compared to other European countries has one of the lowest shares of renewable energy production (Eurostat 2020 in Dallenés et al., 2023), while according to other statistics, Belgium appeared to be one of the biggest nuclear energy producing countries on the continent (Eurostat, 2022, December 21st). Case-specific literature has indicated the infrastructural incompatibility of nuclear and renewable energy sources (Verbruggen, 2008). As several environmental organizations, among which Greenpeace, claim that the risks tied to the prolonging of some of the Belgian nuclear power plants has been underestimated with a factor of two million (De Morgen, 2023), understanding who influenced this decision based on what beliefs and resources could be a matter of public safety too. If the tested hypothesized causal mechanism appears to be true and nuclear techno-optimism has impacted policy-outputs of nuclear phase-out postponement, this research can immediately grant insights explaining why that is the case in the local context of Belgium. This allows Belgian policy-makers to consider this new knowledge, improving Belgian energy and climate policies.

2. Literature review

2.1. Concepts & theory

2.1.1. Climate delay

Despite broad consensus in climate science, how to collectively approach the causes and consequences of climate challenges has been subject of heated debate (Brulle, 2013; Roper et al., 2016; Shue, 2022). According to Shue (2022), this dissension has originated especially from powerful political and economic actors and institutions. Over the last decades in Western countries, corporate and conservative powers have been reported to be spreading doubt and division on global warming (Brulle, 2013; McCright & Dunlap, 2010). In the United States for example, conservative think tanks have published articles that misrepresent scientific research results, leading media outlets to report on misinformation (Brulle, 2013; McCright & Dunlap, 2010; Roper et al., 2016). In European countries too, conservatism has increasingly been affiliated with opposition to climate science and consequently, opposition to climate action (Hess & Renner, 2019).

When general consensus is broken, reaching agreement for decision-making gets increasingly more difficult (Roper et al., 2016). On the topic of anthropogenic global warming, consensus has been broken by deliberately confusing and dividing the general public, ultimately leading to slowed-down decision-making on climate policies (Brulle, 2013; McCright & Dunlap, 2010). Non-decisions and postponement that follow from this strategy then cause climate delay (Roper et al., 2016). By causing delay in climate policy-making, powerful political and economic actors are able to preserve business-as-usual and the interests they yield from it (Brulle; 2013; Hess & Renner, 2019; Roper et al., 2016; Shue, 2022). One instrument of corporate powers to reach climate delay is the usage of ideological strategies (Lockwood, 2018; Roper et al., 2016).

2.1.1.1. The role of discourse

A discourse is a collection of shared ideas through which people understand and construct the world around them (Muller, 2015). Discourses of climate delay do not deny climate change and a need for action, but rather distract from the core issue by proposing inadequate actions based on partial truths (Lamb et al., 2020; Shue, 2022). These discourses tend to misrepresent factual knowledge and break consensus (Lamb et al., 2020). Not the discourse itself, but its mobilizable power defines the impact of discourses of climate delay on the general climate conversation (Bourdieu, 1991 in Roper et al., 2016, p. 783). According to Bourdieu (1991 in Roper et al., 2016, p. 783), the mobilizable power of a discourse on its turn is defined by its resonance with already established beliefs. The more actors, especially powerful actors, that resonate with the discourse, the higher its mobilizable power (Bourdieu, 1991 in Roper et al., 2016, p. 783). The role of ideological strategies in this will be discussed more concretely in section 2.2.

2.1.1.2. The role of countermovements

Groups that interpret reality in the same ways by the use of the same discourses, are called 'discourse coalitions' (Muller, 2015). Their shared interpretations follow from shared assumptions. When these groups organize themselves to act on their shared worldviews, as they would like to materialize them into reality, discourse coalitions turn into advocacy coalitions (Jenkins-Smith et al., 2018). These advocacy coalitions can take the form of social movements and countermovements. Countermovements have been defined as networks of actors that share the same beliefs and economic interests, that are oftentimes elite-driven and opposed to the successful emergence of a social movement (Brulle, 2013; Brulle & Aronczyk, 2019). So too in reaction to early successes of a movement for climate action, a powerful countermovement that pushes against climate regulations has emerged as well (Brulle & Aronczyk, 2019).

2.1.2. Techno-optimism

Shared beliefs, when grouped into discourse and advocacy coalitions, have the power to shape policies (Weible & Sabatier, 2006; Sabatier & Weible, 2007; Jenkins-Smith et al., 2018). One of the discourses of climate delay as portrayed by Lamb et al. (2020), is the discourse of techno-optimism. Danaher (2022, p. 26) defines techno-optimism as "*a stance, (a collection of beliefs undergirded by a commitment) that incorporates the view that technology plays a key role in ensuring that the good prevails over the bad*". The degree to which technology plays a key role can differ to different degrees in different contexts, on different technologies. The discourse should thus be seen as '*a cluster of views*' that fit the description (Danaher, 2022). Danaher (2022) argues that conservative views can fit into this, as technology can be seen as a means to keep the 'good' of business-as-usual to prevail over the possible 'bad' of change. Techno-optimist discourses generally overestimate unproven or inefficient technological solutions, while other possible solutions, like societal changes, remain underexposed (Lamb et al., 2020). Danaher (2022) confirms these critiques, as the belief in technology would not always be rooted in empirical evidence and has appeared unable to sufficiently solve the problems at hand. On top of that, the philosophy of techno-optimism would not always take the realities of planetary boundaries into account (Danaher, 2022). This way, techno-optimist beliefs would push for non-transformative solutions and thus form discourses of climate delay (Lamb et al., 2020).

2.1.2.1. Ecological modernization

York et al. (2010) consider techno-optimism as a discourse engrained in modernized societies. 'Modernized' is conceptualized by these authors as societies that go through scientific and technological development, industrialization, economic growth, the expansion of its markets, urbanization and globalization (York et al., 2010, p. 77). Empirical evidence has been growing that these developments are leading to degradation of the environment (Dockstader & Bell, 2020; York et al., 2010). The ecological modernization theory however claims that through continuous economic and technological innovation, a transition towards sustainability would automatically emerge (York et al., 2010). From that perspective, transformative societal changes towards sustainability would be unnecessary and undesirable (Buttel, 2000; York et al., 2010, Hultman, 2017). Although ecological modernization recognizes the problem of ecological concerns, it assumes they can be

solved within the structures in place, through the continuation of modernization. In political venues of modernized societies, this discourse has been widely accepted as the norm (Hajer, 1995 in Buttel, 2000).

2.1.2.2. Ecomodernist values and identity

In discourse coalitions, incoming information is filtered through the lens of already shared beliefs (Jenkins-Smith et al., 2018). New information that confirms the existing ideas is accepted easily, while information that challenges them gets marginalized (Jenkins-Smith et al., 2018). So too, information on possible risks is perceived differently in different coalitions (Kahan et al., 2007). Kahan and colleagues (2007) call this way of processing information as a mechanism to defend the group identity 'identity-protective cognition'.

The 'white-male effect' is argued by these researchers to be one form of thinking and acting on identity protection. White men appear significantly more likely to hold individualistic and hierarchical beliefs than women and non-white men (Kahan et al., 2007). Coalitions in this upper left quadrant also appear more risk averse on social and environmental threats (Kahan et al., 2007).

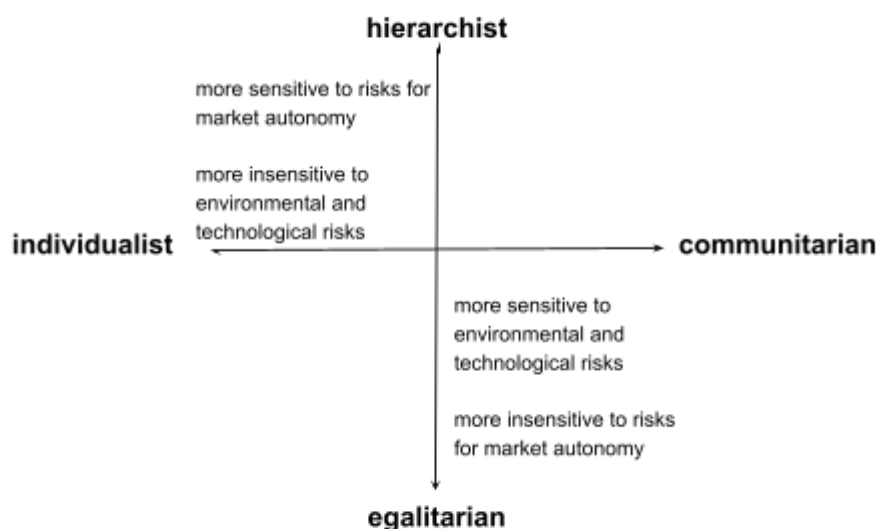


Fig. 1: Worldview typologies & risk perception. Based on Kahan et al. (2007) & figure 1 (Kahan et al., 2007, p. 468).

Stemming from classical and neo-classical economic values, like rationality and individuality (Abreu et al., 2023), throughout processes of industrialization an identity of industrial masculinity took shape (Hultman, 2016). This identity is based on the division between nature as a passive entity and 'man' as its rightful dominator. As these core beliefs remained unquestioned, the science on climate change was questioned instead (Hultman, 2016). This denial of climate change was found to be a mechanism of identity protection for white conservative men (McCright and Dunlap, 2011 in Hultman, 2016). Since the 1990s, industrial masculinity evolved into ecomodern masculinity, as denying climate change completely grew to be almost impossible due to scientific evidence.

Based on traditional masculine identities, ecomodern masculinity generally reduces ecological concerns to concerns of national security (Dockstader & Bell, 2020). Contrary to industrial masculinity where it was seen as a 'feminine' trait, thinking about solutions for climate change was now deemed useful and incorporated in ecomodern masculinity as green consumerism (Dockstader & Bell, 2020). This way, the system based on economic growth, rationality and technological fixes remained unquestioned and fundamental. For this reason, Hultman (2016, p. 8) refers to the end result of ecomodern masculinity as merely 'green wash'. "*Ecomodern masculinity is capitalism's response to environmental crises of its own making*" (Dockstader & Bell, 2020, p. 15). Although it promises sustainable transformation, it is doubtful if the core beliefs of ecomodern masculinity and ecological modernization can deliver on this. Critical feminist literature criticizes this non-transformative character of current climate governance in modernized societies (Bee et al., 2015).

2.2. Case-specific literature

2.2.1. Nuclear energy & techno-optimism

"Issues that women traditionally organize around [...] have been marginalized in debates that treat climate change as a scientific problem requiring technological and scientific solutions without substantially transforming ideologies and economies of domination, exploitation and colonialism" (Gaard, 2015, p. 20). Nuclear power is a recurrent technological object of study within ecofeminism (Swier, 2019). In the 1980s already, surveys in the United States showed that women generally opposed the development of nuclear technology more than men, with 25% of women self-identifying as anti-nuclear versus 14% of men, and 8% of women as pro-nuclear versus 23% of men (Nelkin, 1981, p. 16). Similar trends were observed in Western European countries. Radical feminists denounced the centralization of political and economic power that results from nuclear energy and pledged for structural changes towards less hierarchical and more holistic approaches, where the relation between human and nature would not be based on domination (Nelkin, 1981). In her reflective review on nuclear energy from a Japanese perspective, Kinefuchi (2021) draws upon the ecofeminist concepts of 'remoteness' and 'hierarchical dualism'. Remoteness, as a result of disconnect in space and time for example between the consumer and producer, helps to uphold dualism and so too nuclear hegemony (Kinefuchi, 2021). Exactly this hierarchical way of thinking in industrialized societies would lie at the core of the climate crisis, according to Kinefuchi (2021).

Kinefuchi (2021) goes on to debunk the narrative of nuclear energy to be 'green and safe'. Just like the Belgian researcher Verbruggen (2008), she concludes that although nuclear energy is considered carbon neutral, the process of nuclear energy production is not. Furthermore, sustainability entails more than carbon neutrality alone that nuclear energy is not considering; like the human and environmental harm of uranium mining, happening for about 70% on indigenous land in the Global South (Kinefuchi, 2021, p. 386). Risks and disadvantages are 'externalities', that are being outsourced throughout the entire nuclear energy production process (Kinefuchi, 2021; Verbruggen, 2008). In uranium mining to the Global South, with regards to safety risks and nuclear disasters to the population and regarding nuclear waste to future generations (Kinefuchi, 2021; Verbruggen, 2008). Lastly,

there is the safety threat of nuclear weapons developing from knowledge on nuclear power (Huh & Kwon, 2021). On top of that, nuclear energy production is said to be intertwined with powerful actors in the societal fabric, like academia and big corporations (Huh & Kwon, 2021).

2.2.2. Nuclear energy & climate delay

Nuclear energy cannot be considered a viable energy source for the long-term future (Huh & Kwon, 2021; Verbruggen, 2008). To do so, according to Verbruggen (2008) it should be an unlimited, democratically decided, affordable and globally accessible energy resource, with low environmental risk. On top of not meeting these criteria, nuclear energy would not be compatible with the infrastructural needs of a society predominantly running on renewable energy (Verbruggen, 2008). Nuclear energy cannot serve as a long term sustainable source of energy, and resources for scientific research and innovation should flow towards energy efficiency and renewable alternatives instead (Huh & Kwon, 2021).

In Belgium's neighboring modernized countries, public opinion in favor of nuclear power has correlated with senses of climate skepticism. In Germany, a higher level of resistance to climate action has been found to correlate with lower levels of trust in renewable and higher levels of trust in nuclear energy (Engels et al., 2013). A similar trend was observed in the UK where between 2005 and 2010, trust in nuclear energy increased as climate concerns were decreasing (Spence et al., 2010).

3. Hypothesis & conceptual framework

According to Verschuren and Doorewaard (2010, p. 75), a hypothesis is defined as “an unambiguously formulated expectation about the effect of a variable *X* on another variable *Y*”. Formulating a hypothesis helps to clarify the essence of the research aim and how the main concepts of the research relate to each other (Jenkins-Smith et al., 2018). The goal of testing a hypothesis is not to generalize its results as a theory, but to improve the validity and robustness of the hypothesized causal mechanism in the local context and of the specific case-study (Yin, 2009).

Techno-optimist discourse in climate policy can prevent transformative change beyond the structures and systems in place, leading to climate delay (Danaher, 2022; Lamb et al., 2020). When the beliefs central to a discourse align with the beliefs of a certain person or group, they can identify with that discourse (Roper et al., 2016). In the Advocacy Coalition Framework, policy participants organize into advocacy coalitions around shared policy core beliefs (Weible & Sabatier, 2006; Jenkins-Smith et al., 2018). In this way, identification of policy participants with ecomodern masculinity is found to be a mechanism of identity protection (Dockstader & Bell, 2020), leading to the formation of countermovements against climate action (Brulle, 2013; Brulle & Aronczyk, 2019), rejecting the need for transformative change in the face of ecological concerns (Hultman, 2017) and institutionalizing climate delay (Roper et al., 2016). In this research, the causal mechanism is tested that in modernized societies, shared policy core beliefs of techno-optimism would lead to policy-outcomes of climate delay. Applied to this case, the hypothesis is tested if policy core beliefs of techno-optimist discourse have contributed to the policy-decision to postpone nuclear phase-out in Belgium. The amount of evidence of causality found in the specific case can indicate how valid and robust that hypothesis is in that specific case, not how generalizable the hypothesis is for other cases (Yin, 2009). The results retrieved from this research can however specify in which steps the hypothesized causal mechanism that techno-optimism would lead to climate delay might be more valid and robust.

Figure 2 maps the hypothesized causal mechanism as derived from the theory. This conceptual research framework allows the theorized hypothesis to be tested in the case of Belgian nuclear phase-out. This mechanism is further operationalized in the following chapter on methodology.

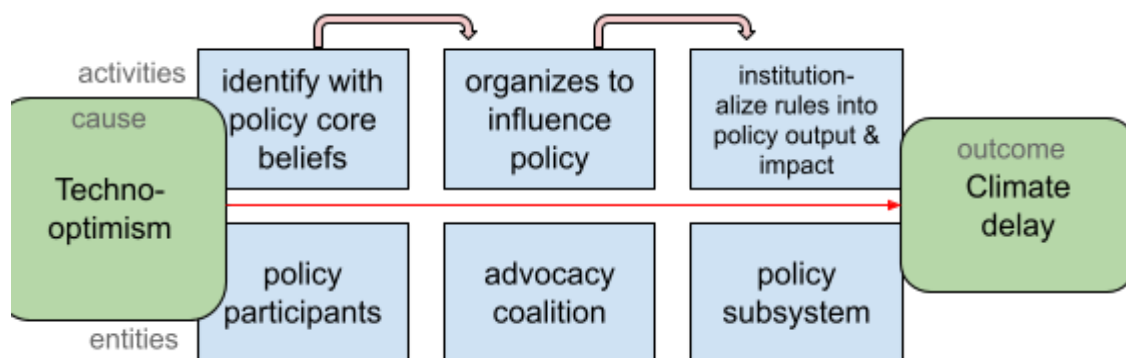


Fig. 2: Conceptual framework: the hypothesized causal mechanism, based on Beach (2018, p. 6).

4. Methodology

4.1. Research design

4.1.1. Theory-testing through single case-study research

Case-study research is a qualitative research strategy that examines a contemporary phenomenon in its local context (Yin, 2009). Especially when older theoretical connections are being tested and a particular specific phenomenon examined, single case-studies can be very useful (Gustafsson, 2017). From the literature, the hypothesis was derived that techno-optimism could be a driving force behind policy outcomes of climate delay. As the validity of this hypothesis will be tested in a specific case, this research would be 'theory-testing', according to the design of a research objective by Verschuren and Doorewaard (2010). As case-studies are oftentimes used for theory-testing research (Gustafsson, 2017), a theory-testing single-case study thus fits well with the research aim to better understand the phenomenon of climate delay by testing the role of techno-optimism in resistance to nuclear phase-out in Belgium.

4.1.2. Research framework

Single-case studies lend themselves well for analysis through the Advocacy Coalition Framework (Jenkins-Smith et al., 2018). This framework is useful to understand changing policy on a contested topic, in a layered context across different levels of society over a longer period of time (Weible & Sabatier, 2006; Sabatier & Weible, 2007). Especially for changes in energy and environmental policies, researchers have made use of this research framework (Jenkins-Smith et al., 2018). By focusing on beliefs and how people organize around them, insights can be gained on the worldviews through which people are changing policy. This way, ACF is a useful tool to unravel unquestioned normative assumptions that underlie processes of policy-making (Weible & Sabatier, 2006).

The identification that results from alignment of a discourse with people's established beliefs (Roper et al., 2016) and the emergence of countermovements and their institutionalization that follows as described by Brulle & Aronczyk (2019), as described in the literature, fits into the philosophy of the Advocacy Coalition Framework. This framework attempts to explain the process of decision-making and policy-change through coalition forming of individuals, based on shared beliefs (Schlager, 1995; Weible & Sabatier, 2006). This framework does not assume individuals to act according to instrumental rationality, leaving more room for the complexity of other factors shaping human behavior (Schlager, 1995; Weible & Sabatier, 2006).

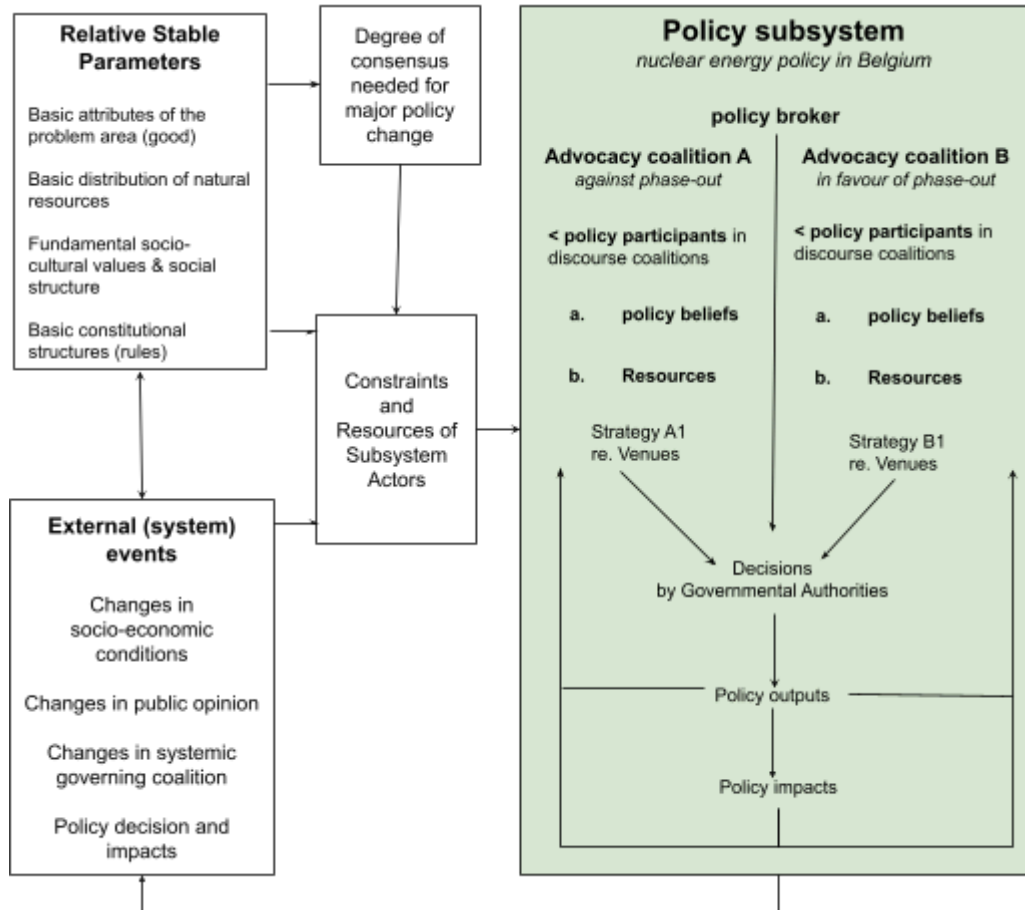


Fig. 3: Research framework, based on Sabatier & Jenkins-Smith, 1999 in Weible & Sabatier (2006, p. 124).

4.2. Case selection: nuclear phase-out in Belgium: 1999-2022

The Advocacy Coalition Framework is most relevant when the level of disagreement on the researched policy topic is high (Jenkins-Smith et al., 2018). Furthermore, a 'positive' or useful case to test a theorized causal mechanism, is one where both cause, outcome and contextual conditions are present (Beach, 2018). The political debate on nuclear phase-out in Belgium is a case that fits these descriptions, as will be explained in this section.

As a country that has been developing scientifically and technologically, has been industrializing, expanding its markets, striving for economic growth and going through processes of urbanization and globalization, according to the definition by York et al. (2010, p. 77), Belgium can be considered a modernized society. Dallenes et al. (2023) argue Belgium to be an interesting case for research on the energy transition, as statistics from 2020 show how the country is lacking behind on renewable energy development compared to other European countries (Eurostat 2020 in Dallenes et al., 2023). With 13% of total energy consumed being generated by renewable sources, only Luxemburg (12%) and Malta (11%) did worse (Eurostat, 2022, January 19th). On nuclear energy however, Belgium came in as the fifth biggest nuclear energy producing country across the EU in 2021 (Eurostat, 2022, December 21st). Correlation does not automatically equate causation, yet the

contextual conditions are present. These diverging statistics on Belgium's energy mix offer an invitation to test the hypothesized causal mechanism in the case of Belgian climate and energy policies.

The first governmental consensus on the intention to phase-out nuclear energy production in Belgium can be found in the federal coalition agreement of 1999 (Belgische Kamer van Volksvertegenwoordigers, 1999). In 2003, this government proceeded to implement a law to phase-out industrial nuclear energy production by 2025. From then on, operating nuclear power plants were agreed not to exceed 40 years of service, and no new nuclear power plants would be built (FOD Justitie, 2003). In 2013 however, nuclear power plant *Tihange 1* was extended with 10 years of lifespan (FOD Justitie, 2013) and in 2015, legislation allowed nuclear power plants *Doel 1 & Doel 2* to extend their operational time by ten years as well (FOD Justitie, 2015). In 2022 again, the Belgian government decided to extend the operational time of the newest nuclear power plants *Doel 4* and *Tihange 3* from forty to fifty years, ultimately postponing the deadline of nuclear phase-out to 2035 (FOD Justitie, 2022). This way, the operability of five out of seven of the Belgian nuclear power plants has been extended. These policy-outputs of nuclear phase-out postponement show outcomes of climate delay, as they are delaying a transformative energy transition towards renewables, as explained in the literature.

According to several environmental organizations, among which Greenpeace, risks tied to the prolonging of some of these nuclear power plants has been underestimated with a factor of two million (De Morgen, 2023). Despite the fact that the largest share of Belgian energy research and development budgets have been invested in nuclear energy since the second World War, they have failed to deliver on the expected results and innovations (Verbruggen, 2008). Rather than drawing conclusions and looking for alternatives, research by Van Impe (2018) has shown how the Belgian government and energy business have been misrepresenting the science on nuclear energy (Van Impe, 2018). As described in the theoretical literature review, the misrepresentation of science can be a way to hinder the formation of climate policies (McCright & Dunlap, 2010) and shows signs of techno-optimism, conceptualized by Lamb and colleagues (2020) as the overestimation of unproven or inefficient technological solutions.

4.3. Research methods

Qualitative research on context-sensitive data can be more prone to the author's own perception and thus bias (Abreu et al., 2023). Yin (2009) too warns for higher chances of bias in single case-studies. By making use of multiple methods, various data sources and triangulation, the validity and reliability of this research can be optimized (Yin, 2009).

Through the methods of discourse network analysis, semi-structured interviews and policy document analysis, various data sources complement each other in order to answer the research question:

How has the discourse of nuclear techno-optimism impacted policy-output of nuclear phase-out postponement in Belgium between 1999 and 2022?

The research will be conducted by answering three subquestions, based on the three stages of the hypothesized causal mechanism, conceptualized in figure 2:

SQ 1: What policy participants have been prominent in the development of nuclear techno-optimist discourse in the Belgian political debate on nuclear phase-out between 1999 and 2022?

SQ 2: How have the advocacy coalitions organized themselves around their shared policy core beliefs in the Belgian political debate on nuclear phase-out between 1999 and 2022?

SQ 3: How have the advocacy coalitions influenced policy-output of nuclear phase-out postponement?

4.3.1. Discourse network analysis

To start answering the first subquestion, a discourse network analysis is conducted. This method allows an overview of the discourse coalitions present in the policy subsystem to be created. For this, the election programs of the parties that went into government between the elections of 2007 and 2019 are analyzed. This timeframe was established, as every government formed after these elections has reached agreement to postpone nuclear phase-out beyond the calendar as established in the nuclear phase-out law of 2003 at some point in their legislative term. This amounts to the analysis of 22 election programs that have been composed for the federal Belgian elections of 2007, 2010, 2014 and 2019.

4.3.1.1. Data collection

These 22 programs have been downloaded integrally as pdf documents from *Manifesto Project Dataset* (Lehmann et al., 2024). This was done by browsing the dataset and documents between the years 2007 and 2019, restricted to the country Belgium. On the website of *Belelite* (Aspeshagh et al., 2024), the composition of the government coalitions was consulted. Based on that, the election programs of each of the parties that went into government after the elections of 2007, 2010, 2014 and 2019 were collected from *Manifesto Project Dataset* for them to be analyzed.

4.3.1.2. Data analysis

The collected election programs have been scanned for their stances on nuclear energy within the broader views on climate and energy policy of the political party. The stances of the parties on nuclear energy have been analyzed and coded into five categories; four nuclear techno-optimist statements and a last category for explicit statements of the parties in favor or against nuclear phase-out. Through *Discourse Network Analyzer* software, the stances of the parties were categorized into 'agreement' (yes) or 'disagreement' (no) with the five statements. Codes have been derived from the case-specific literature on nuclear

energy and have iteratively been complemented with findings from the data. The operationalization and coding of the four nuclear techno-optimist statements is explained in further detail in the box below.

Box 1: Operationalization of the nuclear techno-optimist statements

As discussed in the theory chapter, the phenomenon of technological optimism entails unproven or inefficient technological solutions that are being overestimated (Danaher, 2022; Lamb et al., 2020). In this case-study, four recurring statements of nuclear techno-optimism have been derived from the literature and data:

- *“Nuclear energy is **green**”.*

As in the logic of ecological modernization, the sustainable energy transition is understood as solely the reduction of emissions and increase in material efficiency (York et al., 2010). ‘Sustainability’ is then solely understood as net carbon neutrality (Kinefuchi, 2021).

Because of this, nuclear energy is insufficiently green, as it:

- underexposes the environmental and societal aspects of **nuclear waste** (Kinefuchi, 2021; Verbruggen, 2008)
- underexposes and minimizes **incompatibility with renewable infrastructure** on the long term, externalizing risk of not succeeding at the green energy transition (Verbruggen, 2008)

- *“Nuclear energy is **safe**”.*

As disadvantages of nuclear energy are minimized and risks externalized (Kinefuchi, 2021; Verbruggen, 2008), nuclear energy would be insufficiently safe, as:

- disadvantages of **uranium mining** are underexposed and externalized to population outside of Belgium; the Global South and indigenous communities (Kinefuchi, 2021)
- risks of **nuclear disasters** are underexposed, minimalized & externalized to the population (Kinefuchi, 2021; Verbruggen, 2008)
- **knowledge on nuclear power** poses a risk of proliferation, which is underexposed, minimized & externalized to the (world) population (Huh & Kwon, 2021)

The next two nuclear techno-optimist statements reoccurred frequently in the data. In the literature however, they have not been discussed in equally detailed ways as the two previous statements have been.

- *“Nuclear energy is needed to safeguard **energy security**”.*

This statement remains unproven and could be insufficient, underestimating Belgium's dependence on:

- the **limited resource uranium** from outside of Belgium for nuclear energy production

- the **French nuclear operator** Engie and technologies from other countries for the operability of nuclear power plants
- the **technological operability** of its nuclear power plants
- “*Nuclear energy is needed to safeguard **energy affordability***”;

This statement remains unproven and underestimates:

- the externalization of costs to the **taxpayer** for
 - research & development
 - maintenance of the current power plants
 - deconstructing the old power plants
 - building of the new power plants
- the externalization of costs to the **Global South** (cost of health for uranium mining, possibly nuclear waste) and to **future generations** (cost of health for nuclear waste & possible nuclear disasters...)

The binary ‘yes/no’ classification of agreement to the statements creates a clear-cut quantitative overview of the complex debate. On the other hand, the software does not allow much room for the debate’s nuances. Oftentimes, the views on nuclear energy by political parties follow more of a ‘yes, but...’ or a ‘no, and...’ approach. Systematic analysis in the same reasoning for all party programs thus is essential in the process of classification. To balance out the disadvantages and allow the benefits to complement each other, the quantitative results from the discourse network analysis are interpreted alongside the list of 274 statements. This way a concise overview is created on the stances on nuclear energy of the political parties that went into government after the elections from 2007 until 2019.

The first way in which this overview of policy core beliefs is presented, is through an affiliation network. Here, the degree to which the political parties agree and disagree to each of the four statements can be weighed out against each other, reflecting the degree of techno-optimist discourse in their policy core beliefs on nuclear energy. A ‘combined score’ is calculated through the *Discourse Network Analyzer* software by subtracting the amount of disagreement to a particular statement from the amount of times a political party agrees with that same statement (Leifeld, 2013). A positive ‘combined score’ then indicates agreement with the nuclear techno-optimist statement, while a negative combined score indicates overall disagreement. The higher the scores, the higher the (dis)agreement. Since only the election programs of parties that went into government after said elections are analyzed, the amount of programs analyzed of all parties differs. That is why the relative value of the combined scores especially is insightful to compare stances across parties.

Absolute combined score	amount of disagreements to a particular statement subtracted from the amount of agreements of that political party to that same statement
Relative combined score	amount of disagreements to a particular statement subtracted from the amount of agreements of that political party to that same statement, divided by the total amount of analyzed election programs of that party
Positive combined score	combined score > 0 , indicating a positive stance on the nuclear techno-optimist statement
Neutral combined score	combined score $= 0$, indicating a neutral or non-existent stance on the nuclear techno-optimist statement
Negative combined score	combined score < 0 , indicating a negative stance on the nuclear techno-optimist statement

Table 1: Overview of how to interpret the combined scores in the affiliation network.

Once the stances of the political parties on the nuclear techno-optimist statements have been derived, how these policy participants relate to each other is examined. To create the best overview of this, the data has been exported from the *Discourse Network Analyzer* software as a co-occurrence subtract network with no duplicates. What this means will be explained step by step.

A co-occurrence network reveals the degree to which two different actors both agree or disagree on the same statement (Muller, 2015). The higher the level of co-occurrence, the more they share the same discourse and thus form a discourse coalition on a certain topic. A subtract network of co-occurrence subtracts the amount of times two parties do not share the same stance on statements (one agrees, one disagrees) from the amount of times these two policy participants do share the same stances (both agreeing or both disagreeing) across all categories (Leifeld, 2013). As no duplicates are considered, in this network the frequency of the statements is irrelevant, allowing comparison between the political parties (Leifeld, 2013). The amount of analyzed data differs among the political parties, according to how often they went into government after the elections between 2007 and 2019. Also the amount of text in the election programs, in general and on nuclear energy specifically, varies across political parties. By excluding duplicates, the stances of the political parties on nuclear energy can be leveled and compared to each other. Here again, a positive score indicates that both actors share the same beliefs, while a negative score shows opposition. The higher the score, the higher the correspondence or opposition. The visualization of the co-occurrence network has been established with the help of Ucinet and NetDraw software.

As the discourse network analysis attempts to distinguish discourse coalitions on nuclear energy in Belgium, apart from the nuclear techno-optimist statements, explicit statements in favor or opposition to nuclear phase-out have been coded as well. In the margins of the affiliation network (table 4), the amount of statements agreeing and disagreeing with nuclear phase-out can be consulted for every political party. These statements have been added to the margins, as a direct link with techno-optimism cannot be derived from them. In the

co-occurrence network however, this category of statements has been included. The explicit agreement or disagreement with nuclear phase-out is relevant information to distinguish the discourse and advocacy coalitions present, yet cannot prove the presence of nuclear techno-optimist discourse in the political party programs.

The results as obtained from the affiliation network and the co-occurrence subtract network complement each other to gain insight into the most prominent policy participants and their stances on nuclear energy. Complemented with data gathered from semi-structured interviews, results from this analysis allow insights in the prominent policy participants in discourse and advocacy coalitions regarding nuclear energy in Belgium. The methodology of these interviews will be explained in more depth in the following section.

4.3.2. Semi-structured interviews

The discourse network analysis allows a first distinction of the policy participants into advocacy coalition A: against nuclear phase-out and advocacy coalition B: in favor of nuclear phase-out. To answer the second subquestion of this research, in-depth knowledge on how these advocacy coalitions have been organizing themselves is needed. This knowledge cannot be derived from secondary data alone. Semi-structured interviews can be a valuable complementary method in a case study, as they allow in-depth insights into a local context (Verschuren & Doorewaard, 2010). 517 minutes of conversation with 12 interviewees, knowledgeable on the Belgian nuclear energy debate, have granted some relevant complementary insights on the researched policy subsystem.

4.3.2.1. Data collection

Derived from plenary and commission reports within the timeframe of this research, an overview has been created of the members of the Belgian Federal Parliament that have been active in energy policy-making between 1999 and 2022. Based on their role and term in the Federal Parliament, the most relevant parliamentarians have been contacted. Given the aforementioned scope of this research, only parliamentarians from the political parties that have been part of at least one government coalition between 1999 and 2022 were contacted. For more contextual information, the election results in the given timeframe can be consulted in **Appendix A** and a timeline of government coalitions and relevant roles within the government on energy policy-making in **Appendix B**.

Two of the twelve interviewees for this research can be categorized as 'policy brokers'; one being an energy scientist at a Belgian university and the other a representative of a Belgian governmental institution affiliated with nuclear energy. Another similar government institution replied not to be able to participate in an interview on the political debate on nuclear energy, as the institute cannot articulate political statements. Another knowledge institute on nuclear energy had not replied to the invitation, despite follow-up emails.

The other ten interviewees are affiliated with political parties and can be categorized within either or both of the advocacy coalitions. Each of these interviewees have been involved in Belgian energy and climate policy-making and thus in policy-making on nuclear energy,

either as collaborator of the political party or its study center, as a member of the Belgian Federal Parliament and the Commission working on energy themselves or as a Belgian Minister of Energy, active between 1999 and 2022. When invitations for a 45 minute semi-structured interview were sent out, an equal distribution of interviewees from each of the 9 political parties was considered. At least one person of each political party that went into government in the timeframe of this research has been interviewed, except for both the Flemish and Wallonian Social Democrats. None of the five relevant Social Democrats that were contacted appeared available, nor were they able to refer to someone else who could be available for a semi-structured interview.

Once the participant agreed to the semi-structured interview, they were sent a project information sheet (**Appendix C**), the form of informed consent (**Appendix D**) and the ten interview questions (**Appendix E**) in advance of the interview. The ten questions that guided the semi-structured interviews are formulated based on the research framework of figure 3. These questions were formulated especially for the ten interviewees directly involved in policy-making. For the two policy-brokers, the essence of these questions remained, yet the questions have been formulated differently as to match the specific role of that interviewee within the policy subsystem. Interviews were held in the mother tongue of the interviewees, depending on whether they are Flemish or Wallonian, in Dutch or in French. Interviews have been conducted both online and in person. The data has then been transcribed in the original language.

The data collected through semi-structured interviews is only used for the purpose of this research. In the description of the results, the data are anonymized and will be deleted when this thesis research has been completed, as explained in the informed consent form (**Appendix D**).

4.3.2.2. Data analysis

The data collected through semi-structured interviews has been analyzed in its original language. Quotes as displayed in the result section have been translated as closely as possible from either Dutch or French to English. The analysis of these semi-structured interviews took place through the software of *NVivo*, based on the research framework in figure 3, coded as operationalized in table 2 below.

4.4.3. Policy document analysis

Backed with knowledge on the political debate on nuclear energy in Belgium, the prominent actors, discourses, advocacy coalitions and insights on how they have operated, the final stage of the research seeks to understand the last chain in the hypothesized causal mechanism: the policy-output. To find an answer to subquestion 3 especially, policy document analysis is conducted, on coalition agreements and on implemented government bills¹ that postpone nuclear phase-out.

¹ proposal to amend a law, submitted by the governing coalition.

4.4.3.1. Data collection

The coalition agreements and government bills were retrieved from the database of the official website of the Belgian Federal Parliament: <https://www.dekamer.be> .

4.3.3.2. Data analysis

The seven coalition agreements of every government coalition that went into power after the six elections of 1999, 2003, 2007, 2010, 2014 and 2019 were analyzed. This way, the intentions of each government coalition on nuclear energy policy have been derived, from the *Verhofstadt I Government* that implemented the phase-out law in 2003 until the *De Croo Government* that decided to postpone the phase-out calendar to 2035. The intentions as derived from the coalition agreements are then checked with the eventual policy-outputs of nuclear phase-out postponement as decided on in 2013, 2015, 2016 and 2022. These four government bills too have been submitted to policy document analysis. By comparing the results of the policy document analyses with the results derived from the previous research steps, patterns have been distilled on how the advocacy coalitions have been able to influence nuclear energy policy and the postponement of nuclear phase-out.

4.4.4. Additional document analysis

More contextual knowledge on the development of nuclear energy in Belgium and the nuclear phase-out law of 2003 has been derived through the document analysis of books. '*Kernenergie (on)besproken*' by Erik Laes and other researchers (2007) offers insights into the historical roots of nuclear energy and the accompanying debate in Belgium. It has been written by different researchers and research groups in command of the Flemish Institute for Scientific and Technological Aspects research (*viWTA*). The second book, '*Kernenergie in de Wetstraat*', has been written in 2004 by Luc Barbé. Barbé is the former chief of staff of the Belgian Green Secretary of State for Energy in 2003, Olivier Deleuze, who initiated the law of nuclear phase-out. In this book, Barbé testifies on his own experiences behind the scenes of policy-making on nuclear energy at that time. In a factual way, Barbé informs the reader on the context of the time and how decisions on nuclear energy came to be or not to be. The analysis of both books is conducted through the same operationalized Advocacy Coalition Framework (table 2) and woven into the result description, where this contextualization is relevant. Lastly, for relevant substantiation of the Belgian political context, an introduction course to political sciences by Devos (2017) and a course on Belgian political parties (Reynaert, 2018) is consulted at times as well.

	Conceptualization	Operationalization
Relative Stable Parameters	Factors that rarely change over a longer period of time within the policy subsystem (Sabatier & Weible, 2007)	<ul style="list-style-type: none"> • Basic attributes of the problem area (good) • Basic distribution of natural resources • Fundamental socio-cultural values & social structure • Basic constitutional structures (rules)
External (system) Events	A driver of change that originates from outside the policy subsystem (Weible & Sabatier, 2006; Sabatier & Weible, 2007)	<ul style="list-style-type: none"> • Major socio-economic changes • Changes in public opinion • Changes in the systematic governing coalition • Policy decisions and impacts from other subsystems
Constraints and Resources of Subsystem Actors	General constraints and resources that apply to all subsystem actors	<ul style="list-style-type: none"> • Constraints • Resources
Policy subsystem	The territorial and functional area in which policy participants from all levels operate to influence policy (Weible & Sabatier, 2006; Sabatier & Weible, 2007)	<ul style="list-style-type: none"> • Territorial: Belgium • Functional: climate & energy policy
Policy participants	Individual actors who participate in the policy subsystem based on their beliefs (Weible & Sabatier, 2006)	Members of parliament, ministers, chiefs of staff, employees at government institutions, researchers ...
Discourse coalitions	Groups that interpret reality in the same ways by the use of the same discourses, are called 'discourse coalitions' (Muller, 2015).	Political parties & political families <ul style="list-style-type: none"> • Greens • Social Democrats • Christian Democrats • Liberal Democrats • Flemish Nationalists
Advocacy coalitions	Policy participants that organize themselves and coordinate action based on shared policy core beliefs to influence policy (Jenkins-Smith et al., 2018)	<ul style="list-style-type: none"> • Advocacy coalition A: against nuclear phase-out • Advocacy coalition B: in favor of nuclear phase-out

Policy beliefs	Deep core beliefs	Fundamental beliefs that span multiple policy subsystems (Weible & Sabatier, 2006)	Ecological modernization the core belief that the development of <ul style="list-style-type: none"> ● science ● technology ● industrialization ● economic growth ● markets expansion ● urbanization ● globalization will automatically lead to a sustainable transition, without the need of fundamental societal transformation (Buttel, 2000; York et al., 2010, Hultman, 2017)
	Policy core beliefs	Salient and contested normative beliefs that span the entire policy subsystem on the direction a certain policy topic should take (Weible & Sabatier, 2006; Sabatier & Weible, 2007; Jenkins-Smith et al., 2018)	Nuclear techno-optimist discourse: <ul style="list-style-type: none"> ● Nuclear energy is green ● Nuclear energy is safe ● Nuclear energy guarantees energy security ● Nuclear energy guarantees energy affordability
	Secondary beliefs	More narrow and specific policy preferences that relate to either the territorial or thematic subcomponent of the policy subsystem (Weible & Sabatier, 2006; Sabatier & Weible, 2007)	<ul style="list-style-type: none"> ● Against nuclear phase-out ● In favor of nuclear phase-out
Resources	Availabilities of advocacy coalitions to coordinate and strategize to influence policy, based on its five subcomponents by Weible & Sabatier (2006) & Sabatier & Weible (2007)		<ul style="list-style-type: none"> ● Formal legal authority ● Public opinion ● Information ● Mobilizable troops ● Financial resources
Strategy	How advocacy coalitions advocate to influence decision-making		Lobbying, back door diplomacy, influencing public opinion...
Venues	Arenas where there is a possibility to influence beliefs and policy (Weible & Sabatier, 2006)		The Belgian federal Government, the Belgian federal Parliament, within political parties, between political parties, in the media, science, think tanks...

Policy broker	Compromising policy participant, respected by both coalitions with a certain degree of decision-making authority (Weible & Sabatier, 2006)	Scientists, governmental agencies & institutions...
Policy-output	the eventual output of the policy-making processes	Nuclear phase-out postponement
Policy-impact	the eventual societal impact of the policy-making processes	Climate delay

Table 2: conceptualization & operationalization of the research framework in the case of Belgian nuclear phase-out postponement

5. Results

The results described in this chapter follow the structure of the research framework. As the different research methods and data sources complement each other, so does the description of the results.

5.1. Relatively stable parameters

5.1.1. Basic attributes of the problem area

The Advocacy Coalition Framework lends itself well to the examination of policy-making on complex, contested topics (Weible & Sabatier, 2006; Sabatier & Weible, 2007). Over the years, the debate on nuclear energy in Belgium has proven to fit that mold. As expressed by Interviewee 5, the word “*crisis*” has been part of general discussions on energy policy since the oil crises of the late 1970s. The debate on nuclear energy in particular has been described by other Interviewees as “*polemic*” (Interviewee 4), “*politicized*” (Interviewee 11) and “*absolutist*” (Interviewee 8). Very little room would be left for nuance, despite the reality of nuclear energy being very nuanced and full of counterintuitive facts and arguments (Interviewee 8). Both between and within political parties, a lot of disagreement exists on this topic. “*It is an unbelievably complex topic. Considering worldviews, considering interests; economically, prestigiously, considering money, culture struggle and party politics*” (Interviewee 6).

Energy appears to be a very challenging issue for policy-making. Energy policies can impact citizens directly, yet are so complex and intertwined with other policy matters that they can remain obscure for the average citizen. Households rely on electricity every day, and pay for it every month (Interviewee 8). The technological and governance aspect of how this energy came into their homes however, transcends the comprehension of someone who has not been educated on the matter. This remoteness between political decision-making and daily life seems to have created a certain disconnect. The distance between the citizen and the politician then offers a fertile soil for fear and distrust to grow (Interviewee 8). Nuclear energy in particular then can evoke emotions affiliated with nuclear safety (Interviewee 9). It can be a challenge to translate the complicated and at times counterintuitive knowledge on nuclear energy to the broader public in accessible ways, as the charged policy topic is prone to fall victim to people’s projections (Interviewee 8).

Lastly, to fully understand the basic attributes, the historical context in which the problem area of nuclear energy in Belgium emerged will be sketched. By the end of the Second World War, powerful nations on the global level had started developing nuclear weapons. To be able to do so, those nations were in need of the resource uranium. Other nations, like Belgium at the time, were in need of money to in the first place win the War (Barbé, 2004) and afterwards rebuild their economies (Laes et al., 2007). In September 1944, a *memorandum of understanding* was signed by the Belgian government, the United Kingdom and United States of America, exchanging privileged access for Belgium to “*nuclear knowledge for commercial, non-military goals*” in return for access to uranium on Congolese land² (Laes et al., 2007, p. 29). From 1951 until 1956, export taxes on uranium from Congo

² ‘Belgian Congo’ was the Congolese land colonized by the Belgian government up until June 30th 1960.

to the United States were collected by the Belgian state to be invested in nuclear research (Barbé, 2004; Laes et al., 2007). From these funds, eventually the *Belgian Nuclear Research Center (SCK-CEN)* as is known and operative today, was raised (Laes et al., 2007, p. 30). Over the years, these investments have granted Belgium a pioneering position in Europe regarding the development of nuclear technologies (Barbé, 2004).

5.1.2. Basic distribution of natural resources

The basic distribution of knowledge and information appears to be a fundamental challenge in the debate on nuclear energy in Belgium. “*The debate is complex, also because there are no independent, objective scientists in the debate that say: this is what it is and how it works*” (Interviewee 6). The lack of clear-cut factual knowledge produced by science, leads to a lack of clear, factual information in the public debate. Neither within the public, the media nor in politics there is a high level of expertise on the topic (Interviewee 5 & 6). As there are more policy-makers that studied law than there are with a scientific background, Interviewee 12 fears this impacts the way policy is made with regards to nuclear energy. “*Only a small number of people with an opinion on the matter know the details on the technology and its implications*” (Interviewee 8). According to Interviewee 5, “*A debate can be had between people based on knowledge, and based on objective knowledge*”, which is a resource that would be lacking in the debate on nuclear energy in Belgium.

Due to this lack of knowledge, disagreement can be observed on the natural resources for energy production at hand in Belgium. While Interviewee 7 claims Belgium’s geography does not allow the country to rely on the wind and the sun for renewable energy production, interviewee 11 points out that for nuclear energy production Belgium depends on other countries for the resource uranium too. As the past 20 years have been rather prosperous, the general Belgian public has assumed that affordable energy would always be available (Interviewee 11). Yet, 90% of the energy used in Belgium is imported and Belgian energy policy-making has not been shaped in very strategic ways (Interviewee 11).

As a small, open economy, two thirds of Belgium’s welfare has been dependent on international trade (Belgische Kamer van Volksvertegenwoordigers, 1999 p. 43). As expressed by the Verhofstadt II Government, “*brains are our only raw material*” (Belgische Kamer van Volksvertegenwoordigers, 2003, p. 13), Belgium’s export of knowledge and competitiveness within the European knowledge economy has appeared important for the country across the years and governments. Investments in research and development on nuclear energy oftentimes are an intention all governing parties agree on, as the *Belgian Nuclear Research Center (SCK-CEN)* is considered a worldwide pioneer on that (Belgische Kamer van Volksvertegenwoordigers, 2008; 2014; 2020).

5.1.3. Fundamental socio-cultural values and social structure

Belgium has a partycratic political system, in which political parties are powerful actors in the country’s policy-making (Devos, 2017). The regions Flanders and Wallonia each have their own electoral system and political parties. These parties can on the federal level however be

structured in political families. As there are 5 political families that made part of the government coalition between 1999 and 2022, these will be briefly introduced from the left- to the right-handed side of the spectrum. The overview of these political parties and their abbreviations between brackets can be consulted in the table below. All the changed party names between 1999 and 2022 are included and listed up chronologically. The origins and ideologies of each of the political families will be briefly illustrated too.

Political family	Flemish party	Wallonian party
Green	<i>Anders Gaan Leven (Agalev / Groen! / Groen)</i>	<i>Ecolo</i>
Social Democratic	<i>Socialistische Partij (SP) / Socialistische Partij Anders sp.a / Vooruit</i>	<i>Parti Socialiste (PS)</i>
Christian Democratic	<i>Christelijke Volkspartij (CVP) / Christen, Democraat & Vlaams (CD&V)</i>	<i>Parti social chrétien (PSC) / Centre démocrate humaniste (cdH) / Les Engagés</i>
Liberal Democratic	<i>Vlaams Liberaal Democratisch (VLD) / Open Vld</i>	<i>Parti Réformateur Liberal (PRL) / Mouvement Réformateur (MR)</i>
Nationalist	<i>Volksunie (VU) / Nieuw-Vlaamse Alliantie (N-VA)</i>	

Table 3: The Belgian political families and their Flemish & Wallonian political parties

At the most left-handed side, the Greens are a relatively young political family that emerged in Belgium from the green movement in the 1970s (Reynaert, 2018). According to Interviewee 8, the Flemish Green party has been more moderate whereas their Wallonian colleagues had been more radical at times. This can be explained by the different Flemish and Wallonian electoral public, since Wallonia has a more left-wing culture than Flanders (Interviewee 8).

The Social Democrats are a more established political family in Belgium. Its political parties arose from workers strikes and unions in the late 19th century (Reynaert, 2018).

At the center of the political spectrum, there is the political family of the Christian Democrats. Before becoming Christian Democratic in the early 20th century, this political family had rather conservative Catholic values (Reynaert, 2018). As can be derived from the election results as displayed in **Appendix A**, the Christian Democratic beliefs have been valued more by the Flemish voter than in Wallonia across the timeframe of this research.

The next more established political family in Belgium is the one of the Liberal Democrats. Political action organized around the liberalist ideology can be traced back to the origins of

Belgium as a state in the 1830s (Reynaert, 2018). The Wallonian and Flemish Liberal Democrats of today however differ from each other in certain aspects. *MR* has been described as very “*business-friendly*” and “*mercantile*”, and a party that is not experiencing any pressure from right-wing parties in the Wallonian electoral system. The Flemish Liberal Democratic party *Open Vld* however has the Flemish nationalist party *N-VA* and the far-right *Vlaams Belang* on its right-hand side of the political spectrum, that it needs to distinguish itself from (Interviewee 8).

On the most right-handed side of the Belgian political spectrums, for parties that have been in government during the timeframe of this research, one can find the Flemish Nationalists. *N-VA* originated from the Flemish movement and aims for more autonomy for the Flemish region (Reynaert, 2018).

5.1.4. Basic constitutional structure (rules)

Belgium is a federal state, where different levels of government each have their own decision-making authorities (Devos, 2017). As a parliamentary democracy, Belgian citizens directly elect the members of the parliaments for all governing levels. A Belgian federal government is formed when political parties with a majority of the seats in the Federal Parliament compromise to a coalition agreement (Devos, 2017). Interviewee 1 describes a coalition agreement as a compromised, watered-down version of each of the election programs of all parties involved. The stances agreed here serve as the base for the new government coalition in the new legislature (Interviewee 1). When a party is part of the governing coalition, its parliamentarians are expected to operate according to the views as described in the coalition agreement (Interviewee 1). The *degree of consensus needed for major policy change*, in this case to amend the law of nuclear phase-out, is a majority of the votes in the Parliament, where at least half of its members are present at the time of voting (Devos, 2017).

The Belgian Federal Parliament is divided in commissions for its daily work. Up until 2019, the commission that handled matters on energy was mainly an economic commission; the Commission of Business, Science Policy, Education, National Scientific and Cultural Institutions, Small and Midsize Enterprises & Agriculture. Since 2019, this commission has been split up (Interviewee 1 & 3), leading the debate on nuclear phase-out to be discussed in the Commission of Energy, Environment and Climate since (Belgische Kamer van Volksvertegenwoordigers, 2019).

“In Belgium, we are extremely nonchalant when it comes to thinking about our governance and structures” (Interviewee 4). *“Particracy is the solution to all our problems, on its turn creating new problems”*. This then leaves a lot of unquestioned and uncriticized space for certain institutions, like the *Belgian Nuclear Research Center SCK-CEN*. *“SCK can be considered a bastion”*, as Belgian nuclear institutions would be persistent in their rules (Interviewee 4). Opposed to these institutions, the environmental movement can be considered rather weak (Interviewee 4). Also the governmental agencies and institutions are granted less political leverage than the nuclear institutions, *“which”*, according to Interviewee 5, *“is terrible: politicians do not trust the administration, despite the very good people working there”*.

Some Interviewees explained the Belgian constitutional structure by comparing it to elements of its neighboring countries. Compared to neighboring country France, another country producing nuclear energy, the Belgian state is not as present in the private energy sector (Interviewee 10). This would lead to a power imbalance between the French multinational *Engie* that operates nuclear power plants in Belgium and the Belgian state in the event of negotiating new agreements (Interviewee 10). Compared to the Netherlands, Belgium loses a lot of information and know-how when new ministers and governments get into place. Opposed to the Dutch, Belgian ministers bring their own staff, meaning that a lot of the built up knowledge and know-how in the ministries is lost, eventually leading to a lack of information and continuity at the policy-making levels (Interviewee 12).

5.2. External events

5.2.1. Changes in systematic governing coalition

Governing coalition changed systematically 6 times within the timeframe of this research; after the elections of 1999, 2003, 2007, 2010, 2014 and 2019. Election results can be consulted in **Appendix A**, more information on the governing coalitions can be found in **Appendix B**.

As proclaimed in their coalition agreement in the Belgian Federal Parliament on July 14th 1999, the new *Verhofstadt I Government* had understood the scattered election results and shift in the political landscape as a clear demand from the public to make Belgian governance ready for the 21st century (Belgische Kamer van Volksvertegenwoordigers, 1999). The Christian Democrats went into opposition for the first time since 1958, while the Greens went into the governing coalition for the first time ever (Aspeslagh et al., 2024).

The new Verhofstadt II Government in 2003 no longer contained the Greens, but added the social liberal party *Spirit*³. This new government intended to prioritize the socio-economic challenge of unemployment and deteriorating economic growth (Belgische Kamer van Volksvertegenwoordigers, 2003).

After the elections on the 10th of June 2007, Belgian federal politics went into turbulent times. The Flemish Christian Democratic party *CD&V* and the Flemish Nationalist party *N-VA* had joined forces in the elections as a cartel, winning the elections with 18,51% of the Belgian votes (IBZ, 2024). The formation of a federal government with a Flemish Nationalist party proved to be complicated. Discussions on reforms of the federal Belgian state and its competences dominated the discussions of the federal government formation. Half a year after the elections and with no coalition agreement in sight, the ad interim *Verhofstadt III Government* was formed, consisting of both the Wallonian and Flemish Christian and Liberal Democrats, joined by the Wallonian Social Democrats. For three months they would govern, for the sake of the country's economic and political stability while negotiations for a long term government coalition continued (Belgische Kamer van Volksvertegenwoordigers, 2007). *Verhofstadt III* did not govern based on a coalition agreement, but a short coalition declaration, based on 10 action points.

³ *Spirit* took part in the elections of 2003 in a cartel with the Flemish Social Democratic *sp.a*.

In between the elections of 2007 and the elections of 2010, three more governments followed *Verhofstadt III*; *Leterme I* (March 20th 2008 - December 30th 2008), *Van Rompuy I* (December 30th 2008 - November 25th 2009) & *Leterme II* (November 25th 2009 - December 6th 2011). Despite the rotation of prime ministers, the formation of the governments stayed largely the same, working based on the same coalition agreement of *Leterme I*. Apart from the debate on Belgian state reforms, other external events these governments needed to tackle were the economic recession that followed from the financial crisis of 2008 (Belgische Kamer van Volksvertegenwoordigers, 2008).

In April of 2010, the Belgian *Leterme II Government* fell over disagreements on reforming the Belgian federal state, leading to advanced elections in June 2010. The biggest external events that influenced the coalition agreement that was formed at the end of 2011, 541 days after the elections, were still these disputes on the reform of the federal state and the economic recession. Because of the financial crisis management of the last years, the government's expenses needed to be cut down to get the country's finances sorted (Belgische Kamer van Volksvertegenwoordigers, 2011). As there were other major contested topics at play and the time pressure to form a government only augmented, other contested policy topics, like nuclear energy, had to be compromised on for pragmatic reasons (Interviewee 9).

The Michel I Government I, formed after the elections of 2014 had no left wing parties in its government. The government still tended to the economic problems of unemployment, retirement and social security, while trying to lower its government debt (Kamer van Volksvertegenwoordigers, 2014).

The elections of 2019 resulted in scattered election results and, especially in Flanders, a big win for the party of the far-right; *Vlaams Belang*. The agreement among democratic parties not to govern with the extreme right, called '*cordon sanitaire*', again led to a long period of government formation negotiations. During these negotiations, the covid pandemic had broken out. Eventually seven parties; the Greens, Social and Liberal Democrats of Flemish and Wallonian side accompanied with the Flemish Christian Democrats, formed a government on October First 2020. *the De Croo Government* had to tend to the Covid crisis, and the economic crisis the pandemic had started. Apart from that, the digital and ecological transitions were ongoing, which this new government in this new legislature intended to tend to as well (Belgische Kamer van Volksvertegenwoordigers, 2020, p. 13).

5.2.2. Policy decisions and impacts

One of the intentions set by *Verhofstadt I* was to coordinate the evolving European regulations with both the federal and the regional levels of policy-making in Belgium (Belgische Kamer van Volksvertegenwoordigers, 1999). As put by Interviewee 6: "*Liberalization requires regulation*". Certain rules need to be in place for a free and integrated market to function, so too for the European market of gas and electricity. In 2011, the *Di Rupo Government* intended to transfer competences to the EU to strengthen the European Energy Union too (Belgische Kamer van Volksvertegenwoordigers, 2011). According to

Interviewee 2, the fate of nuclear energy depends for a good part on European regulation, as the success of new models of nuclear power plants depends on their scalability, which depends on the European stamp of approval in its regulations (Interviewee 2).

For nuclear energy in particular, there are non-binding guidelines by the *International Energy Agency (IEA)*, that different countries each implement in their own ways (Interviewee 12). Binding international legislation exists as well, like the *Euratom Directive (2011/70)* on how geological disposal should be managed (Interviewee 12). This directive obligated the *Di Rupo Government* to integrate safer nuclear waste management into Belgian policies (Belgische Kamer van Volksvertegenwoordigers, 2011).

After agreements on state reforms in 2011, certain federal competences needed to be transferred to the regional governments, among which certain elements of climate and energy policy. Nuclear energy however remained a federal matter (Kamer van Volksvertegenwoordigers, 2011).

In 2014, a new system to subsidize gas power plants as a substitute for nuclear energy was rejected by the EU, as this practice is categorized as illegal state support (De Morgen, 2021). When in 2021 Green federal Minister of Energy Tinne Van der Straeten attempted to achieve nuclear phase-out as planned by substituting nuclear capacity with temporary gas centrals, the provincial council qualified to issue the permit for that gas power plant to be built in Flanders, refused permission (De Morgen, 2021, December 23rd). European regulation can influence the policy made by its member states, just as much as levels of policy-making within a federal state can impact the policy-making on the federal level.

5.2.3. Public opinion

The public opinion on nuclear energy is polarized. According to Interviewee 9, a survey of 2021 would have showcased a divide of 50-50. The public opinion however has fluctuated over the years. To understand the political debate on nuclear phase-out postponement between 1999 and 2022, the contextualization back to the beginning of nuclear energy production in Belgium needs to be understood. As described by Laes et al. (2007), after the Second World War, the promise of complete energy independence and the perspectives of economic development due to nuclear energy production in Belgium was positively received by the general public. As told by Interviewee 6, the technology had remained unquestioned throughout the 1950s. In the 1960s however, some critical questions on nuclear energy started rising (Interviewee 6). Only when the actual building of nuclear power plants on Belgian soil was initiated, protests started to arise in the 1970s (Laes et al., 2007). The event of nuclear disasters, like the nuclear disaster of Chernobyl in 1976, made the public more aware of the possible implications of Belgian nuclear energy production on their safety (Interviewee 11). In the 1980s, the debate evolved to consider more and broader aspects of energy policy, such as political and economic implications (Laes et al., 2007). Implications of nuclear waste and the proliferation risk started sprouting as well. From 1990 until 2003, aspects of sustainable development and potential nuclear related risks of terrorism entered the debate too (Laes et al., 2007). In 2002, the year before the law of nuclear phase-out was implemented by the Belgian government, only 7% of the Belgian population believed nuclear

energy would be the most affordable source of energy, while 44% believed that to be true for renewable energy sources (Laes et al., 2007, p. 165).

In December 2011, around the middle of the examined timeframe of this thesis, the external event of the nuclear disaster of Fukushima put nuclear power back on the political agenda (Interviewee 4), negatively affecting its reputation (Interviewee 8). This disaster led to the rise of awareness on the safety risks tied to nuclear, shifting the public opinion away from nuclear energy (Interviewee 4, 6, 8, 9 & 11). Interviewee 4 discussed another element that spurred unrest on the safety of nuclear power plants in the public opinion; in Dutch called the '*scheurtjesreactoren*'. This can be translated as '*reactors with little rips*'. The nuclear reactors *Tihange 2* and *Doel 3* both closed down in 2012 until 2015, to examine their safety as little rips had been detected in the walls of the power plants (VRT NWS, 2022). In 2017 again, *Doel 3* needed to close down for 9 months. In 2014, there were signs that *Doel 4* would have been sabotaged from the inside out, also increasing mistrust in whether this technology could safeguard the public's safety (Interviewee 4). A couple years later however, awareness of safety risk decreased and the public opinion started moving more in favor of nuclear energy again (Interviewee 2 & 4). Some reasons for this find their roots in changed socio-economic conditions, as described in the section below.

5.2.4. Changed socio-economic conditions

In 2014 the Crimean war led to some energy shortages, and was referred to by Interviewee 7 as "*a big supply problem that was a fantastic enabling element, where I immediately saw an opening window that we tapped into*". Energy shortages in 2014 led to the extension of nuclear power plants again (Interviewee 7). This seemed to shift the public opinion to become more favorable or at least tolerant towards nuclear energy. Most people want their energy supply in an affordable way secured, and are less occupied with where that energy would be coming from (Interviewee 1).

When Russia invaded Ukraine in February of 2022, European *socio-economic conditions* changed as the dependence on Russian gas was tangible and energy prices in Belgium skyrocketed (Interviewee 1, 2 & 7). According to these policy-makers, the fear for energy security and affordability shifted public opinion in favor of nuclear energy production on Belgian soil (Interviewee 1, 2 & 7). Some see this extension rather as a short term necessary measure, accompanied with the acceleration of the energy transition (Interviewee 11). Others interpret the extension of two nuclear power plants until 2035 as a sign that nuclear energy will always be a necessity (Interviewee 2, 7 & 9). Interviewee 2 called the war in Ukraine an "*eye opener*" for many people, on the insurmountability of nuclear energy for the future. The climate urgency and the need to decarbonize quickly would have shifted public opinion favoring nuclear energy too (Interviewee 9). Interviewee 12 spoke of a "*Nuclear renaissance*", referring especially to the technology of Small Modular Reactors (SMRs) that a growing number of people would have their hopes up for.

5.3. Policy subsystem

The subtract co-occurrence network will be the first network to be described in the results chapter, as it grants an immediate visualization of how the political parties relate to each other on the topic of nuclear energy. Figure 4 is the visualization of the matrix as derived from the *Discourse Network Analyzer* software that can be consulted in **Appendix F**.

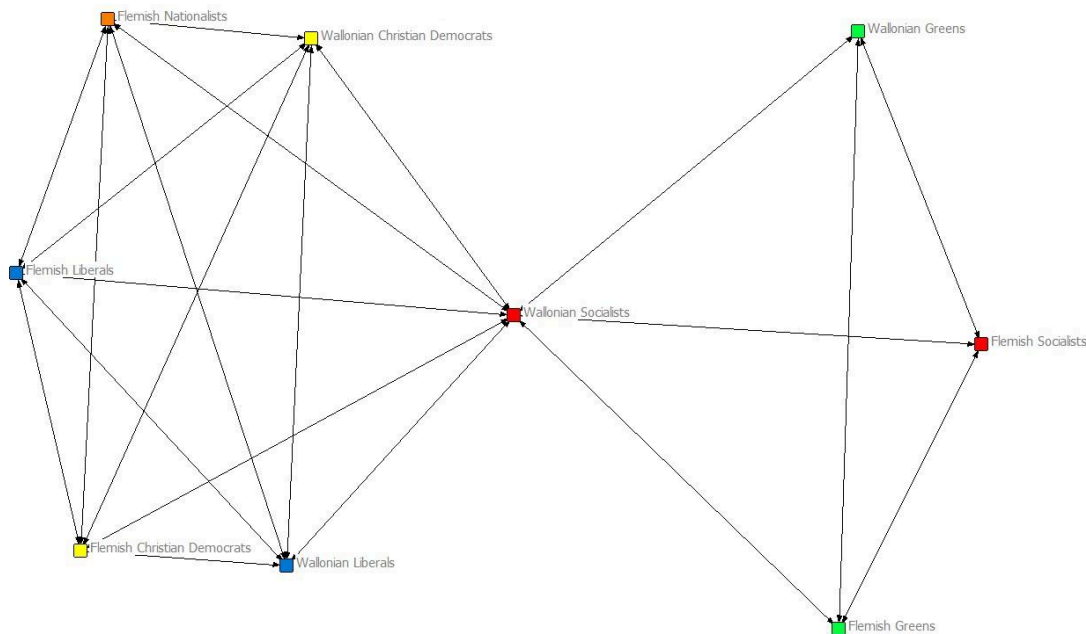


Fig. 4: Co-occurrence subtract network, excluding duplicates⁴.

From this network, an immediate distinction can be derived between two groups. The Liberal Democratic and Christian Democratic political families alongside the Flemish Nationalists and Wallonian Social Democratic party on the one hand, the Green and Social Democratic political families on the other. Despite the Wallonian Socialists as the central node, at first glance, the policy subsystem on Belgian nuclear energy appears divided along the political spectrum of left and right.

An arrow between two policy participants appears in the network when they score positively in the co-occurrence subtract network, meaning the amount of times they share a stance on nuclear energy surpasses the amount of times they do not (Leifeld, 2013). The highest scores of co-occurrence between political parties in the network is 5.00, shared by both the Christian Democratic political family and the Wallonian Liberal Democrats on the one side and by the Greens and Flemish Social Democratic party on the other (**Appendix F**). These last three parties each share the lowest score of co-occurrence with the Flemish Nationalist party: -2. What this means will be explained in further detail in this chapter, by adding in findings from the other data.

In table 4, the results from the discourse network analysis are portrayed in an affiliation network, Both the absolute (black) and relative (gray) combined scores are included. What

⁴ In this figure, 'Socialists' refer to the Social Democrats and 'Liberals' to Liberal Democrats.

these results tell us about these policy participants and the advocacy coalitions is described below.

	green			safe			secure			affordable			TOTAL comb.	phase-out		
	yes	no	comb.	yes	no	comb.	yes	no	comb.	yes	no	comb.		yes	no	comb.
Flemish Christian democrats Election programs: 4	2	4	-2	3	7	-4	8	2	6	7	3	4	4	5	8	-3
			-0,5			-1			1,5			1	1			-0,75
Wallonian Christian democrats Election programs: 2	10	6	4	2	8	-6	9	2	7	3	2	1	6	5	6	-1
			2			-3			3,5			0,5	3			-0,5
Flemish Liberal democrats Election programs: 4	1	2	-1	1	0	1	1	3	-2	0	3	-3	-5	2	3	-1
			-0,25			0,25			-0,5			-0,75	-1,25			-0,25
Wallonian Liberal democrats Election programs: 4	5	5	0	1	4	-3	10	2	8	6	3	3	8	4	11	-7
			0			-0,75			2			0,75	2			-1,75
Flemish Social democrats Election programs: 2	0	4	-4	0	3	-3	0	3	-3	0	6	-6	-16	3	0	3
			-2			-1,5			-1,5			-3	-8			1,5
Wallonian Social democrats Election programs: 3	0	5	-5	1	5	-4	1	8	-7	0	9	-9	-25	4	1	3
			-1,67			-1,33			-2,33			-3	-5			1
Flemish Nationalists Election program: 1	3	2	1	1	1	0	4	0	4	1	0	1	6	2	5	-3
			1			0			4			1	6			-3
Flemish Greens Election program: 1	0	2	-2	0	4	-4	0	2	-2	0	7	-7	-15	4	0	4
			-2			-4			-2			-7	-15			4
Wallonian Greens Election program: 1	0	2	-2	0	3	-3	0	1	-1	0	4	-4	-10	3	0	3
			-2			-3			-1			-4	-10			3
Total			-11			-26			10			-20				-2

Table 4: Affiliation network from the discourse Network Analysis

5.3.1. Advocacy Coalition A: against phase-out

In this subchapter, the analysis of the advocacy coalition that is opposed to nuclear phase-out in Belgium will be described. The evolution of policy participants that represent this coalition and their beliefs are discussed, as well as the resources this coalition has been able to draw from and the strategies they used for advocating on their shared beliefs.

5.3.1.1. Policy participants

Political parties on the right wing, more conservative side of the political spectrum in Belgium appear to have a more positive outlook on nuclear energy. Derived from the affiliation network, the only political party with positive combined scores across all four of the nuclear techno-optimist statements, is the Flemish Nationalist *N-VA* (table 4). This leads to a high score of 6 in the total combined balance, only based on the Flemish Nationalist party program of 2014. The Wallonian Christian Democrats end up with an absolute total combined score of 6, resulting in a relative total combined score of 3. Across all four of its party programs, *MR* ends up with an absolute combined score of 8, culminating to a relative total combined score of 2 for the Wallonian Liberal Democrats. The Flemish Christian Democrats of *CD&V* are the last party with a positive total combined score, amounting to 4 in absolute and 1 in relative terms (table 4). These positive combined scores indicate the presence of nuclear techno-optimism in these parties' policy core beliefs. Complemented with negative combined scores of all these parties in their stances on nuclear phase-out, it can be derived that all four of these parties have a rather optimistic outlook on nuclear energy and are opposed to nuclear phase-out.

The results derived from the semi-structured interviews confirm these observations too. The Flemish Nationalist party *N-VA* and the Wallonian party of Liberal Democrats *MR*, the two parties on the most right-handed side of their respective electoral spectrums, have been the most constant in their opposition to nuclear phase-out (Interviewee 2, 3 & 6). According to Interviewee 2, in 2011-2012 only the far right party *Vlaams Belang* would have still agreed with *N-VA*'s opposition to nuclear phase-out, while according to Interviewee 7 *MR* would have been the only party remaining to advocate for nuclear power in 2014. Interviewee 3 concludes that since 2014, both parties have had similar optimistic stances on the role of nuclear energy in Belgium.

In oftentimes less outspoken ways, the political family of Christian Democrats has been part of this advocacy coalition too. Historical roots in the Belgian nuclear landscape, as its former ministers have been involved in the construction and development of nuclear power plants, as described by Interviewee 9, might be one explanation. Backed by scientific studies, today *Les Engagés* do not believe that pushing for nuclear phase-out would be necessary or beneficial (Interviewee 9). The Flemish Christian Democrats of *CD&V* call the Wallonian Liberal Democrats their "*biggest ally*" in their stance on nuclear energy (Interviewee 1). *CD&V* and *MR* have uninterruptedly been in government together since 2007. Government coalitions and their coalition agreements can sometimes lead political parties to act deviantly on a policy issue than their own policy beliefs prescribe (Interviewee 1, 9 & 10). Despite

sharing the same ideology, the Wallonian and Flemish Christian Democrats have not always shared the same views on nuclear energy, as will be described in the next section. Participation in the government coalition seems to be a determinative factor for that among the Christian Democrats.

The Flemish Liberal Democrats lastly, have been even more ambiguous in their stance on the matter. Despite appearing negatively oriented towards nuclear techno-optimist statements, the party ended up with a negative combined score on statements of nuclear phase-out too (Table 4). *Open Vld*, a party that also has participated in every government coalition since 2003, has never extensively elaborated on nuclear energy in its party programs. According to Interviewee 1, this party, along with the Flemish Social Democrats, has always acted in unpredictable ways on the topic. Explanations for that might be found in the fact that both parties participated in the *Verhofstadt I Government* that implemented the law for nuclear phase-out in 2003. The anecdote of Prime Minister De Croo of *Open Vld* contradicting his own coalition agreement by signaling pro-nuclear narratives for personal gain has been mentioned by Interviewee 2 and 6. Motives of political parties to advocate against or in favor of nuclear phase-out can thus differ and appear to depend on factors that exceed their shared beliefs alone. Based on the co-occurrence subtract network (fig. 4) however, *Open Vld* can be counted into the advocacy coalition against nuclear phase-out.

Aside from political parties, the advocacy coalition against nuclear phase-out includes non-political policy participants too. Actors that agree with *MR* and *N-VA* in their opposition against nuclear phase-out have been described as ‘*an alliance of ecomodernists*’ by Interviewee 6. Certain energy companies, lobby organizations, knowledge centers, universities, professors and journalists would make up an informal coalition that upholds nuclear power in Belgium (Interviewee 5 & 6).

5.3.1.2. Policy beliefs

The most recurring argument against nuclear phase-out boils down to the following: it would not be possible to transition towards a 100% renewable energy mix in time to meet the climate goals, without jeopardizing Belgium’s energy security and affordability. The degree to which nuclear energy would be indispensable in the Belgian energy mix varies across policy participants.

Among *N-VA*, *MR*, *Les Engagés* and *CD&V*, ‘secure’ is the category yielding the highest combined score across the four categories (Table 4). As these four parties form the core of the advocacy coalition, it can be derived from the affiliation network that energy security would be their primary argument against nuclear phase-out. Nuclear energy should not be phased-out, as renewable energy would be unreliable (N-VA, 2014; MR, 2007; MR, 2010) and “*its potential is not endless*” (MR, 2007, p. 252), especially given the geography of Belgium (MR, 2010; Interviewee 7). While fossil fuels are not inexhaustible either, this advocacy coalition agrees it would be best to keep the energy mix as diversified as possible, actively including nuclear energy as long as there is no viable alternative (CD&V, 2007; 2010 & 2014; MR, 2010; N-VA, 2014).

In 2007, the Wallonian Christian Democrats criticized the previous government's lack of a strategy for the energy field and advocated for the realization of nuclear phase-out (cdH, 2007, p. 131). After having been part of the governing coalition themselves from 2007 until 2010, the sentiment had turned completely to nuclear energy being indispensable for Belgian energy security in the mid-long term (cdH, 2010). *CD&V* and *MR* seem to have made a turn in the opposite direction in the last few years. Despite opposition at first, by 2019, both parties had included support for the nuclear phase-out law of 2003 in their election programs (CD&V, 2019; MR, 2019). *MR* advocated for the support of alternatives to nuclear energy like renewables, flexible mechanisms for storage and demand, and activating more gas power plants to achieve this (MR, 2019, p. 112), while CD&V (2019) highlighted the compatibility of gas power plants with the flexible nature of renewable energy too.

Arguments within this advocacy coalition vary from nuclear power being referred to as “*not the eighth world wonder*”, yet “*a bad for a good*” (Interviewee 9) to a source of energy “*essential for our economy*” (Interviewee 3). According to Interviewee 3 and 7, nuclear power would be the most affordable source of energy, benefiting the profits of enterprises and purchasing power of households. The fear of energy insecurity without nuclear energy production in Belgium has transformed into a fear of insecurity of the accompanying low energy prices (CD&V, 2007; 2010; 2014). This fear of lack seems to specifically apply to industrial actors. “*Our energy-intensive industry is among the world's best in terms of energy efficiency. However, it requires sufficient baseload electricity. Its availability is a crucial requirement for the further phase of the nuclear phase-out*” (CD&V, 2014, p. 56). As Belgian research and knowledge on nuclear technology belongs to the world top, for economic reasons this knowhow should not be lost and should thus be invested in (CD&V, 2019). A slight disagreement about the degree to which nuclear energy would be needed and for what reasons can thus be observed within the advocacy coalition. Yet, a consensus seems to exist that nuclear energy to a lesser or more extent would be needed to meet the country's energy needs in an economically responsible way.

Some policy participants in this advocacy coalition do not differentiate between renewable and nuclear energy sources in terms of how ‘*green*’ they are, as both ways of energy production are not emitting CO₂ (Interviewee 7). Nuclear phase-out would lead to the use of carbon emitting gas for substitute electricity production (Interviewee 2; MR, 2014). At the rate Belgium has been decarbonizing, the country already is not meeting its goals and would thus never be able to achieve them while at the same time divesting from nuclear energy (Interviewee 7 & 9). There are however policy participants within this advocacy coalition that point out the issue of nuclear waste that comes with nuclear energy production, indicating it as a problem (Interviewee 1 & 9). Yet this advocacy coalition seems to deem the issue of nuclear waste an inferior problem to other energy issues of security, affordability and decarbonization, as “*100% safety never exists*” (Interviewee 1).

“100% safety never exists” (Interviewee 1).

Safety is not very explicitly discussed by this advocacy coalition, but is assumed to be the number one priority for everyone involved, referred to as “*condition zero*” by Interviewee 1 for nuclear energy production to be possible in Belgium. Safety assessments are made by

the independent federal agency for nuclear control *FANC*⁵ and should be strictly followed by policy-makers (Interviewee 1 & 2). Nuclear safety is believed to be a strictly technological, non-political matter. Questions on the safety of nuclear power plants and risks of nuclear disasters from the coalition advocating in favor of nuclear phase-out have been called “easy *populism*” by Interviewee 3. Political decisions to close down certain nuclear power plants for safety reasons have been questioned by some university experts and the energy engineering bureau *Tractebel*. The criticism has risen from this advocacy coalition that these shutdowns of nuclear power plants would have happened for political reasons rather than technological ones (Interviewee 9).

The policy participants of this advocacy coalition envision an equal distribution of Belgium’s energy mix; running half on nuclear and half on renewable energy (Interviewee 1 & 2). In the mid-long term, by 2035, new models of nuclear power plants should be built that are resistant to any outside threat, considering incidents, terrorism and cyber security (Interviewee 9). From 2040 onwards, Small Modular Reactors (SMRs) should be available, due to technological development (Interviewee 1 & 9). In the longer term, beyond 2050, the energy mix might shift towards higher percentages of renewable energy than nuclear energy (Interviewee 2 & 9). Some policy participants believe that new nuclear technology might develop to become a renewable source of energy itself, as the fuel cycle of uranium might become circular (Interviewee 9). In any case, this coalition believes in the potential of technological development of nuclear technology, advocating that the needed investments in its research and development should be made. Remarkably however, one of the most pro-nuclear political parties has stated that an eventual nuclear phase-out would be indispensable, and to be realized by 2065 (N-VA, 2014). This should grant the authorities enough time to eventually transition towards renewable energy. In the short to mid-long term however, currently operational power plants should be prolonged and new nuclear power plants should still be built (N-VA, 2014).

5.3.1.3. Resources

Although affairs of energy policy are progressively being transferred to the supranational levels of policy-making, like the EU, the *formal legal authority* of energy security and nuclear energy production remain matters of the national policy-making level (Interviewee 7 & 11). This can be a useful resource for political parties that are successful in elections and oftentimes are a part of the governing coalition.

In terms of *information* as a resource, policy participants are able to refer to studies on why nuclear energy should not be phased out too quickly (Interviewee 2, 7 & 9).

The biggest resource for this advocacy coalition, seems to be that of *public opinion*. For the general public, the priority of energy policy would be for *‘the light to stay on’* (Interviewee 1 & 2). Energy is a complex technical policy domain, just as much as it is a part of people’s daily lives (Interviewee 8 & 9). Arguments of energy security and affordability are the ones that seem to affect public opinion on energy the most, as people just want energy *‘to be there*

⁵ Federal Agency for Nuclear Control: Authority on nuclear safety & protection against nuclear radiation (FANC, 2023, May 9th).

and for it to be affordable" (Interviewee 1). How that energy has been produced is of secondary importance for the general public, according to Interviewee 1, especially since the most recent energy crisis of 2022. These two most tangible concerns of energy security and affordability are the two main arguments used by this advocacy coalition against nuclear phase-out. The urgency of the climate crisis and the fact that nuclear energy production is assumed carbon neutral, is an additional argument leading public opinion to turn wary of nuclear phase-out (Interviewee 9).

The general public that primarily cares about their energy security and affordability, can be labeled as *mobilizable troops*. Lobbying hard on all levels, *Nuclear Forum*⁶ has attempted to mobilize everyone, from policy-makers to the public opinion, to favor nuclear energy and thus oppose nuclear phase-out (Interviewee 8). Specific strategies will be discussed in the next section.

Finally, there are the *financial resources* that can help this advocacy coalition reach its goals. There is a lot more to be said about this than the scope of this research allows. From the interviews, it can be derived that big industries, interest and lobby groups are involved advocating in favor of nuclear energy and in opposition to its phase-out (Interviewee 4, 6 & 8).

5.3.1.4. Strategy

Coalition A seems to have advocated for its beliefs in well-considered, strategic ways. It already starts with semantics, as Interviewee 6 introduces the concept of "*nukespeak*". By naming the byproduct of nuclear energy production "*irradiated nuclear fuel*" instead of "*nuclear waste*" for example, the idea that this byproduct could be recycled one day can gain traction (Interviewee 6). Through small openings like these in language, ambiguity can find its way into the debate, leading to doubt and uncertainty on the factual knowledge.

"*Strategic ambiguity*" would also be used by this coalition (Interviewee 6). On safety issues for example, some of these policy participants would claim to be pro-nuclear for civic use, but explicitly opposed to nuclear weapons. This distinction would be hard to make according to Interviewee 6, as will be explained in further detail later on. Ambiguity is spotted in party programs too; as some parties, for example the Flemish Liberal Democrats, communicate their stances on nuclear energy in less clear ways than others.

Other ways of convincing policy participants of nuclear energy's safety, as done by *Nuclear Forum*, is by organizing guided tours in the nuclear power plants for Members of Parliament (Interviewee 8). Interviewee 6 refers to the general communication by the *Nuclear Forum* as "*masterful propaganda*". "*There is no need to beat around the bush: Nuclear Forum, the lobby organization, poses nuclear energy as the fantastic silver bullet for the energy issue*" (Interviewee 8).

"Those who could undermine it, are marginalized" (Interviewee 6).

⁶ Interest group for nuclear technologies, active in Belgium.

Beyond trying to influence the debate, there have been reports from Interviewees of attempts to shut the political debate down. Policy participants advocating to phase nuclear energy out have been framed as “*anti-innovation*” and “*anti-progress*” (Interviewee 6). Risk aversion to nuclear energy is then portrayed as aversion to economic progress and prosperity, which would make advocating against nuclear energy advocating against stability (Interviewee 6). Policy participants advocating for nuclear phase-out for the sake of safety have indeed been called “*populist*” (Interviewee 3), “*emotional*” and “*irrational*” (Interviewee 9). These untruthful narratives would essentially manipulate and end an open democratic debate (Interviewee 6).

During the interviews, a couple of examples have been shared where this advocacy coalition would have manipulated the debate by tweaking the truth. In 2021, the *Superior Health Council* of Belgium published an expert report on the sustainability of nuclear energy, concluding that nuclear energy does not meet the criteria of sustainable development (Hoge Gezondheidsraad, 2021). One hour after publication, the report had been delegitimized by pro-nuclear experts, leading to the report not being picked up even in the scientific field, let alone in the broader spheres of public opinion (Interviewee 6). In the process of trying to influence policy, this coalition seems less respectful towards democratic structures and processes; delegitimizing other policy participants and decisions that have been democratically made that oppose their own stances.

Finally, “*there are tactics too that make people collectively forget things*”, briefly referring to the study of “*agnotology*” (Interviewee 6). Failed nuclear programs, or cooperation with nuclear states are intentionally being overshadowed with positive or hopeful nuclear news (Interviewee 6).

“*The right-wing and the conservatives have persistently campaigned around nuclear energy. I believe this does have an impact on the social support for nuclear phase-out*” (Interviewee 4). Derived from the interviews, advocacy coalition A seems to be better organized and strategized to influence nuclear energy policy-making, enabling itself to set the agenda and the tone of the debate. This seems to make them more effective than advocacy coalition B.

5.3.2. Advocacy Coalition B: in favor of phase-out

5.3.2.1. Policy participants

Derived from the co-occurrence and affiliation network, the Greens and Social Democrats seem to be the most opposed political families regarding nuclear energy. For each of the four techno-optimist statements, their party programs displayed a negative combined score. All four of these political parties also yielded positive combined scores on the statement in support of nuclear phase-out. Both of these findings thus signal wariness towards nuclear energy and a preference for nuclear phase-out. Ultimately, despite scoring negatively on the statement for nuclear phase-out (relatively -0,25), *Open Vld* is the last political party with a negative combined total score (relatively -1,25) for nuclear techno-optimism.

Data derived from the semi-structured interviews complements and confirms abovementioned dynamics: the advocacy coalition in favor of nuclear phase-out especially comprises political parties on the left, more progressive side of the political spectrum

(Interviewee 3, 7 & 8). The Greens especially have been the driving force behind nuclear phase-out since they imposed the law in the *Verhofstadt I Government* in 2003 (Interviewee 1, 2, 7 & 8). According to Interviewee 8, it would be tangible when the Greens are not in government, as then, the push for nuclear phase-out diminishes drastically.

Yet, oftentimes the Greens would be able to count on the support of Social Democrats (Interviewee 4 & 11), and to a lesser degree, the Flemish Liberal Democrats (Interviewee 1, 4 & 8). The historical roots of Social and Liberal Democrats in the *Verhofstadt I Government*, that implemented the law of nuclear phase-out in 2003, might play a role in that (Interviewee 4). At times, *CD&V* has been working to phase-out nuclear energy from the Belgian energy mix (Interviewee 7 & 8). Even *MR* has at times signaled to be favoring nuclear phase-out. The previous Belgian Prime Minister Charles Michel (*MR*) for example, had expressed opposition to nuclear energy in 2019, despite the stance of his own party, as he aspired to become the next president of the Council of the European Union (Interviewee 7). In 2017 *MR* as a party had made a U-turn in their stance on nuclear energy, from then on favoring nuclear phase-out. Allegedly this had been decided on for electoral reasons, to find rapprochement to the Greens, according to Interviewee 3.

In 2012, in the aftermath of Fukushima, all parties, except for *N-VA* and the far right *Vlaams Belang* favored nuclear phase-out (Interviewee 2 & 4). "On what planet does *N-VA* live?", was a question that would have been raised by the then Social Democratic Prime Minister (*PS*), as the Flemish Nationalist party had proposed to investigate possibilities for new nuclear power plants at the time (Interviewee 2). This shows that in that period of time, a consensus existed that there are risks tied to nuclear energy production that need to be considered.

While the political debate on nuclear energy seems polarized, more policy participants might agree with the idea of nuclear phase-out than it might look like at first sight, according to Interviewee 11. Since the law of 2003 had been accepted through the legitimate democratic processes in place, following governments have agreed to make their policies in accordance with this law (Interviewee 11).

Civil society actors like the green movement and climate and environmental organizations are convinced nuclear phase-out and a 100% renewable energy mix in Belgium is possible (Interviewee 2 & 11). Interviewee 4 adds however that the green, environmental movement at large and the anti-nuclear movement in particular have never been very powerful in Belgium. On top of that, within the green movement a shift has happened from a focus on environmental to prioritization of climate issues, deprioritizing the issue of nuclear energy (Interviewee 4).

Other non-political policy participants in this advocacy coalition reported on by the Interviewees are some researchers (Interviewee 6 & 9) and the renewable energy sector (Interviewee 11).

5.3.2.2. Policy beliefs

The statement category with the lowest combined scores for Belgian Green and Social Democratic parties and the Flemish Liberal Democrats, has been the category of *affordability* of nuclear energy (table 4). In their election programs of 2007 and 2010, Social Democrats had already denounced the uneven distribution of costs and benefits between the Belgian energy consumer and the operator of the nuclear power plants (PS, 2007; s.pa, 2010). The costs to keep nuclear power plants operational have been borne by the public, while profits have been privatized by the operator (PS, 2019). In 2019, all of the four most left wing, progressive parties agreed that public money should no longer support fossil and nuclear energy, and should instead be invested in supporting the energy transition (Ecolo, 2019; Groen, 2019; PS, 2019; s.pa, 2019). “*We should no longer be wasting money to patchwork*” (Groen, 2019 p. 16) and phase-out nuclear energy as foreseen by 2025. This advocacy coalition agrees that the polluter pays-principle should be implemented, holding *Engie-Electrabel*⁷ financially accountable for the costs that come with nuclear energy production, instead of privatizing profits and collectivizing costs (Ecolo, 2019; Groen, 2019; PS, 2019; sp.a, 2019). One of the main arguments of *Open Vld* as to why nuclear energy would not safeguard energy affordability, is that the monopoly position of the nuclear energy producer *Engie-Electrabel* is blocking the free market (Open Vld, 2010).

“*This reduction in the cost of electricity production [due to nuclear power plants being operative for longer than initially planned] did not translate into a reduction in the price offered by energy suppliers, but rather into an increase in their profits*” (PS, 2007, p. 124).

In the semi-structured interviews as well, the *affordability* of nuclear energy was a resurfacing argument for nuclear phase-out. Firstly, the construction of nuclear power plants had appeared to be unexpectedly expensive (Interviewee 5, 6 & 11). New nuclear power plants constructed in Finland and France have exceeded their initial budgets respectively with a factor of 3 to 5 (Interviewee 5), leading to accumulated excesses of 15 billion euros (Interviewee 11). Furthermore, processing uranium to become suitable nuclear fuel is expensive too (Interviewee 5). Ultimately at the end of the fuel cycle, managing nuclear waste is a long term project with a big price tag (Interviewee 9). Due to costs of maintenance, the longer nuclear energy is being produced, the more expensive it gets, while in the meantime, higher production of renewable energy has been leading to ever lower energy prices (Interviewee 5, 6, 8 & 11). The nuclear operator *Engie-Electrabel* would be planning to quit producing nuclear energy as it has gotten too expensive and too risky (Interviewee 6, 7 & 9). This indicates nuclear energy to indeed not be the most cost-effective way of producing energy. The Flemish Liberal Democratic party too believes an eventual phase-out of nuclear energy would economically be the most beneficial (Interviewee 8). Even the otherwise very pro-nuclear *N-VA* has voted against the extension of a nuclear power plant in the past, as the consequences for the government’s budget would have been too disadvantageous and unclear (Interviewee 2).

Besides the high costs tied to nuclear energy production as summed up above, Interviewee 4 explains how the real cost of nuclear energy is unclear, and has never been communicated

⁷ the Belgian branch of the French energy multinational Engie, providing energy & operating the nuclear power plants in Belgium.

in transparent ways. Claims on the affordability of nuclear energy remain unproven and thus uncertain (Interviewee 6). The cost of the current extension of the youngest nuclear power plants *Doel 4* and *Tihange 3* for example, still remains uncertain (Interviewee 6). Yet what is certain, is that a lot of tax-payer's money goes to nuclear research projects (Interviewee 4) and that in the end, it is the Belgian state and thus the Belgian taxpayer that will end up with the bill (Interviewee 12).

On top of the extra costs, it has taken longer than expected to build new nuclear power plants in France, Finland and the USA. These delays easily accumulate to 15 years (Interviewee 11). Whether and when the new models of Small Modular Reactors (SMRs) will be built, is still uncertain too (Interviewee 5 & 6). As has been discussed in the previous section on advocacy coalition A, for several policy participants within this subsystem, *energy security* is the biggest priority and guideline in their energy policy-making. This has led them to be unwilling to 'risk' the phase-out of nuclear energy production in Belgium (Interviewee 1 & 2). As the capacity of renewable energy and interconnectivity with neighboring countries has grown over the years, some policy participants have started to shift their perspectives on this (Interviewee 1). Interviewee 11 drew in the example of *Tihange 3*, that has not been operational in March and April of 2024 due to unforeseen issues. "*The first question always is: 'will that be an issue for our energy security?' and here the answer is, quite the contrary*" (Interviewee 11). The absence of the nuclear baseload provided by *Tihange 3* would now leave room for European renewable energy to enter the grid in Belgium as well (Interviewee 11).

A broad consensus is shared between many policy participants across the policy subsystem that nuclear waste is a problem yet unsolved (Interviewee 1, 4, 6, 8, 9 & 11). While some members of the advocacy coalition against phase-out say there is a solution for nuclear waste storage and management, the coalition favoring phase-out believes that geological storage only postpones damage, outsourcing the problem to nature and next generations (Interviewee 1, 8 & 11). Contrary to certain pro-nuclear policy participants, this advocacy coalition also does not believe that nuclear waste could ever become recyclable (Interviewee 6 & 8). "*The waste could be reprocessed once, maybe twice, but that's it. There is no such thing as a closed uranium cycle*" (Interviewee 6). One policy participant summarized that carbon neutrality does not automatically equal sustainability, and that it thus is questionable if nuclear energy really is a 'green' source of energy (Interviewee 8).

Another argument why nuclear energy would not be *green*, is that uranium mining is polluting to the environment (Interviewee 8) and has historically been extracted in unfair ways, referred to as "*grabbing*" from former 'Belgian Congo' (Interviewee 11). This argument connects to the hidden costs of nuclear energy production and shines a light on the social aspect of sustainability that does not seem to be considered by advocacy coalition A.

Finally, advocacy coalition B seems to think and talk more explicitly about the *safety* risks tied to nuclear energy production, both in daily management as in cases of possible emergencies. After the nuclear disaster of Fukushima, international safety measures for nuclear power plants had been increased. The Belgian nuclear power plants built before the nuclear disaster would be incapable of meeting these stricter criteria, according to Interviewee 11. After the nuclear disaster of Fukushima happened and awareness on nuclear safety rose, the subcommission on nuclear safety of the Belgian Parliament

discovered after closer investigation that the governance structures in place for safety monitoring and nuclear waste management in Belgium have been operating in inadequate and insufficient ways (Interviewee 8).

“It has been technology on nuclear power for civic use that ultimately led to the creation of the atomic bomb” (Interviewee 11).

Lastly, another topic of *safety* that has not been discussed by advocacy coalition A, is the risk of nuclear proliferation. Policy participants from advocacy coalition B raised the argument that no division can be made between the development of nuclear technology for civic and military use; the development of nuclear energy and nuclear weapons (Interviewee 6 & 11). Interviewee 6 referred to a speech of pro-nuclear French president Emmanuel Macron, when he visited a specialized French factory for nuclear components in 2020, proclaiming himself: *“Sans nucléaire civil, pas de nucléaire militaire, sans nucléaire militaire, pas de nucléaire civil”* (Le Monde, 2020). The knowledge produced on nuclear technology for electricity generation would be shared with the military and vice versa, making the nuclear energy industry and the military interdependent. This would even economically benefit the military industry, as they would need to invest less of their military budgets in research and reactors themselves (Interviewee 6). This sectoral interdependence in a globalized economy quickly transcends borders, creating interdependence between countries with nuclear expertise, like France and Russia (Interviewee 6). This way, safety concerns regarding nuclear technology take on geopolitical aspects as well.

“French nuclear energy, the model, cannot function without cooperation with the Russians” (Interviewee 6).

In the end, this advocacy coalition agrees that in different aspects, there are hidden costs tied to nuclear energy production that can be avoided by phasing-out of nuclear energy.

5.3.2.3. Resources

In terms of *formal legal authority*, this advocacy coalition benefits from the Belgian legal framework, where the law of 2003 is in place, imposing nuclear phase-out. On top of that, especially international agreements, directives and regulation appeared to be helpful resources for nuclear phase-out in terms of safety measures and nuclear waste management (Interviewee 11).

Information could be a helpful asset for the advocacy coalition too, as according to some policy participants, knowing the facts should suffice to understand why nuclear energy should be phased out (Interviewee 5, 6 & 11). One example is the fact that the renewable energy sector has been growing stronger against the nuclear lobby, due to the lower prices of its renewable energy production (Interviewee 5, 8 & 11). However, the lack of correct information can also be a constraint for this advocacy coalition. There is a widespread lack of knowledge on this complex issue in society; among citizens (Interviewee 8), journalists (Interviewee 5 & 6) and politicians (Interviewee 6 & 12), constraining developments in energy policy-making based on these facts. Also within the green movement, knowledge on nuclear energy has been diminishing (Interviewee 6).

How facts are portrayed by the media plays an important role in the perception of nuclear energy by citizens and businesses in Belgium (Interviewee 5 & 6). Certain newspapers have been communicating on nuclear energy in more factual and transparent ways on nuclear technology, helping to shift the *public opinion* in favor of nuclear phase-out (Interviewee 6). The biggest shift in public opinion favoring nuclear phase-out happened in 2011-2012, after the external event of the nuclear disaster in Fukushima (Interviewee 4, 8 & 11).

Some *mobilizable troops* of this advocacy coalition are the green and environmental movement (Interviewee 2, 4 & 11) and the renewable energy sector (Interviewee 11). As was mentioned before, within the green movement however, over the years a shift in focus from environmental issues to climate issues has occurred, bringing the topic of nuclear energy more to the background (Interviewee 4).

Advocacy coalition B finally does not have access to the same *financial resources* as advocacy coalition A. The non-political policy participants in this coalition are mostly citizens organized in movements (Interviewee 4, 6, 11), while advocacy coalition A is backed by lobbyist organizations (Interviewee 6 & 8). On top of that, there are more political parties to be found in advocacy coalition A than B, and the parties of advocacy coalition A tend to do better in elections than those in advocacy coalition B. Election results define the party's budgets, affecting their financial resources and power.

5.3.2.4. Strategy

Advocacy coalition B seems to be less strategically substantiated than their opponent. Firstly, the politicization of the nuclear issue by the green movement has been diminishing over the years (Interviewee 4). Despite being supported by the legal framework and having factual proof at hand, policy participants in favor of nuclear phase-out oftentimes find themselves in a defensive rather than offensive position in the political debate, as a consequence of the strategic approach by the opposing advocacy coalition, as described above. The awareness advocacy coalition B attempts to bring to the general public on the safety risks tied to nuclear energy production for example, have been portrayed by the opponents as "*easy populism*" (Interviewee 3).

Yet, the coalition has achieved some wins in attempting to phase-out nuclear energy. "*Back door diplomacy*" across parties from the majority and opposition for "*rational arguments*" in 2007 (Interviewee 8) has led to some breakthroughs. This has happened in cooperation with parties that are more on the fence on the topic, that may agree with the aim of nuclear phase-out, but might be afraid of the electorate in openly communicating on it (Interviewee 5 & 8).

5.3.3. Policy broker

A policy broker is a compromising policy participant, respected by both coalitions with a certain degree of decision-making authority (Weible & Sabatier, 2006), and is thus assumed to carry a certain level of objectivity.

“It does not exist in Belgium. There is no independent institution [for knowledge production on nuclear technology]” (Interviewee 6).

Objectivity however appears to be a fundamental obstacle in the political debate on nuclear energy. “A *debate assumes objective knowledge*” (Interviewee 5), which according to Interviewee 5, is lacking. Interviewee 6 agrees, explaining that there are experts on elements of nuclear energy at Belgian universities, but there is no overarching independent knowledge institution gathering all knowledge. The double role of the pro-nuclear *Belgian Nuclear Research Center SCK-CEN* has been denounced by Interviewee 4 and 6.

The media play an important role in how information is perceived by the broader public and politicians. According to Interviewee 9, up until 2021 the media had been reporting on nuclear energy assuming phase-out was unavoidable, influencing public opinion and so too political decisions, despite the studies and figures demonstrating the possibilities of the technology. According to others again, the media and journalists have been leaving too much room for disinformation on nuclear energy to spread, because they lacked the knowledge to report on the matter in a correct way (Interviewee 5 & 6). Interestingly, media that is assumed to be neutral, have been criticized by both advocacy coalitions regarding subjectivity, yet in the opposite directions.

One policy broker discussed by several Interviewees, is the *Federal Agency for Nuclear Control (FANC)*; an independent governmental authority on nuclear safety, charged with the task to protect society from nuclear radiation (FANC, 2023, May 9th). This agency gives the green or red light on whether or not a nuclear power plant could safely become or remain operable (Interviewee 2). The importance for this authority to be able to act independently without being overruled by politics has been stressed by Interviewee 1. Interviewee 4 on the other hand criticized the lack of transparency by *FANC*, declaring blind trust in the agency to be dangerous. In the aftermath of the nuclear disaster of Fukushima in 2011, transparency by *FANC* had however improved (Interviewee 4). Finally, Interviewee 5 pointed out that the green light from *FANC* has at times been interpreted by politicians as a confirmation of the general feasibility of nuclear energy in the energy mix. It is however important to keep in mind that *FANC* only looks at the technicalities of safe operability of the Belgian nuclear power plants, not whether or not it would be the most feasible energy source available considering energy security, affordability and aspects of sustainability (Interviewee 5).

The *National Institute for Radioactive Waste and Enriched Nuclear Fuels (NIRAS)* operates in a similar way as *FANC*; they cannot express preferences in the political debate on nuclear energy and phase-out, yet they have an authority and responsibility on nuclear safety (Interviewee 6 & 12). *NIRAS* in particular is responsible for the safe management of nuclear waste (Interviewee 12). Despite its supposedly objective and neutral role in the policy subsystem, certain environmental organizations refuse to cooperate in its participatory projects regarding safe nuclear waste storage in Belgium (Interviewee 12).

A lack of trust among policy participants and a lack of truly objective policy brokers in this policy subsystem can be observed. This can be linked to the lack of objective knowledge and knowledge institutions available, as described before. The reflections of the two non-political policy participants that were interviewed for this thesis, went from “*I am not sure if politicians know all the facets to consider, when it comes to nuclear energy*” (laughs)

(Interviewee 12) up until “*I think people know that does not exist*”, referring to the Small Modular Reactors they are promoting (Interviewee 5). In any case, according to Interviewee 5, the academic debate would not be as heated and polarized as the political debate.

5.3.4. Decisions by Governmental Authorities

The intention to phase-out nuclear energy production appeared for the first time in Belgian politics in the coalition agreement of *Verhofstadt I*. The government agreed that after 40 years of service, nuclear power plants should be deactivated, no new reactors should be built and the development of alternative energy sources should be prioritized (Belgische Kamer van volksvertegenwoordigers, 1999, p. 7). On January 31st 2003, these intentions have been implemented into the nuclear phase-out law. As this law for nuclear phase-out had not been prepared, and was implemented right ahead of elections, it has been interpreted by certain parties of the opposition as a ‘stunt’ for electoral gains, a symbolic law (Interviewee 1).

As communicated by FANC on January 30th 2023, this is an overview of each of the seven nuclear power plants that have been operative in Belgium. For each power plant, table 5 provides insight into the year it started producing energy, its closing year as stated in the nuclear phase-out law (FOD Justitie, 2003) and, in case of policy changes since, its newly expected closing year.

	Starting year	Closing year (phase-out law 2003)	Actual (expected) closing year
Doel 1	1975	2015	2025 (amended in 2015)
Tihange 1	1975	2015	2025 (amended in 2013)
Doel 2	1975	2015	2025 (amended in 2015)
Doel 3	1982	2022	September 2022
Tihange 2	1983	2023	January 2023
Doel 4	1985	2025	2035 (amended in 2022)
Tihange 3	1985	2025	2035 (amended in 2022)

Table 5: Overview of the Belgian nuclear power plants starting and closing dates (FANC, 2023, January 30th).

Interviewee 7 referred to a first attempt to amend the 2003 nuclear phase-out law in 2009, where a Wallonian Social Democratic Minister of Energy was in place. The *Van Rompuy Government* had indeed negotiated and agreed on a ‘*protocol agreement*’ with the French energy company *Groupe GDF Suez*, now called *Engie*, on the extension of three nuclear power plants with 10 years (De Standaard, 2009). *Doel 1*, *Doel 2* and *Tihange 1* would be allowed to stay open until 2025, in exchange for an annual sum of 245 million euros every year; a share of the excess profits this would yield the operator, to be paid to the Belgian state (De Standaard, 2009; De Morgen, 2021). As the *Van Rompuy Government* had fallen due to disagreement on a reform of the state, this agreement had not been transferred into law in time to be enforced (De Morgen, 2021). In their party program for the following elections, the Flemish Social Democrats, that had not been part of the governing coalition, criticized this agreement negotiated by the previous government, as the deal would have been especially beneficial to the French energy multinational *Engie* and disadvantageous to the Belgian energy consumer (sp.a, 2010).

After a decade-long debate, the law of nuclear phase-out was amended for the first time in 2013. *Tihange 1* was agreed to be extended for 10 years, and thus planned to close down by October 1st 2025 instead of October 1st 2015 (FOD Justitie, 2013). This change was implemented by Wallonian Christian Democratic Minister of Energy Melchior Watelet in the *Di Rupo Government*, for reasons of energy security and affordability (Interviewee 9). Apart from making an exception for *Tihange 1*, the 2013 law adjustment went on to exclude the 40 years of nuclear power plant operationality rule from the phase-out law completely. On the other hand, regulations of an annual fee were added to the law, to be paid by the operator of *Tihange 1* to the Belgian state, in exchange for its extended term of production (FOD Justitie, 2013).

The context in which this policy change emerged has been elaborated on by Interviewee 9. More than 500 days after the elections of 2010, government negotiations were still going on. As time pressure for a government to be formed rose, the Wallonian Christian Democrats accepted to become part of a governing coalition that kept working towards nuclear phase-out by 2025 (Interviewee 9). “*It wasn’t so much a change of conviction, but rather a pragmatic need for compromise to form a government*”, according to Interviewee 9, for the Wallonian Christian Democrats to join the governing coalition. Delivering the Secretary of State on Energy, Melchior Watelet (*cdH*), the decision was made to extend only one nuclear power plant, *Tihange 1*, to stay operative until 2025 instead of 2015. This compromise was made to safeguard energy affordability and security in the short term, while working on complete phase-out by 2025, as foreseen (Interviewee 9). It was remarked by Interviewee 2 and 4 that this amendment to the phase-out law of 2003 happened again with Social Democrats in government, under a Wallonian Social Democratic Prime Minister.

Just as *Tihange 1* in 2013, in 2015 *Doel 1* and *Doel 2* have been extended in their operability with 10 years too (FOD Justitie, 2015). Although *Doel 1* had already been shut down earlier, in accordance with the nuclear phase-out law, the amendments of 2015 allowed the power plant to restart and operate for another decade. Again, this policy-change was implemented to safeguard energy security, this time by *Wallonian Liberal Democratic* Minister of Energy Marie-Christine Marghem after the 2014 winter of energy shortage (De Morgen, 2021). Prime Minister Charles Michel (*MR*) declared this extension to be “*important for the economy*” (in De Morgen, 2021). In this policy-change too, a share of the excess profits from

Doel 1 and *Doel 2* was agreed to go to the Belgian state (FOD Justitie, 2015). The share of the excess profits yielded from this extension paid to the Belgian state had been lowered, in exchange for *Engie* to invest in renewable energy (De Morgen, 2021). In 2016, the same government amended the nuclear phase-out law again, specifying the fee for the extension of *Doel 1* and *Doel 2* to be 20 million euros for every year between 2016 and 2025 (FOD Justitie, 2016, p. 37731).

After two Belgian environmental organizations had sued the extension of *Doel 1* and *Doel 2* in 2015, in 2020 the amended law had been deemed unlawful by the Belgian Constitutional Court (Grondwettelijk Hof, 2020). For the 2015 policy change to be legitimate, it should have been preceded with an assessment of possible environmental impacts of these extensions. Furthermore, citizens should have had the chance to participate in this process of policy-making (Grondwettelijk Hof, 2020). The government would need to make this right by the end of 2022. In the fourth amendment to the 2003 nuclear phase-out law in October 2022, these issues were addressed and resolved.

In the negotiations for the government formation after the elections of 2019, the stance of the new government on nuclear phase-out had been heavily debated again, to eventually end up reaffirming the law of nuclear phase-out again (Interviewee 1). As the *De Croo Government* went into power in the fall of 2020, Green Minister of Energy Tinne Van der Straeten had one year to prove nuclear phase-out by 2025 would be possible without jeopardizing the country's energy security (De Morgen, 2021). Because of different external events, like the war in Ukraine as has been described earlier, it had appeared impossible to do so. In 2022, the nuclear phase-out law was amended again, this time extending *Doel 4* and *Tihange 3* with 10 years (FOD Justitie, 2022). This allowed both nuclear power plants to stay operable until 2035, trespassing the original deadline of nuclear phase-out by 2025. An extension of these two youngest nuclear power plants has appeared necessary for energy security in the short term (Interviewee 8). The *De Croo Government* has furthermore decided to fund research on fourth generation nuclear power plants, like SMRs, as solutions for 2045 and beyond (Interviewee 2). The budget: 100 million euros (Interviewee 1 & 6). Over the last years, many experts have been informing the Energy Commission of the Federal Parliament on this and study trips have been organized as well (Interviewee 10). The investments in nuclear technological development however have been linked to criteria; on the proliferation risks, flexibility, affordability and security of the technology, among other things (Interviewee 11).

Respectively in 2022 and 2023, the nuclear power plants that have experienced several safety issues, *Doel 3* and *Tihange 2*, have been closed down (FANC, 2023, January 30th). Generally, when the decision is made to prolong nuclear power plants, for some it is a necessary measure to ensure energy security in the short term, while for others it is part of a medium and long term vision on the Belgian energy mix (Interviewee 7).

5.3.5. Policy-outputs

“It was remarkable to note that between 2003 and now no one has actually taken the initiative to do either one or the other” (Interviewee 11). According to Interviewee 11, neither one of the scenarios, phasing-out or not phasing-out nuclear energy production in Belgium

past 2025, had been prepared for. Interviewee 5 adds: *“Precisely those political parties that accuse the current government of not doing enough to extend nuclear energy, are the ones who did not prepare the extension themselves at the time [when they were in government]”*. *“Government after government has confirmed the law of nuclear phase-out and has not questioned nor annulled this law”* (Interviewee 11), and yet nuclear phase-out has remained a contested policy topic over the years. Overall, a long-term vision on energy policy considering all relevant facets appears to be lacking in Belgium (Interviewee 5 & 11). Interviewee 8 talks about a lack of *“stability”* and *“coherency”* over the past 15 years. A *“historical error”*, according to Interviewee 11.

Interviewee 4 described the presence of a paradox. *“Although it [nuclear energy] is progressively a smaller part of the energy issue, it is taking a progressively bigger part of the political energy”*. A disproportionate and growing amount of time and energy goes into the debate on nuclear phase-out, considering its reducing share in the energy mix. The energy debate should be held in a broader way and not only be occupied with electricity generation through nuclear energy production (Interviewee 8). *“We might be having the wrong debate”*, Interviewee 6 concludes. *“It has become a symbolic discussion”* (Interviewee 6), Interviewee 4 even refers to it as a culture war.

“The debate on nuclear energy has turned into some kind of culture war. Very intense, little overview, little moderation. And that is not beneficial, because that actually distracts us from the major energy challenges that we have to tackle together, challenges that require broad political support across coalitions and legislatures.” (Interviewee 4).

“A long process of many ups and downs, pushing and pulling” is how interviewee 8 described the developments of the law of nuclear phase-out since 2003. *“Deficient investments in replacement capacity due to many discussions on their costs, imminent black-outs, bottlenecks in the energy cross border transmission infrastructure and the issue of gas as temporary energy source for the transition up until the energy crisis that followed the war in Ukraine, leading to a revival of nuclear”* (Interviewee 8). Interviewee 6 argues that even without the war in Ukraine that started in February of 2022, closing all 7 Belgian nuclear power plants by 2025 would not have been possible anyway, given the history of the Belgian debate on nuclear phase-out. Nuclear phase-out is a process of the long term (Interviewee 6). Interviewee 5 called it a pitiful process mostly of *“cherry-picking”* and *“kicking the can down the road”* by policy-makers, out of, in his opinion, unnecessary fear for the voter.

“They [politicians] are incapable of listening to input, they will try to look for negative input so that they can profile themselves” (Interviewee 5).

As the political debate appears to not always be rooted in factual knowledge, neither do the policy-outputs that follow from it. *“The industrial-economic part keeps being forgotten”* (Interviewee 6). Europe lacks the factories that can make the specialized elements needed to build new nuclear power plants, creating dependence on Russia for future European energy production (Interviewee 5 & 6). For the actual building of these power plants, another problem arises. Globally, there is a lack of employees with the right education and skills to manufacture and manage new nuclear power plants (Interviewee 6 & 12). These concrete

challenges do not seem to be considered by policy-makers on the topic of nuclear energy and its phase-out trajectory.

The decisions made by government authorities on the nuclear phase-out law show the process of nuclear phase-out has been postponed in Belgium. In the near future, Interviewee 2, 4 and 6 expect the new government formed after the Belgian elections of June 2024 to make amendments on article 3. This article of the nuclear phase-out law prohibits new nuclear power plants to be built on Belgian soil (FOD Justitie, 2003). The disappearance of this law however would only be a precondition, opening the door as a first step to build new models of nuclear power plants in Belgium. The debates on new nuclear infrastructure would still need to be had and voted through (Interviewee 2). Interviewee 4 reflected too that the existence or non-existence of article 3 would be rather irrelevant. The annulment of this article might even shift the political debate, as then the “burden of proof” whether nuclear phase-out would be possible or not could shift from advocacy coalition B to advocacy coalition A, changing the dynamics of the debate (Interviewee 4).

5.3.6. Policy impacts

The lack of coherence and stability in the policy-output on nuclear phase-out as described above, has had an impact on Belgian society. Whereas advocacy coalition A seems to be able to comfort the general public, the coalition advocating to phase-out nuclear energy finds itself in a more defensive position where it needs to bring a more complex and less optimistic message. “*Don’t worry*” is what those against phase-out say, nuclear technology will provide solutions so as a society, we will not have to make major changes to the ways we live and operate (Interviewee 6). Yet, “*there is no silver bullet*” to the energy issue (Interviewee 5). The reality of energy policy-making demands more nuance than it has been granted in the Belgian political debate on nuclear energy to be effective (Interviewee 8). The endless political debate on the matter is rooted in uncertainty and appears to not always be held in transparent ways, leading to doubt, mistrust and eventually no decisive action.

Due to the constantly changing legislative framework, *NIRAS* does not know how much nuclear waste there will be to manage in the coming decades and centuries (Interviewee 12). When frameworks change, participative processes with local communities where this waste might be stored need to be redone. This can take a lot of time and effort, ultimately reducing the support of these local stakeholders for nuclear waste storage in their proximity. The matter of nuclear waste would too oftentimes be treated by politicians as an afterthought, affecting the safe management of nuclear waste (Interviewee 12).

“*And at the same time, in the background and up against all political counterwork, the sector does what it needs to do*” (Interviewee 5). As the prices of renewable energy production keep decreasing, the energy sector is moving into the direction of more renewable energy and energy interconnectivity between countries. Forcing nuclear energy into the energy mix is an artificial way of creating demand, ultimately leading to higher energy prices (Interviewee 5 & 6). “*Sooner or later, the costs will be for the state*” (Interviewee 12). In the end, nuclear energy production is financed by the taxpayer (Interviewee 5, 6, 12). The benefits of this debate however, can be reaped by powerful energy industries. Although this research examined the place of nuclear energy in the energy transition, fossil fuels are

intertwined in the debate on nuclear phase-out too. *“The fossil fuel industry especially finds it fantastic we are debating nuclear energy, because then we are not debating them and the phase-out of fossil fuels”* (Interviewee 6).

“The gap between facts and perception keeps on growing” (Interviewee 6).

Another dangerous impact of the policy-making process on nuclear energy in Belgium, is its effect on the public opinion. *“The dramatic part is of course that you don’t- you reassure people, and the companies agree that you are going to do things that you cannot do”* (Interviewee 6). People are being soothed with the idea that nuclear energy can provide energy in a way that is secure, affordable, green and safe. In the next 20 years, decarbonization processes need to happen ten times faster than they have in the past 20 years, in order to meet our decarbonization targets (Interviewee 9). *“Everything left open to doubt, to additional ‘would it not be possible if we did this or that’, will eventually only delay the transition”* (Interviewee 11). *“We cannot afford all these debates”* (Interviewee 11), for the sake of energy affordability and geopolitical energy security. Also with nuclear power plants, countries such as Belgium and France have experienced energy insecurity in the last decade (Interviewee 11). *“The efforts of those who put forward nuclear energy as the solution to all problems, are in vain. And it is enough just to look at the facts”* (Interviewee 11).

5.4. Synthesis: Advocacy Coalition Framework dynamics

As visualized with the arrows in the research framework (fig. 3), many aspects of the Advocacy Coalition Framework interact with each other. The dynamics of these interactions will be briefly synthesized in this section, before moving on to the discussion and conclusion of this research.

The results of this research have shown that the complexity of energy policy and the lack of objective knowledge available on nuclear energy are determinative *relatively stable parameters* of the political debate on nuclear energy in Belgium. They influence the policy process from the start, allowing doubt and distrust to grow among policy participants. The Belgian partycratic system and the constitutional structures in place seem to enable these developments.

Both for the formation of a new government as to pass changes to the law of nuclear phase-out in the Belgian Federal Parliament, the *degree of consensus needed* is a majority. This allows meaningful policy-change to be passed relatively easily, despite the polarized debate. Negotiations or votes can end up very close to 50-50 in favor or in opposition to nuclear phase-out, yet the narrow majority at the time of voting will decide, impacting the further trajectory of the policy-process. This rule of simple majority thus influences the policy subsystem of nuclear energy policy in Belgium and can partly explain why nuclear phase-out policy-making has been referred to by Interviewee 8 as *“a long process of many ups and downs, pushing and pulling”*.

Partly because of the relatively low needed degree of consensus, changes in governing coalitions have the potential to change the trajectory on nuclear phase-out. At the same

time, the participation of a political party in a governing coalition can influence their stance on nuclear energy too. As a small federal State within the EU, decisions made on the Belgian regional levels and on the EU level can influence the policy trajectory as well. The biggest *external event* affecting the nuclear phase-out policy processes however, seems to be public opinion. Due to the lack of knowledge, the perceived relation between changed socio-economic conditions and energy policy has the potential to trump the factual relation. This way, the advocacy coalition that succeeds at persuading the public opinion seems to harvest the biggest resource for the implementation of its beliefs into the policy subsystem.

As the resources of both advocacy coalitions in particular have been discussed, there are *constraints and resources* that are shared across both groups too. The aspect of knowledge and its interpretation is a first constraint, prohibiting the subsystem from decisive policy-making. As told by Interviewee 5 and 6, it is the job of scientists to develop new technologies that they hope to be relevant and effective. For this, financial support for research and development is required. In the information flow between scientist and politician, obstacles can arise. *“These people [researchers] are saying; we have got a technology [SMRs]; that can get started in 2040-2050 [...] while the others will take care of 90% of the solution. And here I see the [political] debate that these SMRs will solve everything and we will not be needing anything else”* (Interviewee 5). Interviewee 5 refers to the role the media plays here; excluding certain relevant information from scientific papers in their reporting, and politicians in turn *“cherry-picking”* the information that helps them bring their point across from there. Thus, apart from the *relatively stable parameter* that having objective knowledge at hand on nuclear energy is a challenge, that knowledge being interpreted correctly appears to be another issue that can work either as a constraint or a resource.

Due to a lack of objective knowledge and policy brokers, each of the advocacy coalitions seems to start from its own truth and own scientific sources. When deciding on the party's stance on nuclear energy in internal working groups, political parties informally invite energy experts and stakeholders that at least partly share their ideology (Interviewee 1 & 2). Within the party, individuals, especially those with power or expertise, can influence the party's stance on nuclear energy too (Interviewee 2 & 9). In order to be informed, some parties join lobby events (Interviewee 3 & 7). These informal alliances between political parties and stakeholders lead them to protect their shared interests, each on their own front (Interviewee 6). Starting from different factual knowledge, a lack of trust seems to have emerged between the policy participants. This can be observed in the hostility between the advocacy coalitions and the polarized political debate on nuclear energy that has been contested for decades.

6. Discussion

6.1. Reflections on methodology

As explained in the methodology section, a theory-testing single-case study analysis can be useful to gain in-depth knowledge on a phenomenon in its local context. Despite these benefits, there are some limitations to this research design as well.

The first limitation of the single-case study as described in the literature, is the concern for bias. Qualitative research on context-sensitive data can be more prone to the author's own perception (Abreu et al., 2023). To counter this concern and optimize the validity and reliability of the results, Yin (2009) recommended to make use of multiple methods, various data sources and triangulation. These recommendations have been implemented into this research, as has been extensively described in the methodology chapter. To transparently showcase the results of the case study in order to make them more reliable to someone who is not familiar with the case, recommendations by Gustafsson (2017) to add explanatory tables, figures and appendices were implemented as well.

For document analysis in general, Bowen (2009) warns for 'biased selectivity' in data selection, where a researcher would not collect all relevant data due to their own biases. By collecting data in systematic ways and describing the processes of data collection transparently in the methodology chapter, biased selectivity has been minimized. All relevant election programs, coalition agreements and (amendments to) the nuclear phase-out law have been collected and analyzed. As for the semi-structured interviews, a balance of relevant policy participants across the policy spectrum was aimed for and achieved.

To avoid bias and over-interpretation of findings, Beach (2018) calls for accurate assessment of potential evidence for the hypothesized and tested causal mechanism. In this research, this has been implemented in the thorough conceptualization and operationalization of the research framework, embedded in the literature (table 2). By systematically analyzing the semi-structured interviews and policy documents based on this same research framework and weighing the results from the different data sources and research methods against each other, synergies could be found. The overlap of results then indicated the validity of those pieces of evidence for the tested causal mechanism and have been thoroughly described in the results. The uniqueness of the evidence furthermore can be assessed by reflecting if there could be alternative explanations to the piece of evidence (Beach, 2018). The notion of evidence uniqueness has been considered throughout the research process and will be addressed in more detail in the conclusion.

Secondly, every research method has its own strengths and limitations. Methods of discourse network analysis, semi-structured interviews and policy document analysis have been combined to conduct this research, in an attempt for them to complement each other's advantages and disadvantages.

The discourse network analysis created a clear overview of the debate. A limitation of a quantitative overview of a political debate however, is that it leaves little room for nuance. For example in the category of nuclear safety, almost all party programs and coalition agreements discussed the danger of nuclear weapons and the importance of internationally

agreeing on non-proliferation treaties. Yet, by some policy participants of advocacy coalition B this risk has been linked to the development of nuclear technology, while advocacy coalition A portrayed the proliferation risk as a completely unrelated policy topic. Consequently, stances on nuclear proliferation risks could not be coded as a disagreement with the nuclear techno-optimist statement that nuclear energy would be safe. The loss of nuance through discourse network analysis could be observed in the co-occurrence subtract network as well. Derived from this network, the Wallonian Social Democrats would be a neutral policy participant, connected to every other political party in the subsystem. However, this might be an overinterpretation, as a consequence of Wallonian parties generally having longer election programs than Flemish parties, progressive parties oftentimes being more outspoken on nuclear energy in their election programs than the conservative ones and *PS* being the progressive party that went into government the most during the timeframe of this research.

Yet, the loss of nuance in the debate through discourse network analysis could be compensated with the in-depth data obtained through the semi-structured interviews. On their turn, the statements made by Interviewees could be verified with the data from the policy document analysis and additional document analysis. By being able to compare the intentions of the governments in place from their coalition agreements to the decisions they implemented through their amendment bills to the nuclear phase-out law, a comprehensive overview of the policy-making process could be sketched.

Lastly, strengths and benefits of the research framework will be discussed. By the use of the Advocacy Coalition Framework, the behavior of policy participants and advocacy coalitions can be explained based on their shared beliefs (Schlager, 1995; Weible & Sabatier, 2006). Assuming people's behavior to stem from their beliefs, this framework does however not allow the researcher to systematically consider other motivations of cooperation between policy participants, like self-interest (Sabatier and Weible, 2007). The literature showed there can be other factors at play for coordinated action. Strategies of climate delay can be intentionally fed to the public through misinformation (McCright & Dunlap, 2010; Roper et al., 2016) and powerful actors are more prone to be active in countermovements (Brulle & Aronczyk, 2019). In the next section, how the results of this research tie back to the literature will be discussed.

This research attempted to better understand the Belgian case of nuclear phase-out postponement by examining the processes of policy-making regarding the 2003 nuclear phase-out law and its amendments within its political context. More insights could be gained in future research by including the analysis of parliamentary debates on this law too. To understand the policy-system in a broader way, other laws and regulations of nuclear energy policy could be studied; such as regulations on the nuclear power plants provisions or on nuclear waste management. Now that an overview of the role of beliefs in nuclear phase-out postponement has been sketched through the Advocacy Coalition Framework, additional research on money flows in the Belgian nuclear sector and policy-making could offer insights in the interests and resources at play in this policy subsystem. These proposals for future research could add to the currently still incomplete overview of the Belgian political debate on nuclear energy production and its phase-out too.

6.2. Theoretical implications

The results of a theory-testing single-case study cannot be directly generalized for the whole tested theory (Yin, 2009). However, apart from generating knowledge on the specific case, the results can gain new insights on the tested theory; possibly questioning the validity of certain aspects of it and making others more robust (Yin, 2009). By elaborately comparing the results to the literature, the reliability of the research and its results can be improved (Gustafsson, 2017). In the case of nuclear phase-out postponement in Belgium, this research tested the hypothesized causal mechanism that in modernized societies, shared policy core beliefs of techno-optimism would lead to policy-output of nuclear phase-out postponement and policy impact of climate delay. Evidence for this hypothesis has been found in this case, as well as the presence of ties between nuclear techno-optimist discourse and deep core beliefs of ecological modernization.

6.2.1. Policy participants & shared beliefs

As mentioned in the literature by Hess and Renner (2019), conservatism in European countries has increasingly been affiliated with opposition to climate science and action. Regarding nuclear energy, the data has shown that mostly the right-wing and conservative side of the Belgian political spectrum tends to be optimistic about nuclear energy, opposing nuclear phase-out. Powerful political and economic actors have been described in the literature as able to preserve business-as-usual in their own best interest, by making non-decisions that postpone climate action (Brulle; 2013; Hess & Renner, 2019; Roper et al., 2016; Shue, 2022). Cooperation of political and economically powerful actors in the advocacy coalition opposed to nuclear phase-out has been observed, and has even been called “*an alliance of ecomodernists*” by Interviewee 6.

From the perspective of ecological modernization, transformative societal changes towards sustainability would be unnecessary, as business-as-usual would generate the innovations needed to solve issues related to sustainability (Buttel, 2000; York et al., 2010, Hultman, 2017). Techno-optimist discourses can sprout from these deep core beliefs, overestimating unproven or insufficient technological solutions while underestimating others (Danaher, 2022; Lamb et al., 2020). The data from the discourse network analysis has clearly shown the presence of nuclear techno-optimist beliefs in the policy subsystem, particularly in advocacy coalition A. This finding can be concluded directly from the affiliation network as portrayed in table 4 and has been confirmed by the data from the interviews too. Dockstader & Bell (2020) described ecological concerns through the lens of ecomodern masculinity as concerns of national security with solutions of green consumerism. The main arguments of advocacy coalition A to maintain nuclear energy in the Belgian energy mix: the conviction that nuclear energy would be needed to safeguard Belgium’s energy security and affordability. The consumption of nuclear energy, deemed to be ‘green’ through the nuclear techno-optimist lens, would allow Belgium to keep consuming similar and growing amounts of energy. The techno-optimist conviction that nuclear energy is a necessity within the energy mix appears to be rooted in the deep core beliefs of ecological modernization as well, assuming unquestioned economic growth through technological development (York et al., 2010). The assumption that energy demands will keep on rising is present in advocacy

coalition A (CD&V, 2010; Interviewee 2) leading them to conclude that without nuclear energy, these growing demands could not be satisfied.

6.2.2. Advocacy coalitions & influencing policy

Advocacy coalition A fits the definition of countermovements, as described by Brulle (2013) and Brulle & Aronczyk (2019): a network of powerful actors sharing beliefs and economic interests that has emerged in opposition to the green and anti-nuclear social movement. By framing its opponents in favor of nuclear phase-out as “*anti-innovation*”, “*anti-progress*” (Interviewee 6), “*irrational*”, “*emotional*” (Interviewee 9) and even “*populist*” (Interviewee 3), the debates turns very polarized and difficult to proceed in constructive ways. Spreading confusion and division through ideological tactics is a strategy that has been used to slow down decision-making on climate policies (McCright & Dunlap, 2010; Brulle, 2013; Roper et al., 2016; Lockwood, 2018). The mechanism of ‘identity protective cognition’ through the ‘white-male effect’ as applied by Kahan et al. (2007), may have led predominantly white men to identify with the discourse, strengthening the mobilizable power and public opinion as a resource of advocacy coalition A. Further research on these identification processes could be useful. From this research, it can be concluded that the mobilizable power of the nuclear techno-optimist discourse seems to have worked as policy-output of nuclear phase-out postponement has been effectuated and evidence for the causal relation has been obtained.

6.2.3. Institutionalizing climate delay in the policy subsystem

As derived from the literature, nuclear energy would not be a viable source of energy for the future because it is a limited source of energy, incompatible with the infrastructure of renewable energy (Verbruggen, 2008). Even the pro-nuclear party *N-VA* agrees to a certain extent to this notion, aiming itself for nuclear phase-out by 2065 (N-VA, 2014). As nuclear energy does not offer a long term solution for the energy needs in the context of a climate crisis, Huh & Kwon (2021) argued efforts towards research and regulations on this energy source would be inefficient. The link between opposition to nuclear phase-out and opposition to decisive climate action, leading to climate delay, has been explicitly expressed by Interviewee 11: “*We cannot afford all these debates*”. “*Everything left open to doubt, [...] will eventually only delay the transition*” (Interviewee 11). Unclear policies and regulation on nuclear energy can create doubt within the sector, leading private actors to be hesitant to invest in alternative energy sources for the energy transition. Nuclear energy has been displayed by pro-nuclears as the “*silver bullet*” to solve the climate crisis (Interviewee 5). The conviction that nuclear technology could fix this crisis while the status quo can be retained, is what keeps people from worrying about said crisis, as this would be unnecessary (Interviewee 6). These convictions, especially when they are nested in the public opinion, can stun the urgency of the crisis, leading to weakened climate action and climate delay.

6.2.4. Wider implications

The ecofeminist concept of ‘remoteness’ as introduced to the literature on nuclear energy by Kinefuchi (2021) can be observed in the researched policy-subsystem as the disconnect

between the daily consumption of energy in Belgium and the policy-making on the topic. This remoteness seems to have created a vacuum in which untruthful narratives on the need for nuclear energy had the possibility to emerge. These narratives, that nuclear energy would be needed to safeguard energy security and affordability, seem to then have been exploited by actors that benefit from nuclear energy production. The ecofeminist concept of 'hierarchical dualism' can be observed too, in the lack of room for nuance allowed in the debate, as raised by Interviewee 8. The debate on nuclear phase-out in Belgium would be held in a binary way, where rationality wins from irrationality and so called 'facts' from emotions. Critical feminist theories, like ecofeminism, focus on collective systemic change, questioning the market powers and capitalist system that according to Bee et al. (2015) currently are the default logic in climate governance. For future research on nuclear energy, techno-optimism and climate delay, it could be interesting to build on ecofeminist theory in order to develop an alternative approach.

7. Conclusion

By examining the case of Belgian nuclear phase-out postponement through the Advocacy Coalition Framework and conducting discourse network analysis, semi-structured interviews and policy document analysis on several different data sources, this research attempted to answer the research question:

How has the discourse of nuclear techno-optimism impacted policy-output of nuclear phase-out postponement in Belgium between 1999 and 2022?

From the findings, it can be concluded that the nuclear techno-optimist discourse has indeed influenced nuclear phase-out postponement in Belgium. Advocacy coalition A, consisting of political parties on the conservative side of the political spectrum and opposed to nuclear phase-out, has appeared to be a powerful driving force for that. These policy participants were the ones that carried this discourse out the most in their election programs and policy-making. They did so mainly by focusing on the conviction that nuclear energy would be indispensable to safeguard Belgium's energy 'security' and 'affordability'. The availability of affordable energy might be the most tangible aspect of energy policy for the average Belgian energy consumer, and thus the lack thereof a concern the general public can grasp and relate to. Whether nuclear energy production would be sufficiently 'green' or 'safe' are more abstract and remote aspects of energy policy. This could be one explanation as to why advocacy coalition A would be doing better in influencing the public opinion as compared to advocacy coalition B; the advocacy coalition in favor of nuclear phase-out that communicated a more complete picture on nuclear energy production in their argumentation. The politicization of energy security and affordability in this debate looks like a strategy of advocacy coalition A to institutionalize policy-output of nuclear phase-out postponement in Belgium.

As the advocacy coalition opposed to nuclear phase-out has appeared the most influential, the nuclear techno-optimist discourse and prioritization of energy security and affordability has flowed through to the policy-making processes too. Safety concerns are assumed to be taken care of by the authorized government agencies. Issues of sustainability are mentioned to be important as well, although as long-term concerns they seem to be postponed in the event of unforeseen circumstances affecting Belgium's energy security and energy affordability. These developments however cannot be uniquely allocated to the nuclear techno-optimist discourse. External events and institutional structures, like the global economy, can influence these decisions as well. After the financial crisis of 2008 for example, following coalition agreements reported to be prioritizing fixing the Belgian budget deficits that arose after the Belgian government had rescued Belgian banks. Causation has not been proved in this research, but since 2009, every government coalition has attempted to extend nuclear power plants by 10 years. A share of the excess profits made by the nuclear operator from these extensions would go to the Belgian government, helping to fill the Belgian budgetary crater that followed from the 2008 banking crisis. Also when other policy topics were more politicized, such as the debates on Belgian state reforms, other policy topics, like nuclear phase-out, needed to wait and policy decisions on those matters were were postponed.

While energy affordability is a big argument in the case of nuclear phase-out in Belgium for both advocacy coalitions, the question to ask in order to understand underlying intentions is: *affordable to who?*. While it is oftentimes portrayed as affordability for the average citizen, election programs from advocacy coalition A and policy documents have seemed to prioritize energy affordability for economic actors and the energy intensive-industry. The importance of economic competitiveness was a recurring topic in coalition agreements. Although a focus on economic growth and market expansion lies in the logic of ecological modernization, these aims are likely to transcend shared beliefs alone. As a small and open economy located centrally in the EU, competitiveness is a matter of keeping the Belgian economy and welfare afloat. With brains as *“our only raw material”* (Belgische Kamer van Volksvertegenwoordigers, 2003, p. 13), the pioneering role in research on nuclear technology might be an asset difficult to let go of in a globalized knowledge economy.

There are certainly path dependencies and lock-in effects at play in the Belgian policy-making processes on nuclear energy. Sudden external shocks can postpone the energy transition too. Yet, some of these concerns seem to have been instrumentalized in the political debate on nuclear phase-out for other reasons. Ideas that have been portrayed as ideological convictions in the best interest of the Belgian general public, might actually have been shared interests of a more elite-driven group of powerful actors in disguise. This can be derived from the twisted logics and paradoxes that exist throughout the political debate. The dependence on Russian technologies and know-how in order to be able to build nuclear power plants is information that seems to be ignored, while the spiked energy prices as a result from Russia's invasion of Ukraine are immediately acted upon by extending nuclear power plants in order to gain independence from Russian gas.

The discourse of nuclear techno-optimism appears to be present in the Belgian case of nuclear phase-out postponement. Furthermore, it has shown to be powerful enough to contribute to the phase-out postponement in Belgium over the last decades. Enough impactful policy participants seem to have been able to identify with the discourse, so that it created a strong advocacy coalition against nuclear phase-out. However, this discourse needs to be understood as one of multiple elements behind the policy-processes of nuclear phase-out postponement in Belgium.

7.1. Policy recommendations

The context-specific knowledge generated through this research could offer relevant information and insights to policy-makers on the role of nuclear energy in the Belgian energy transition. Despite the debate appearing polarized and the focus of this research being to understand this contested policy topic, shared grounds for future Belgian climate and energy policy-making have been found as well. Remarkably, none of the governments and political parties reckon nuclear energy to be the only and ultimate source of energy. Nuclear phase-out would eventually be insurmountable, it is the timeframe and pathway towards nuclear phase-out that are the essence of the political debate. All policy participants agree to a certain degree that the development of renewable energy will be insurmountable in the future and that the greenest, safest and cheapest energy that guarantees energy security, is the energy that is not being used. Regardless of the future trajectory of nuclear phase-out, the energy transition towards more renewable energy and energy efficiency would still need

policies in place in order to develop and flourish. For this to happen in an effective way, while considering the role of nuclear energy in Belgium, two concrete recommendations will follow.

Firstly, there is a need for the political debate to be held in a transparent way, based on facts. More independent research should feed the debate. There is a need for more independent research to feed the debate. In the long term, reforms of the *Belgian Nuclear Research Center (SCK-CEN)* could be considered. Given the urgency of the energy transition in light of the climate crisis, in the short term however, it would be helpful if all policy participants started the debate from the same indisputable facts. Indisputable facts can be, among other numbers, be the money flows from governments to different energy sources, the price of energy from different energy sources and the availability of workers in the field to build them.

Secondly, a holistic approach to the climate and energy policy currently seems to be lacking. All aspects of nuclear energy production should be considered in the political debate; its role in safeguarding energy security and affordability, safety and sustainability regarding the Belgian population, Global South and future generations. Geopolitical issues should be included in these discussions too. Regulations on the EU level could help overcome political disputes on the Belgian national level and the issue of Belgium's economic competitiveness within the EU. This way, competitiveness could be swapped for win-win situations for Belgium and its neighboring countries through interdependencies for renewable energy supply. Coordinated action across policy-making levels as a result from constructive debates could help the energy transition to speed up, rather than slow down.

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Appendix A: Belgian election results

The percentages in this table, obtained from the website of the Belgian Civil Service on Domestic Affairs (IBZ, 2024), show the share of the valid votes for each of the political parties, for each of the elections relevant for this research. The percentages in bold indicate the party to have become part of the **governing coalition** after that specific election.

	1999	2003	2007	2010	2014	2019
Flemish Social Democrats	9,55%	14,91% (in cartel with spirit)	10,26% (in cartel with spirit)	9,24%	8,83%	6,71%
Wallonian Social Democrats	10,16%	13,02%	10,86%	13,70%	11,67%	9,46%
Flemish Greens	6,99%	2,47%	3,98%	4,38%	5,32%	6,10%
Wallonian Greens	7,36%	3,06%	5,10%	4,80%	3,30%	6,14%
Flemish Christian Democrats	14,09%	13,25%	18,51% (in cartel with N-VA)	10,85%	11,61%	8,89%
Wallonian Christian Democrats	5,88%	5,47%	6,06%	5,52%	4,98%	3,70%
Flemish Liberal Democrats	14,3%	15,36%	11,83%	8,64%	9,78%	8,54%
Wallonian Liberal Democrats	10,14%	11,4% (in cartel with FDF)	12,51% (in cartel with FDF)	9,28%	9,64%	7,56%
Flemish Nationalists	5,56%	3,06%	18,51% (in cartel with CD&V)	17,40%	20,26%	16,03%

Appendix B: overview of the Federal governing coalitions of Belgium between 1999 and 2022 (Aspeslagh et al., 2024).

Government coalition	Governing period (dd/mm/yyyy)	Parties (in order of highest election results)	Secretary of state for/ Minister of Energy
<i>Verhofstadt I</i>	12/07/1999 - 12/07/2003	VLD, PRL, PS, SP, Ecolo, Agalev	Olivier Deleuze (Ecolo)
<i>Verhofstadt II</i>	12/07/2003 - 21/12/2007	VLD, s.pa, Spirit, PS, MR	Fientje Moerman (VLD): 12/07/2003 - 18/07/2004 Marc Verwilghen (VLD): 18/07/2004 - 21/12/2007
<i>Verhofstadt III</i>	21/12/2007 - 20/03/2008	CD&V, MR, Open Vld, PS, cdH	Paul Magnette (PS)
<i>Leterme I</i>	20/03/2008 - 30/12/2008	CD&V, MR, Open Vld, PS, cdH	Paul Magnette (PS)
<i>Van Rompuy</i>	30/12/2008 - 25/11/2009	CD&V, MR, Open Vld, PS, cdH	Paul Magnette (PS)
<i>Leterme II</i>	25/11/2009 - 05/12/2011	CD&V, MR, Open Vld, PS, cdH	Paul Magnette (PS)
<i>Di Rupo</i>	05/12/2011 - 11/10/2014	PS, CD&V, MR, s.pa, Open Vld, cdH	Melchior (jr.) Wathelet (cdH) (05/12/2011-22/07/2014) Catherine Fonck (cdH) (22/07/2014 - 11/10/2014)
<i>Michel I</i>	11/10/2014 - 09/12/2018	N-VA, CD&V, Open Vld & MR	Marie-Christine Marghem (MR)
<i>Michel II / Wilmès</i>	09/12/2018 - 17/03/2020	CD&V, Open Vld & MR	Marie-Christine Marghem (MR)
<i>Wilmès</i>	17/03/2020 - 01/10/2020	CD&V, Open Vld & MR	Marie-Christine Marghem (MR)
<i>De Croo</i>	01/10/2020 - ...	PS, CD&V, Open Vld, MR, s.pa, Ecolo, Groen	Tinne Van der Straeten (Groen)

Appendix C: Project information sheet

Thesis project information sheet



The role of beliefs and coalitions in the case of nuclear phase-out postponement in Belgium (1999-2022)

Institute	Copernicus Institute of Sustainable Development, Utrecht University
Student	Ellen De Wit - e.j.g.dewit@students.uu.nl
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Term	September 2023 - June 2024

Overview

The political debate on nuclear energy in Belgium has been contested for years. While many external factors influenced Belgian energy policies on nuclear power, different parties have had fundamentally different views on the matter. **This thesis research aims to better understand the political debate on nuclear energy in Belgium by focussing on the role underlying beliefs and different coalitions have played in these processes of policy-making.**

Approach

I am analyzing the political debate on nuclear energy between 1999 and 2022 through an advocacy coalition framework. **As part of my research I am conducting semi-structured interviews with people who are knowledgeable on this debate.** These interviews would ultimately allow deeper insights in the decision-making processes on nuclear energy in Belgium and how they have been affected by different parties and government coalitions.

Your participation in this research

I have identified you as someone who is knowledgeable on the Belgian nuclear energy debate. This way your participation in a semi-structured interview would be very valuable for my thesis research.

Concretely, **I would like to invite you for one interview of approximately 45 minutes.** This would take place online and, if you agree, be recorded. This material will be anonymized and used for the purpose of this research activity only. Afterwards the data will be deleted.

You have the right to view, withdraw or change your data at any time.

Through your participation, you would help contribute to the understanding of the political debate on nuclear energy in Belgium and to the scientific literature on the role of beliefs in energy and climate policy-making.

Appendix D: Informed consent form

Informed consent form



The role of beliefs and coalitions in the case of nuclear phase-out postponement in Belgium (1999-2022)

As a participant,

I confirm that:

- I am satisfied with the received information about the research;
- I have been given opportunity to ask questions about the research and that any questions that have been risen have been answered satisfactorily;
- I had the opportunity to think carefully about participating in the study;

I agree that:

- video and/or audio recordings may be used for scientific purposes;
- the data collected will be obtained and stored for scientific purposes only and that after the completion of this research activity, the data will be permanently deleted;
- the collected research data will be anonymized and only presented in a de-identified form where no individual will be traceable to any particular statement.

I understand that:

- I have the right to view and change my data;
- I have the right to withdraw my consent to use the data at any time;
- I have the right to see the research report afterwards.

To be completed by the investigator:

The participant consents to being recorded during the interview: yes / no

Name of participant: _____

Date (dd/mm/yyyy), place:

___ / ___ / ____, _____

I declare that I have explained the above mentioned participant what participation means and the reasons for data collection.
I guarantee the privacy of the data.

Name: Ellen De Wit

Date: ___ / ___ / ____ (dd/mm/yyyy)

Appendix E: Interviews questions

1. Can you tell me something more about your role in the political debate on nuclear energy and how you became involved?
2. In 2003, a law was implemented to gradually phase out nuclear energy from the Belgian energy mix. Can you tell me more about your party's position on the nuclear phase-out and how this view may have evolved since 2003?
3. How has your party worked to translate its vision on nuclear energy into policy? Through which routes and with which focus points?
4. Does your party cooperate with certain actors, both political and non-political, to achieve this vision?
5. What are the biggest obstacles to getting your party's positions implemented in decision-making on nuclear energy? Can you give a specific example from decision-making?
6. What are the most favorable factors for your party's positions to be implemented in decision-making on nuclear energy? Can you give a specific example from decision-making?
7. If your party could implement one decision or law in Belgian energy policy regarding nuclear energy, what would it be & why?
8. Finally and more generally, what is the future for nuclear energy in Belgian climate and energy policy?
9. Is there anything else you would like to add that we haven't covered yet?
10. Do you recommend anyone else I should interview on this topic?

Appendix F: Co-occurrence subtract network.

Figure 4 is the visualization of the co-occurrence subtract network, table of the co-occurrence subtract network, as exported from the *Discourse Network Analyzer* software.

For the clarity and readability of the table below, political parties have been abbreviated; F = Flemish, W = Wallonian, followed by the first letter of the political family. The color codes as used throughout this research should help the readability of this network too.

	F. C	W. C	F. L	W. L	F. S.	W.S.	N-VA	F.G.	W.G
F. C		5.00	3.00	5.00	0.00	3.00	3.00	0.00	0.00
W. C	5.00		3.00	5.00	0.00	3.00	3.00	0.00	0.00
F. L	3.00	3.00		3.00	0.00	3.00	1.00	0.00	0.00
W. L	5.00	5.00	3.00		0.00	3.00	3.00	0.00	0.00
F. S.	0.00	0.00	0.00	0.00		2.00	-2.00	5.00	5.00
W.S.	3.00	3.00	3.00	3.00	2.00		1.00	2.00	2.00
N-VA	3.00	3.00	1.00	3.00	-2.00	1.00		-2.00	-2.00
F.G.	0.00	0.00	0.00	0.00	5.00	2.00	-2.00		5.00
W.G	0.00	0.00	0.00	0.00	5.00	2.00	-2.00	5.00	