**Title: Co-Produced Legitimacies: Parliamentary Technology Assessment and Nuclear Waste Management in France**

**Authors: Céline Parotte[1], Pierre Delvenne**

Total word count: 8969
Accepted for publication (January 2018)

**Abstract**: In this article we question the roles and engagement of the French Parliamentary office of Technology Assessment (PTA) in governing Nuclear Waste Management (NWM) over an extended timeframe (1990-2017). We argue that the trajectories of the PTA and the NWM program are so intertwined that we gain analytical purchase from understanding them together. Our empirical analysis looks at three episodes of co-production of technological and political practices: (1) the PTA as an independent assessor (1990); (2) the PTA as a regular follower (1996-2005); (3) the PTA as a whistle-blower (2007-2017). We find that maintaining or redrawing boundaries between science and policy have increasingly been necessary but difficult in the course of the PTA's mainstreaming into the policy-making landscape and the nuclear establishment. We conclude by examining the implications for PTAs of a possible shift from concerns about democratizing expertise to politicizing knowledge for policy.

**Keywords**: Co-production; Parliamentary Technology Assessment; Nuclear Waste Management; High-Level Radioactive Waste; Legitimacy; Politics of Technology Assessment.

**Acknowledgments**: This article was supported by Fonds De La Recherche Scientifique — FNRS. The authors want to express their gratitude to the two anonymous reviewers for their insightful and constructive comments on a first version of this article. They also thank Tom op Het Veld very much for his careful proofreading. Lastly, many ideas defended in the article greatly benefited from the first author's affiliation with the STS Program at Harvard University (Kennedy School of Government). Her special thanks go to Sheila Jasanoff and the research fellows at Harvard STS.

[1] Corresponding author: Céline Parotte, Spiral Research Centre, Department of Political Science, University of Liège, Place des Orateurs (Quartier Agora) 3/29, 4000 Liège, Belgium; Email: celine.parotte@uliege.be; Tel: +32 43664697.

THE MAIN ROLE OF PARLIAMENTARY TECHNOLOGY ASSESSMENT (PTA) is "to explore and assess the possible impact of technology on society in order to support policy making and aid the social debate by providing objective and non-partisan information" (Ladikas and Decker 2004: 3). As boundary institutions connecting politics, science and society and aiming at providing "neutral" policy advice, PTAs are usually not very keen to embrace overly sensitive topics like those related to nuclear energy or the military (see Grunwald 2006). Nuclear waste management (NWM) is such a topic. As the Achilles heel of the global nuclear industry, nuclear waste generates tense public and political debates, as proposed solutions are usually perceived as ways to legitimate the nuclear expansion (Durant 2007) or the technological aspirations of the implementer (Barthe 2002). Yet, several PTA institutions (for instance, in the United Kingdom, in the United States or in France) have regularly examined nuclear-related issues in their country. In this area, the French Parliamentary Office of Scientific and Technological Choices (OPECST) stands out as it has incontestably been the most productive one: of the 54 nuclear projects partially collected by the TA community, OPECST realized 33 of them. [2] Over the years, the French PTA undeniably became a key actor connecting science and public policy in France's nuclear landscape.

We suggest scrutinizing the roles and the engagement of OPECST in the Nuclear Waste Management (NWM) program since its first intervention (in 1990) onwards. We argue that NWM and French PTA's trajectories are so intertwined that they need to be analysed together to understand some contemporary political and technological issues about nuclear waste in France. In her seminal book on the *Radiance of France*, Gabrielle Hecht (2009) highlighted the role played by nuclear technology in the construction of France's national identity. As she convincingly showed, in the aftermath of World War II, the enthusiasm for nuclear power became synonymous of national glory and deposited layers of sediment on previously existing histories and scientific and technological trajectories.

With a dedicated focus on OPECST and NWM, we choose to adopt the idiom of co-production (Jasanoff 2004) to track and discuss the regularities of this sedimentation process, as well as the tensions that arose when disruptive events affected the normal course of sedimentation, and social fractures and conflicts surfaced. The idiom of co-production, briefly stated, "is shorthand for the proposition that the ways in which we know and represent the

[2] http://technology-assessment.info/index.php/component/seek/?x=nuclear&tab=r&kind=r, TA portal, consulted June 2nd 2017.

world (both nature and society) are inseparable from the ways in which we choose to live in it" (Jasanoff, 2004: 2). A co-production framework presumes that technological and political choices shape our world simultaneously, and in turn cannot be seen independent from the background that they themselves help shape (Valkenburg and Aarden 2011). Co-production opens up "the possibility of seeing certain 'hegemonic' forces, not as given but as the (co-)products of contingent interactions and practices. These insights may, in turn, open up new opportunities for explanation, critique and social action" (Jasanoff, 2004: 36). By adopting this framework, we thus distance ourselves from grand narratives according to which Machiavellian promoters of nuclear power would constantly reinforce their power by emptying out and recuperating social and political critique of antinuclear movements (see for instance Topçu 2013).

Rather, we take an extended timeframe of OPECST activities (1990-2017) into account to facilitate an investigation of how exactly, in the case of NWM, the knowledge produced has been incorporated into policy-making, while simultaneously examining the opposite direction of how policy-making practices have influenced the making and use of knowledge generated by OPECST.

Analysing the French PTA and the NWM program together can be justified on several grounds. First, the impact of OPECST on the NWM program has been very significant: the French PTA has successfully initiated two bills in NWM and its members have actively participated in the crafting of the "Reversibility" law in 2016. Initiating legislation is sufficiently unusual to remain a holy grail for PTA institutions that are expected to have an impact on science and technology policy-making (Decker and Ladikas 2004). Second, in France, the interventions of OPECST coincided with a moment of restructuring of the state-experts-publics relationship to collectively deal with nuclear waste management issues (Parotte 2016). Since 1990 and the beginning of what has been named the "participatory turn" (Bergmans et al. 2014), OPECST never stopped following the issue, up to becoming a crucial actor of the NWM landscape. Regarding other national public or expert committees in charge of assessing the NWM program, the features of OPECST are twofold. First, the office assesses the NWM program on a regular basis, of which it evaluates many aspects. Second, OPECST presents a unique feature in the PTA community as the main practitioners who perform the TA work are parliamentarians; this contrasts with many other PTA institutions, where TA work is transferred to the secretariat or subcontracted to a scientific institution. Following OPECST thus allows a questioning of the role and the influence on nuclear policy-making of a science-based evaluator closely related to the Parliament. But regularly assessing

such a sensitive object as the NWM program potentially affects the assessor's practices and legitimacy. Questioning the consequence of such a program on the PTA structure remains a real issue in a global context where the impetus of PTA is constantly challenged (Bütschi and Almeida 2015; Horst 2014; Van Oudheusden et al. 2015). Lastly, the French PTA's trajectory remains insufficiently examined with three notable exceptions: Laurent (2000), Delvenne (2011), and Birraux (2002). Even though these studies have convincingly shed some light on the history and structure of the French PTA, they are mostly socio-institutional analyses. Thus, almost no recent English literature addresses OPECST and no contribution takes it together with a key area of its expertise, NWM.

This article relies on a collection of empirical materials. In total, 30 semi-structured interviews were carried out with NWM actors or experts, including French parliamentarians who are members of OPECST, former directors of French agencies such as the National Agency in charge of NWM in France (ANDRA), the Nuclear Safety Organisation (ASN) and the Institute for Radiological Protection and Nuclear Safety (IRSN), social scientists specialized in NWM field, and several members of the Local Information and Monitoring Council (CLIS). In addition, the 12 OPECST reports on NWM were thoroughly analysed.

The next two sections shortly present the institutional context of the French nuclear landscape and the PTA. This is a necessary first step to understand the depth and extent of the impacts of TA activities on the NWM program, and vice-versa. The third section analyses three successive periods of the interlinked evolutions of TA and the NWM program. We conclude by discussing the mutual outcomes of these episodes of co-production, and by circumscribing important issues of the politics of Parliamentary Technology Assessment.

## Nuclear landscape and main national actors of nuclear waste management in France

With its 58 reactors, France is one of the most nuclearized countries in the world and the first nuclear energy producer in Europe. Nuclear energy accounts for 75% of its electricity production (Nuclear World Association 2015). The two main energy producers (AREVA and *Electricité de France* – EDF) are public companies owned by the State. Nuclear is thus a state issue, constitutive of the national identity of France (Hecht 2009). Most of the political parties (except the Green Party) and every French President of the 5$^{th}$ Republic have been supportive of nuclear energy (Barthe and Meyer 2012; Topçu 2013). To put it in the words of a previous

Minister of Ecology (Green party): "there is no nuclear lobby in France, the State is the lobby" (Lepage 2014: 10).

The nuclear waste landscape is composed of several national actors and each of them contributes to framing, assessing or controlling nuclear waste issues. The main waste producers (public companies and the *Centre de l'Energie Atomique* — CEA, a public nuclear research institution of 16.010 employees) are responsible for their waste and must also assume the financial burden of the final solution for their waste. Created in 1979, the NWM public agency (ANDRA) is in charge of suggesting the final storage concept, managing and implementing the siting process as the long-term solution. ANDRA is also considered as very close to the Government, the producers and their political choices in nuclear energy (Barthe 2006; Barthe and Meyer 2012). The agency is under the tutelage of three Ministers: Ecology, Industry, and Research. The regulatory body (*Agence de Sûreté Nucléaire* — ASN) and its technical support organization (*Institut de radioprotection et de sûreté nucléaire* — IRSN) have the public mission to control and to give final authorization of the final storage. In France it is also called the "nuclear policeman" (ASN representative, personal interview 2014).

Beyond those traditional actors, there are several evaluative and national consultative bodies in charge of assessing one or several dimensions of the high-level radioactive waste process and project (Lehtonen 2015). The very first organization to do so was OPECST, which has continuously been dealing with the nuclear waste process since 1990. Other such actors also include the National Assessment Board (CEN), which assesses scientific research and studies of the implementer since 1995; the Multi-stakeholders High Commission for Transparency and Information on Nuclear Security (HCTISN), since 2008 in charge of assessing the transparency of the different NWM project; the National Commission of Public Debate, which was twice responsible of organizing public debates (in 2005 and 2013); and lastly, a Commission in charge of financial assessment of radioactive waste management since 2009 (CNEF). Interestingly, as we will see in the next section, OPECST has contributed to create almost every one of those evaluative and consultative bodies.

## The French Parliamentary Technology Assessment in the nuclear landscape

OPECST demonstrates several peculiarities when compared to other PTAs, as we have illustrated above. Understanding these distinctive features is key to understanding its impact on public policy.

This Office has been created in 1983 in a context where several "strategic and important decisions tended to escape to democratic control" (Delvenne 2011: 88), first and foremost in the nuclear domain. It has been built as a democratic tool *of* and *for* the Parliament with a twofold aim. First, producing knowledge about societal, political and economic consequences of technological development at the earliest possible stage. Second, improving the outreach capacity of the Parliament and its impacts on the decision-making process. OPECST is usually categorized as a "parliamentary committee model" (Enzing et al. 2011) meaning that it is strongly linked to the Parliament and its parliamentary committees (OPECST Past President, personal interview 2014).

Therefore, OPECST's unique client is the Parliament (i.e. the Bureau of either assembly or a special or permanent committee), its funding support comes exclusively from the Parliament, its board and its staff are exclusively the Members of Parliament (18 senators and 18 deputies from both majority and opposition) and the TA secretariat serves the TA parliamentarians (Ganzevles et al. 2014: 301-02).

OPECST can work either reactively (facing an existing problem raised by a parliamentarian or a committee) or proactively (anticipating new questions and consequences about a technology and organizing feedback to decisional arenas).

Finally, its main particularity concerns the high involvement of the parliamentarians who perform the TA work themselves (Delvenne 2011). Indeed, it is a unique feature for a PTA that each parliamentarian who is appointed "rapporteur" (it regularly happens that two rapporteurs are designated) endorses the tasks to take the lead of public/private hearings, to conduct the scientific assessment, to write the TA report and the associated political recommendations, and finally to present and promote it to the concerned committees. As Delvenne (2011: 92) puts it, "the highly acclaimed quality of the OPECST's reports comes from the personal involvement of the rapporteur. Without this involvement, the survival of that Office as-we-know-it would be compromised." The double status of the TA members (which are both TA practitioners and parliamentarians) gives them a serious advantage to influence their fellow parliamentarians and thus to impact public policies. As TA practitioners, they appraise technological choices, feed the policymakers' reflections with a more political tone that are intended to be directly and readily usable by other parliamentary bodies (Laurent 2000: 132). As policymakers, they also are fully embedded within formal

policy-making bodies and processes. Even if members of OPECST and their staff insist on the separation of the Office's work and the parliamentary committees' work, they admit that, in practice, their procedures can often overlap (OPECST Member and OPECST Past President, personal interviews 2014). Several examples of NWM issues perfectly illustrate this situation. The MP Christian Bataille was regularly appointed as TA rapporteur on NWM issues (10 times!) and he was also the official rapporteur of the parliamentary committee in charge of preparing the NWM law. Henri Revol, another MP and TA member, was appointed twice as the official rapporteur of the senate committee on the topic of NWM. Two OPECST members, Gérard Longuet and Christian Namy, both directly concerned by the geological disposal project, initiated the NWM law proposal in 2016.

From the outset, the French Office has paid central attention to the nuclear field. Its second report in 1985 was about nuclear safety and security. In 1987, after the Chernobyl accident, it was commissioned to study the consequences of the accident and the organisation of the safety and security of nuclear installations.

Six years after its birth, the then still young Office was for the first time commissioned to investigate the sensitive case of nuclear waste issues. OPECST was first assigned to this topic in a context of crisis: the Prime Minister had announced a one-year suspension on nuclear waste research after three years of strong local oppositions against the siting process of geological disposal. The President argued for a "more open process" with a "style of Government that promote[s] dialogue and compromise" (Barthe 2009: 949). At the end of this first experience, the PTA was unanimously considered as the first agent of the 'participatory turn' on NWM in France and, since this first genuine success, it regularly assesses the issue. Among the 33 reports produced on the nuclear domain, 12 focused on nuclear waste issues. OPECST has "progressively become an important centre of expertise of nuclear energy in France" (Delvenne 2011: 89).

Over the years, OPECST also became a key actor in the legal arena at different stages of the NWM decision-making process: before any legislative initiative is taken (for scientific assessments), during the legislative process (OPECST hearings with the concerned parliamentary committees and through TA members' lobbying) and after the enforcement of any new legislation in that domain (to follow up on the law's execution). The Office is also the assessor of several NWM actors' initiatives and it has become the obligatory passage point of several reports and demands.[3]

[3] OPECST assesses the National Plan for radioactive materials and waste management produced by the Government every three years. It also assesses every year the scientific reports produced by the National

The next section describes the successive roles and engagements endorsed by the PTA on NWM issues from a co-productionist point of view, divided into three separate episodes between 1990 and 2017.

## Three episodes of co-production of OPECST and the nuclear waste program

### 1990, Parliamentary Technology Assessment as a new and independent assessor

The first intervention of OPECST was a reactive one in a context of governmental crisis and of ANDRA's failure to manage the high-level radioactive waste' siting process. As Christian Bataille, already parliamentarian and OPECST member at that time, summarizes it, it is very unusual in France to see the executive branch asking the Parliament for assistance: "Let me tell you something with a little irony. In France, the executive culture is dominant to such an extent that when the executive branch feels the need to ask the legislative branch to solve a problem, they are in a very desperate situation" (Bataille 2014).

In such a context, the expected roles of the PTA were to inform ("giving the government a new take on the debate") and to foster a dialogue between the "certainties of scientists" and the "fears of populations" (OPECST 1990: 9). In Ladikas and Decker's terms (2004: 6), OPECST should produce knowledge ("raising knowledge") and play the role of mediator between civil society and the experts ("mediation") to move forward with NWM program. To do so, it first decided to restrict the issue to the high-level civil radioactive waste. Military nuclear wastes and the nuclear energy futures were then excluded from the debate.

This first intervention of OPECST and its rapporteur (Christian Bataille, a socialist MP, representative of a non-nuclearized Department) produced several results. First, it increased knowledge by re-opening up the old technical options previously excluded from the nuclear waste decision-making process. All possible and unrealistic options were exhaustively assessed. Its scientific assessment underlined that the several deadlocks operated in the past had led to geological disposal as the only possible reference option. In order to avoid the deadlocks, OPECST suggested exploring two new research options: the eternal storage above the ground and the partitioning/transmutation of long-life elements. Second, the assessment of

---

Assessment Board for research and the studies into the management of radioactive wastes and materials (called CNE). Finally, the Office will also evaluate the authorisation request of the future site repository (which included the summary of public debate, the report of CNE, the independent advice of French regulatory body). It will be in charge to present its conclusions to the relevant commissions of the National Assembly and the Senate

the pros and cons of the technological solution also highlighted the social mapping of the nuclear waste controversy. The public hearing process, fully organized and managed by the rapporteur, tended to be more inclusive and fairer (Barthe 2002). Actors, such as the waste producers or the local implementer, have been forced to debate their own perspective and interests, together with the local policy-makers and environmentalist groups. Value judgments and scientific results were both considered. By doing so, the PTA formed attitudes and opinions and created self-reflection among the actors. It acted as a "mediator" (Decker and Ladikas 2004), a "referee" (Barthe 2002) able to enforce a nonpartisan procedure and to create a credible space that could contribute to unlocking the blockade. Third, OPECST also initialised several actions that reframed the debate, the decision-making processes, and the action plan of both the Government and the Parliament. It suggested reframing the issue: not just discussing a siting process for a final repository for high-level radioactive waste, but, rather, discussing a siting process for several underground research laboratories in order to identify the most suitable underground location for this type of waste. The PTA underlined the importance of looking for several laboratories and to keep the siting process of the final solution separated from the siting process for the underground laboratories. Those two conditions were considered as prerequisites for co-operation among actors and the re-establishment of trust (OPECST 1990). OPECST also asked for new action plans and new decision-making processes: it considered that additional research programs (on the eternal storage and partitioning/transmutation solutions) had to take place, that independent committee of experts had to be set up to follow those research programs, that ANDRA's independence should be provided, and that the PTA should continue to regularly follow the issue. Finally, it also asked for several new ways of governance. Indeed, for OPECST, the Parliament should be the main and the first institution in charge of framing the nuclear waste management program. Second, at the local level, the PTA considered that elected representatives should be consulted too and, for each site, that a local and oversight information committee had to be created.

In sum, this first episode led to new procedures to improve information and dialogue, new ethical principles, and exploration of new research options. All of these recommendations were integrated in the Waste Act of 1991, also called the Bataille Law (after the name of the PTA member which was also the official rapporteur of parliamentary commission). Clearly, the action of the PTA significantly changed the way in which the NWM issue was addressed (Barthe, 2009: 942).

This success, which was "very unusual in the French political system" (Laurent 2000: 141), had two consequences for the Office. First, OPECST was officially recognized as an important independent actor distinct from the nuclear establishment that had proved to be able to unlock the blockade of the NWM decision-making process. The "virginity" of the PTA had proved to be a notable advantage. Indeed, for the first time in its still short history, the French PTA could forcefully demonstrate its capacity to serve "as a platform for dialogues between many different voices" and its "(…) potential to open new avenues of understanding and inquiry" of scientific and technological issues. This first successful intervention increased its legitimacy as a new but efficient PTA on sensitive issues. Particularly, the role of the PTA rapporteur (Christian Bataille, not acquainted with nuclear issues and coming from a non-nuclearized Department) was unanimously considered as "very valuable for the progress in the management of this issue [nuclear waste management]" (ASN and ANDRA Past Directors, personal interviews 2014).

Consequently, since that period, boasted by its first major success, OPECST has regularly been invited to follow each step of the NWM process and, more generally, to assess the nuclear sector's activities. As underlined by Laurent (2000: 141): "even the Minister of Industry recognized the fact that it is thanks to OPECST that Parliament effectively controls the entire non-military nuclear sector". On NWM issues, the best illustration was given in 1992, when to enforce the law, two Governments with opposed political leanings asked Christian Bataille to be the negotiator for the search of underground laboratories research. As Christian Bataille (2014) later explained us: "I performed all the roles (…): I've been rapporteur of [OPECST] report, rapporteur of [NWM] law proposal and then nominated as mediator at the local level. It's quite unusual because the role of legislator is quite comfortable (…); we vote for the law and afterward the administration applies it and that's why [the law] is not so well applied, sometimes not at all".

Following the trajectory initiated by this first episode of co-production, OPECST moved from being a one-shot independent assessor in 1990, to endorsing the role of a regular follower of NWM program from 1996 to 2005. We will see in the next section that new challenges appeared for the PTA with its new status as well as for the NWM program.

## 1996 – 2005, Parliamentary Technology Assessment as regular follower

During the fifteen years following the Waste Act of 1991, the PTA issued seven reports on NWM, among which five reports were on high-level civil radioactive waste[4]. In that period, the PTA operated in a context where the enforcement of the Waste Act was facing practical difficulties. Indeed, only one underground research facility had been built while two were expected and one of the options (partitioning/transmutation) was challenged regarding the cost of the reprocessing and the lack of existing technical and scientific developments. Nevertheless, the Waste Act had planned the next political agenda of the NWM program: in 2006 a "decision-in-principle" was expected to be taken on which technical option was preferable.

During that period, the main role of the PTA was to assess and follow the enforcement of the Waste Act. Therefore, OPECST compared several technological developments and highlighted the practical difficulties that were encountered. In 1996 and in 1998, its scientific assessment made visible how difficult the realisation of the partitioning/transmutation option was, especially for financial and technical reasons. It tried to provide a comprehensive overview of the consequences connected to those difficulties. This statement was problematic for the PTA: according to Christian Bataille (again rapporteur of the report), the non-implementation of this option and consequently the closing down realized could undermine the acceptance of the final project (OPECST 1996: 23). To avoid this closing down of the options at hand, the PTA suggested focusing on a new action plan. First, it stressed that the reversibility of the geological disposal should be studied because "(…) it constitutes a key element of the trust of the affected population regarding the building of the underground disposal. It will keep the options opened for the future generations (…)" (OPECST 1996: 107). Second, it argued that the long-term storage should be further studied in order to challenge the option of the geological disposal. In 1998, the two PTA's rapporteurs (Christian Bataille and Robert Galley) also stressed how much nuclear energy was "a decisive energy for the upcoming century" and how "(…) until now, [nuclear energy] remains the most balanced solution" (OPECST 1998: 4-5). Contrary to previous positions held by the French PTA, its rapporteurs expressed their support for nuclear energy for the first time.

Both suggestions were subsequently considered in the CEA and ANDRA researches. In 1999, the Nuclear Research Centre (CEA) hired 60 persons to study the long-term storage

[4] In 1996 about the developments of the research programs on civil high-level radioactive wastes; in 1998 about the spent fuel cycle; in 2000 on the impact of nuclear waste storage facilities on public health and the environment; in 2001 on the long-term storage option; and in 2005 on the progress and prospects of research on the management of radioactive wastes.

(OPECST 2001: 7). These research results were then consequently taken up in the next PTA's report.

In 2001, OPECST, yet again represented by Christian Bataille, assessed the long-term storage research and it unequivocally underlined how this option actually presented disadvantages. To justify its position, the Office quoted the CEA and the national expert committee (CEN): "the long-term storage is an option for a short temporary period before burying or reprocessing wastes" (OPECST 2001: 43). The PTA then continued to provide further scientific assessments but clearly intended to justify a future closing down of the options. It thus progressively acted as a filter of the policy and research options about NWM.

In its report of 2005, OPECST (represented by Christian Bataille and Claude Birraux) summarized fifteen years of research on nuclear wastes in order to "move forward in the path opened by the Waste Act in 1991: taking our responsibilities for the future generations" (OPECST 2005: 10). The main purpose of the report was to initialise actions of the Parliament and the Government. OPECST assessed the existing policy options and formulated choices. To do so, the PTA proceeded as it did in 1991. Several public hearings were conducted with all the actors embedded in the NWM process: international and national experts, local policy-makers and NGO were invited to express their views and their preferences (OPECST 2005: 13). Here, the social mapping and the scientific assessment of the technical options served the choices operated and suggested by the OPECST. First, the report concluded that the three options were no longer in competition but, rather, that they had to be seen as complementary options implemented at different time scales. According to this view, the storage option was only a temporary option for the short term, while the geological disposal was to be applied for the long-term and the partitioning/transmutation solution still was a solution of the future for nuclear waste. In others words, regarding existing research already available back then, the PTA suggested the geological disposal as being the main and best option. It added that this option should be associated with an existing underground laboratory (in 2005 only one underground laboratory had been built). But to avoid a full closing down of the alternatives, OPECST suggested adding the reversibility as a main condition to the geological disposal solution. Second, the PTA also anticipated the economic dimension of the implementation of its favoured future solution. It suggested that the financial support dedicated to the long-term solution had to be improved. Until then, the nuclear industry was fully managing this issue. OPECST recommended that an independent fund had to be constituted in order to guarantee the financial support in the long-term, to separate the short-term investments from the long-term ones, and finally to increase transparency and

control. It added that to assess the activities of this fund, an independent commission should be constituted. Third, the PTA also suggested a new decision-making process and a new action plan. As it had already suggested in 2000, a multi-stakeholders national plan for all nuclear waste should be realised.

In 2006, the Planning Act almost entirely adopted the recommendations of the PTA, with a notable exception: the financial dimension of the project remained the full responsibility of waste producers and no independent fund was constituted. Instead, two funds related to the implementer (ANDRA) were created: one for research (secured by a tax on the waste producers) and one for "the construction, the exploitation and the halt of the storage installations" (secured by the waste producers after an agreement with the implementer) (OPECST 2007: 35). Nevertheless, the impact of the work conducted by PTA and its members during the parliamentary decision-making process remained high: PTA members suggested 109 amendments at the National Assembly and the Senate, which were all adopted (OPECST 2007: 26).

Over the years, thus, we have seen that the engagement of OPECST in NWM has been institutionalized and routinized. The PTA has been legally and regularly mandated to organize technology assessment in order to support and shape the policy process. In this second episode of co-production, we find that the role of PTA as regular follower of a sensitive issue has modified its legitimacy in two ways.

First, at the national and the local level, the Office has progressively been considered as part of the nuclear and policy establishment. As an OPECST member (Henri Revol) puts it, the decision-making process was not anymore fully concentrated in the hands of nuclear industry, the Government, and the nuclear waste management organisation, as it used to be. But the decision-making process seemed to change in favour of a "four-part" nuclear decision-makers where the Parliament, through OPECST, had an important part to play (Revol 2006). In this sense, we can say that it became a normalized member of nuclear policy-making. Over the years, the integration of the recommendations provided by the Office positively demonstrated its capacity to lastingly impact the decision-making process in nuclear waste management on several dimensions. More than the process in itself, the engagement activities and the reports of PTA also demonstrated OPECST's capacity to provide balanced outcomes that could be directly used in policy-making. As a member of the local information Committee summarizes it, "if you want to have an idea of what will be the vote of Parliament in the next year [about the Planning Act], read the report of the PTA, you shouldn't be too far from the truth"(CLIS 2005: 17).

But at the same time, the embedded position of the PTA, the failure of the full implementation of the Waste Act in 1991, the high and recurrent involvement of the same TA rapporteurs, and its changing discourses over the years, have also partly undermined its status of independent and neutral actor. The 1998 study on the spent fuel cycle seems to have marked a clear shift compared to the previous PTA position. The PTA rapporteurs explicitly promoted the advantages of nuclear energy, something they never did before (OPECST 1998). Decidedly, the PTA was then associated with the nuclear actors who are known for carefully and consistently striving for the avoidance of any possible deadlocks in the nuclear waste management process. In other words, the PTA appeared as a supporter of the NWM program more than a critique of it. Institutional integration tended to enact the identity of the French PTA inasmuch as its assessments gradually became instrumental means to reach policy recommendations.

This shift from an independent assessor to a regular follower of the NWP program also resulted from the changing context in which the TA was operating. In 1990, it worked to *broaden* and to *open up* the process in order to *mediate* a critical situation. The Waste Act opened up the alternatives and postponed a final decision to a later time. In 2006, the Planning Act was announced as a closing down moment. A technical choice had to be on the move. Then, the PTA started to act more as a filter that *classifies and prioritizes* the options.

But still, for the first time in its history concerning nuclear wastes, one of the recommendations (the financial one) of the PTA was not followed. The next section highlights how the recent shift in the operational phase of NWM tends to exclude PTA from the sensitive operational issues, which modifies its role relative to PTA again.

**2007 – 2017, Parliamentary Technology Assessment as a whistle-blower?**

After the Planning Act of 2006, the executive phase of the NWM program began. The implementer started to build an industrial project fulfilling the safety requirements and that was economically and technically feasible. In 2010, the Government circumscribed a small area (of 30 square kilometres) to conduct further research in order to create the future geological disposal facility. Additionally, every three years, the National Waste Plan (suggested by OPECST in 2000) assesses and clarifies the management of all types of radioactive wastes in France including the project for high-level radioactive wastes.

In this context, OPECST was mainly in charge of following and assessing the multi-stakeholder National Waste Plan[5]. But it has also regularly assessed new developments in nuclear research (mainly on partitioning/separation and geological disposal) and to assess and follow the implementation of the Planning Act. Since the Planning Act, OPECST has produced four reports on NWM (in 2007, in 2011, in 2014 and 2017).

In the reports of 2011 and 2014, the PTA tried to maintain the new ways of governing nuclear waste which had been approved in the previous years (e.g. it insisted on the necessity to keep the Parliament in the decision-making process and to respect a strict enforcement of the Planning Act) and to make visible the negotiation moments where the Parliament and the Office were excluded. The PTA thus acted as a defender of the legislative power and it systematically urged the strict respect of the Law (OPECST 2011: 24). Then, in the same two reports, and in a tone it had never adopted before, the PTA blew the whistle on the negotiation process of the financial aspects of the industrial project and the decisions taken in that respect. It criticised the lack of transparency on this issue. The PTA also denounced the pressure of the waste producers on the public implementer to decrease the cost of the industrial project and to influence its conception. According to the Office, a hundred gatherings were secretly organized between the public implementer, the nuclear industry and the administration to discuss the project. Later, a confidential convention was signed between ANDRA and the waste producers about the future project's conception (OPECST 2014: 40). For the PTA, the NWM program faced what they named "the paradox of tranquillity". According to the improvement of the nuclear waste management context, the nuclear establishment seemed to return to its old mode of governance (OPECST 2011: 55). In other words, the implementation of the program came back to exclusively be the decision of the few experts closely related to the Minister of Industry, without any national consultations and without any parliamentary control. OPECST also drew public attention on the late creation of the independent commission in charge of assessing the financial dimension of the project (it was established in 2009 and realized its first report in 2012 – six years after the adoption of the Planning Act). OPECST continued to criticise the discontinuing operation of transmutation/partitioning from the nuclear industry, officially for financial reasons.

In this third episode of co-production, we find that the consequences of the PTA interventions on nuclear waste issues from 2007 to 2015 are twofold. First, concerning the

[5] Suggested by OPECST and applied on the initiative of the regulatory body, the project entitled "national plan on management of radioactive materials and waste (PNGMDR) has been formalized in 2003 and an interdisciplinary group was constituted. This group is composed of environmental associations, regulatory body, nuclear waste management organization, nuclear waste producers.

improvement of the National Waste Plan, all suggestions to improve the form or the communication strategy of the report and the discussions among the actors were still integrated. Second, the shift from the conceptual to the operational phase of the NWM program seems to exclude the PTA from the next steps of the NWM decision-making process. At this stage, the financial and safety dimension are the two most sensitive dimensions of the project and the impact of the PTA on such issues seems to be very limited or even non-existent. For sure, the PTA can ask to consult confidential documents, it can denounce a lack of transparency and its possible consequences on the legitimacy on the NWM program, but it is not a member taking part in the negotiations anymore. To put it bluntly, the office *undergoes* the operational phase of the NWM program. Consequently, in this third episode, OPECST was more *reactive* than active. During that period, the strong ties with the nuclear establishment seemed to erode. As Christian Bataille puts it, "I have the feeling that the administration wants to regain control over the nuclear field, withdrawing the initiative that the Parliament owned for 25 years" (OPECST 2014: 77).

If OPECST seems to roll back on a critical mode, its role is not that of being included in the "four-part" nuclear decision-makers anymore, as used to be the case. Neither is it considered as a neutral and independent actor like in 1991. In fact, the PTA moves on to an outsider role, even though it remains close to the nuclear establishment's position. Indeed, the Office fights for keeping its influence and the influence of the Parliament on the nuclear waste policy-making.

The PTA's most recent positions seem to point to a possible return of the Office as a regular follower or maybe as a strong and blind supporter of NWM program alongside nuclear establishment. As stressed by a TA member directly concerned by the geological disposal project (2014), even from a weakened position the PTA remains a place to "push the nuclear waste case forward". It thus seems that the Office and its members still strongly desire to contribute to or reinforce the outcomes of nuclear waste policy-making, no matter how. The recent adoption of Reversibility Law in 2016 provides us with a perfect illustration. As we have seen before, reversibility was one of the conditions to move forward with the geological disposal program for NWM. While they could have taken the time to organize hearings on the topic, as they would usually do, OPECST members directly concerned by the geological disposal project tried several times to introduce an article on reversibility's definition in more general laws. After several failures, they finally succeeded in July 2016. This was presented as a huge success by the Office itself, which stressed in its last report (2017: 46) that this law "adopted as a result of the initiative of OPECST parliamentarians"

helped to “remove the last obstacle in the way of [geological disposal facility’s] building”. Since then, OPECST seems to stand fully alongside the nuclear waste establishment’s position. It forcefully argues that “geological disposal is the best option to deal with high-level radioactive waste. The project CIGEO is the only option to ensure the long-term passive safety” (OPECST 2017: 51). A new position that could erode its status of balanced scientific institution a little more.

## Discussion

In this article we suggested that the French PTA has had a huge role in knowledge-driven policy-making of NWM from 1990 onwards. In turn, we similarly suggested that nuclear waste policies strongly influenced the legitimacy, trajectory and impact of OPECST. In short, both processes were co-produced.

OPECST strongly influenced the conceptual phase of the NWM program. Starting about three decades ago, the PTA brought more diverse epistemic cultures and “knowledge” into the nuclear decision-making process. OPECST was indeed successful at a number of things: opening up the research and policy options before legitimizing a closing down of the geological disposal option, introducing reversibility as a main condition to geological disposal, or striving for the inclusion or the creation of new actors in the process. This should be read as unusual, as for NWM the Parliament and the Office clearly influenced the course of events in a domain that has been strictly controlled by the Government and nuclear industries for a long time. As we have shown, OPECST brought legitimacy to NWM program, which was clearly missing at the end of the 80’s. The Office’s regular scientific assessments with a strong political tone have highlighted the stakes, challenges and difficulties of the conception and the execution of such a program. At each important step of the NWM program, OPECST and its members have laid the foundations of the three main laws of the program and have resolved conflicts and addressed tensions likely to affect the decision-making process.

But as a past Director of the French nuclear waste management organization (2014) puts it, when commenting on the third episode of co-production, “if OPECST did actually and visibly open the process to the Parliament, it did not fully accomplish it”. Indeed, since the NWM program entered an operational phase, several crucial elements remain out of its control, especially the very sensitive and economic, technical and safety dimensions. Does the operational phase of the high-level radioactive wastes project mark a return to an old mode of

technocratic NWM governance, as OPECST reports of 2011 and 2014 tend to suggest? Another possible explanation may be that the previous successes of the PTA were only mere exceptions in the French nuclear waste management program of high-nuclearized France. After the approval of the conceptual phase and the geological disposal option, policy-makers, industry experts and waste managers recovered the power they temporary gave the Parliament and its PTA to avoid the deadlocks they were unable to deal with. As Barthe (2006) analysed it for the NWM program's episode in 1990, this openness towards new actors was possible because nuclear industries and Government already agreed that geological disposal was the only possible technical option. To put it differently, it would mean that there was nothing new to negotiate on this technical conceptual stage that the nuclear establishment has opened the floor to new actors such as OPECST to include socio-political dimensions to the NWM program. In the operational phase, the situation is different. New spaces of negotiations have jointly emerged with the process of operationalization. A balance between safety, technical and economic aspects of the geological project needs to be found. The nuclear industry's experts (financially responsible for their waste) and the experts of the Government (responsible for the long-term safety of the technical solution) behave as if it was sufficient to problematize this technical phase alone. Of course, they know that a greater inclusiveness of actors could *reopen* previous questions, reintroduce abandoned or less studied options such as eternal storage.

The exclusion of the PTA from such sensitive issues should be seen an important milestone that could challenge the legitimacy of this "mega-project" (Lehtonen 2015) a little more, as it was the case in the 1980s. Tensions are evident at different decision levels between the multiple actors embedded in the industrial project. Even if no single actor has complete control over the project, we have stressed that over the years OPECST has constituted an important expert knowledge base, acting as a central institution for the nuclear waste management program, and becoming part of the nuclear landscape more generally. At the same time, our results highlight that this supervising role in NWM issues (definitely) has the potential to erode the legitimacy of OPECST.

While it started with enjoying the status of a young, non-partisan, balanced institution, the regular follow up of the Office contributed to transform its image into a "center for nuclear expertise". This central role played by the Office over the years also impacted its longer-term legitimacy as a successful and apparently unchallenged institution. At the same time, OPECST' strong involvement in such a long and sensitive issue has challenged its capacity to act as an independent actor. Indeed, over the years, rather than being a "neutral" institution

inside the Parliament, the Office became an active member of the NWM policy-making. It provided clear guiding outcomes and acted as a lobby from within the Houses of Parliament as it was included in the four-part policy-making together with the nuclear establishment. The strong ties that the Office has built with the issue of NWM also contributed to erode its critical capacity to assess the NWM program from the similar perspective that previously made its success in 1990. The positions it defended as a "regular follower" of the issue contributed to tame critics as they justified a choice already made previous years ago by the nuclear establishment. These results point to a fundamental problem, namely that the more OPECST developed as a "center for nuclear expertise", the less neutral it seems to have become in supervising NWM issues. This is disconcerting because it seems that bringing expertise on board introduces a certain bias into the assessment or – even worse – gets a controversial discussion into a certain direction or even closer to a lobby.

In fact, this possibly reflects the limits of the French model for PTA. We clearly pointed at the advantages of a TA model in which the work is carried out by "double agents", combining the qualities of being TA practitioners and parliamentarians, who can forcefully impact policy-making, initiate new laws and, importantly, take indisputable and direct credit for it. This could make other PTA institutions jealous, as they usually struggle not only to have an impact on science and technology policy-making, but also to *show* they have an impact. However, every model, no matter how unique, has its drawbacks. In the French model, for the emblematic case of NWM policy-making, the double status of OPECST members gradually created a problem of conflict of interests and boundary management.

Reflecting on the de-institutionalization the Danish Board of Technology, Maja Horst (Horst 2014) turned Granovetter's (1973) famous expression on its head and argued that the 'weakness of strong ties' may create unanticipated consequences for PTA institutions, whose institutional mainstreaming could serve as a way of 'taming' the unruly potential of public interest and protest. It looks like an appropriate balance needs to be found between aspirations to normalized epistemic authority and a necessary distance to policy-decisions outcomes. Like any PTA, OPECST is governed through a series of check and balances, but our examination of co-produced legitimacies of the PTA and the NWM program indicates that new internal rules should be enforced to avoid conflicts of interests, like preventing parliamentarians to be rapporteurs more than twice on the same issue, or respecting a rotation policy among the TA members, some of whom have been in place for several decades.

The PTA's current exclusion from the operational NWM phase might have been an opportunity for the Office, allowing it to get rid of its too obvious connections with the

nuclear establishment. But the recent position of the PTA revealed that it clearly decided not to go down this way. In the current configuration, the Office seems to act like an organization favouring the reproduction of an elite structure with partisan interests in favour of the nuclear policies chosen by the Government and the Parliament. Indeed, OPECST's capacity to influence the NWM policy-making has also directly involved and attracted parliamentarians in PTA activities. Since the operational phase, MPs such as Bruno Sido, Christian Namy, Gérard Longuet — all MPs geographically embedded in the CIGEO project — have been very regularly involved in the OPECST reports on NWM, and they often suggested law proposals to ensure the project "moves forward". This accumulated expertise embodied in and personified by a few parliamentarians has recently conceived a new development in the aftermath of the last presidential and legislative elections. The unexpected political tidal wave of the movement of President Macron, *La République en Marche*, has brutally opened up a period of change and uncertainty for the Office, as none of the MPs usually involved in NWM reports have been re-elected. At first glance, this could be considered business as usual: shifts in political majorities and the renewal of political elites have become part of established routines despite being an enduring challenge for TA institutions. However, in the French context, it looks even more complicated as this means a significant turnover among the TA addressees and practitioners at the same time.

## Conclusion

TA has politics, to paraphrase Langdon Winner (1980). Politics here is defined as achieving and exercising positions of influence within, and through, organized party politics (Van Oudheusden et al. 2015). Probably nowhere else is this assertion more striking than in France where OPECST's work is carried out by "double agents", combining the qualities of being TA practitioners and parliamentarians. Such a unique way of performing TA work from within a Parliament has no equivalent in the world. While beyond the scope of this article, based on these findings, it would be insightful for further research to test the idiom of co-production to countries where PTA is differently institutionalized and that have had different nuclear policy-making trajectories.

The three episodes of co-production that we analysed for France show how PTA knowledge has come to be perceived as reliable in parliamentary political settings and authoritative in the nuclear establishment. In a way, this empirical inquiry into OPECST's

activities in the case of NWM is also an inquiry into nuclear France's contemporary political life.

As boundary institutions operating at the interface of science, politics and society, PTAs are often exposed to the task of "drawing or redrawing boundaries in flexible, historically changing and sometimes ambiguous ways. 'Boundary-work' describes an ideological style found in [TA practitioners'] attempts to create a public image for TA by contrasting it favourably to non-scientific intellectual or technical activities (Gieryn 1983: 781)". Whereas boundary work was not a main task for 1990's young OPECST, maintaining or redrawing boundaries have increasingly been necessary but difficult in the course of OPECST's mainstreaming into the policy-making landscape and the nuclear establishment. In other words, the PTA's success and greater impact on nuclear waste policies came along with a blurring of boundaries between TA practice and nuclear policy-making, thereby threatening the legitimacy of the institution as it was getting too close to the issues to be assessed.

In the first episode of co-production, the "virginity" of the French PTA with regard to the topic of nuclear waste had constituted a solid advantage. In addition, the fact that the rapporteur Christian Bataille was not familiar with the issue at stake and had no interest in it contributed to enhance the legitimacy of OPECST as a neutral institution. At this period, no further demarcation with regard to other actors or other types of knowledge was deemed necessary, as TA was a relatively new actor, clearly independent from the nuclear establishment. Problems of legitimacy emerged during the second episode of co-production. The normalization of the PTA in nuclear policy-making, the greater authority of its expertise in the domain of NWM, as well as its growing proximity with the nuclear establishment seriously affected the perception of TA as a tool for (supposedly) neutral, scientific advice. Gradually, in the case of NWM, OPECST came to be perceived as a space for partisan, interested policy-making. The strong involvement of OPECST members in closing down sociotechnical options to manage nuclear wastes eroded the image of neutrality the PTA had so far been benefiting from. Lastly, the third co-production episode showed that even for a very successful PTA, being involved and having an impact on policy-making shouldn't be taken for granted. Our historical account of OPECST can be read as a powerful warning to avoid the reminiscence of the myth of Icarus, whose father first warned him of complacency and hubris, asking him not to fly too low or too high, so the sea's dampness would not clog his wings or the sun's heat melt them. Icarus ignored his father's instructions not to fly too close to the sun; when the wax in his wings melted he tumbled out of the sky and fell into the sea where he drowned.

These findings can be sources of inspiration for other PTA institutions, which are increasingly tempted to take sides and grow into 'partisan TA' in order to have greater and immediate policy relevance (Delvenne et al. 2015). We suggest that while this could be a solution to achieve greater impact on public policies and prove effectiveness, it also requires TA practitioners to pay constant attention to the art of boundary work and to be cautious not to fly too low or too high. Acknowledging a political role would mean a shift in the TA ethos since, from its beginnings in the 1970s, the concept of PTA has been strongly bound to, and (self-)legitimated by, the myth of 'neutrality' as a regulative idea. Claiming to be 'apolitical' in the sense of restricting itself to the role of a 'knowledge broker' and refraining from taking a strong political stance in terms of recommending specific political action has been at the core of TA's understanding of policy advice (Hennen and Nierling 2017). In France or elsewhere, invoking "neutrality" has proved to be helpful for PTA, yet only to embed PTA practices and methodologies in evidence-based modes of policy-making. However, the recent contextual evolutions *both for PTA* — facing a deinstitutionalization trend in some countries or regions, for example in Flanders or Denmark — *and policy-making* — with political trends described as "post-truth" that appear to steer policy-making toward new directions, hostile to facts and to reason — may herald a shift from concerns about democratizing expertise to politicizing (lay and expert) knowledge for policy.

**References**


Barthe, Yannick (2002), 'Rendre discutable. Le traitement politique d'un héritage technologique', *Politix,* **15** (57), 57–78.

--- (2006), *Le pouvoir d'indécision. La mise en politique des déchets nucléaires*, ed. Economica (Economica edn.; Paris).

--- (2009), 'Framing nuclear waste as a political issue in France', *Journal of Risk Research,* **12** (7-8), 941–54.

Barthe, Yannick and Meyer, Morgan (2012), 'Identifying remaining socio-technical challenges at the national level: France.', in INSOTEC report (ed.), (European commission community research), 21.

Bataille, Christian (2014), 'Entretien avec Christian Bataille, rapporteur de l'OPECST depuis 1991, député du Nord, parcours du député dans la gestion des déchets radioactifs en France, le 26 novembre 2014, Paris, 45min.'.

Bergmans Anne, Sundqvist Goran, Kos Drago and Simmons Peter (2014), 'The participatory turn in radioactive waste management: deliberation and the social-technical divide', *Journal of Risk Research*, **18**, 347-363.

Birraux, Claude (2002), 'L'office parlementaire d'évaluation des choix scientifiques et technologiques: le politique et l'expertise scientifique', *Revue française d'administration publique*, **3** (103), 391–97.

Bütschi, Danielle and Almeida, Mara (2015), 'Technology Assessment an Parliaments', in Constance Scherz, et al. (eds.), *The Next Horizon of Technology Assessment* (Berlin: PACITA), 23–26.

CLIS (2005), 'Comité Local d'Information et de Suivi, réunion de suivi du 23 juin 2005', 68.

Cruz-Castro, Laura and Sanz-Menéndez, Luis (2004), 'Shaping the Impact: the Institutional Context of Technology Assessment', in M. Decker, Ladikas, M. (ed.), *Bridges between Science, Society and Policy. Technology Assessment - Methods and Impacts* (Berlin: Springer), 101–27.

Dean, Mitchell (2010), *Governmentality. Power and Rule in Modern Society,* ed. Sage Publication (London) 304.

Decker, Michael and Ladikas, Miltos (2004), *Bridges between Science, Society and Policy. Technology Assessment - Methods and Impacts*, ed. Carl Friedrich Gethman (Ethics of Science and Technology Assessment; Berlin: Springer).

Delvenne, Pierre (2011), *Science, technologie et innovation sur le chemin de la réflexivité. Enjeux et dynamiques du Technology Assessment parlementaire*, ed. Jean-Emile Charlier (Thélème, VII; Louvain-La-Neuve: Harmattan-Academia s.a.).

Delvenne, Pierre, et al. (2015), 'De- and Re-Institutionalizing Technology Assessment in Contemporary Knowledge- Based Economies', *Technikfolgenabschätzung – Theorie und Praxis*, **24** (1), 20–28.

Durant, Darrin (2007), 'Burying globally, acting locally: Control and co-option in nuclear waste management', *Science and Public Policy,* **34** (7), 515–28.

Enzing, C., J. Deuten, M. Rijnders-Nagle, and J. van Til. 2011. *Technology Across Borders – Exploring Perspectives for Pan-European Parliamentary Technology Assessment*. ed. European Parliament. STOA (Brussels).

Ganzevles, Jurgen, van Est, Rinie, and Nentwich, Michael (2014), 'Embracing variety: introducing the inclusive modelling of (Parliamentary) technology assessment', *Journal of Responsible Innovation,* **1** (3), 292–313.

Gieryn, Thomas F. (1983), 'Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists.', *American Sociological Review* **48** (6): 781–95.

Granovetter, M. S. (1973). 'The strength of weak ties', *American Journal of Sociology* **78** (6): 1360-1380.

Grunwald, Armin. 2006. 'Scientific Independence as a Constitutive Part of Parliamentary Technology

Assessment.' *Science and Public Policy*, **33** (2): 103–13. doi:10.3152/147154306781779073.

Hecht, Gabrielle (2009), *The radiance of France: Nuclear power and national identity after World War II*, ed. MIT press.

Hennen and Nierling (2017), 'The Politics of Technology Assessment', call for paper, 3rd European Conference on Parliamentary Technology Assessment, Cork, may 17th–19th, 2.

Horst, Maja (2014), 'On the weakness of strong ties', *Public Understanding of Science,* **23** (1) 43–47.

Jasanoff, Sheila (2004), *States of knowledge: the co-production of science and the social order*, ed. Routledge (London and New York) 330.

Ladikas, Miltos and Decker, Michael (2004), 'Assessing the impact of future-oriented technology assessment', *EU-US Seminar: New Technology Foresight, Forecasting & Assessment Methods, Seville*, 13–14.

Laurent, M. (2000), 'France: Office Parlementaire d'Evaluation des Choix Scientifiques et Techniques.', in Norman J Vig N, Paschen H (ed.), *Parliaments and Technology. The Development of Technology Assessment in Europe* (Albany (NY): State University of New York Press).

Lehtonen, Markku (2015), 'Megaproject Underway. Governance of Nuclear Waste Management in France', in Achim Brunnengräber, et al. (eds.), *Nuclear Waste Goverance. An International Comparaison* (Germany: Springer VS), 117–38.

Lepage, Corinne (2014), *L'état nucléaire*, ed. Albin Michel (Essais doc.: Albin Michel).

OPECST (1990), 'Rapport sur la gestion des déchets nucléaires à haute activité déposé le 14 décembre 1990 par M. Christian Bataille, Député', 367.

--- (1996), 'Rapport sur l'évolution de la recherche sur la gestion des déchets nucléaires à haute activité, tome I : les déchets civils , déposé le 27 mars 1996 par le Député Christian Bataille', (Paris: OPECST), 124.

--- (1998), 'Rapport sur l'aval du cycle nucléaire – tome I : étude générale, par M. Christian BATAILLE, Député, et M. Robert GALLEY, Député, déposé le 11 juin 1998', (Paris: OPECST), 149.

--- (2000), 'Rapport sur les conséquences des installations de stockage des déchets nucléaires sur la santé publique et l'environnement, déposé le 17 mars 2000 fait par Mme Michèle Rivasi.', 469.

--- (2001), 'Rapport sur les possibilités d'entreposage à long terme de combustibles nucléaires irradiés, présenté par M. Christian Bataille, Député', (Paris: OPECST), 117.

--- (2005), 'Rapport sur l'avancement et les perspectives des recherches sur la gestion des déchets radioactifs, déposé le 16 mars 2005 par MM. Christian Bataille et Claude Birraux, députés.', (Paris: OPECST), 341.

--- (2007), 'Rapport sur l'évaluation du plan national de gestion des matières et déchets radioactifs (PNG-MDR) n° 3793 déposé le 6 avril 2007 par MM. Christian Bataille et Claude Birraux', (Paris: OPECST), 144.

--- (2011), 'Rapport sur l'évaluation du plan national de gestion des matières et des déchets radioactifs 2010-2012, déposé le 19 janvier 2011 par MM. Christian bataille et Claude Birraux, Députés.', (Paris: OPECST), 347.

--- (2014), 'Rapport sur l'évaluation du plan national de gestion des matières et des déchets radioactifs, PNGMDR 2013-2015 réalisé par M. Christian BATAILLE, député, et M. Christian NAMY,sénateur.', (Paris, OPECST), 301.

--- (2017), 'Rapport sur l'évaluation du plan national de gestion des matières et des déchets radioactifs, PNGMDR 2016-2018 réalisé par M. Christian BATAILLE, député et M. Christian NAMY, sénateur' (Paris, OPECST), 248.

Parotte, Céline (2016), 'L'art de gouverner les déchets hautement radioactifs. Analyse comparée de la Belgique, la France et le Canada.', PhD Dissertation, University of Liege, http://orbi.ulg.ac.be/handle/2268/203024.

Revol, Henri (2006), 'Rapport fait au nom de la commission des Affaires économiques (1) sur le projet de loi, adopté par l'Assemblée nationale après déclaration d'urgence, de programme relatif à la gestion durable des matières et des déchets radioactifs. Sénat session ordinaire 2005-2006', (Paris: OPECST), 157.

Stirling, Andy (2008), '"Opening Up" and "Closing Down" Power, Participation, and Pluralism in the Social Appraisal of Technology', *Science, Technology & Human Values,* **33**, 262–94.

Topçu, Sezin (2013), *La France nucléaire. L'art de gouverner une technologie contestée*, ed. Seuil (Paris) 349.

Van Oudheusden, Michiel, et al. (2015), 'Broadening, deepening, and governing innovation:Flemish technology assessment in historical and socio-political perspective', *Research Policy*, **44** (10), 1877–86.

Valkenburg, Govert and Aarden, Erik (2011), 'Constructing embryos, constructing politics: Connecting politics and technology in the Netherlands and Germany', *BioSocieties*, **6** (4), 447–465.