3. Normative argumentation; the nuclear case

Suppose you are the members of the Dutch Parliament (Lower House). A majority in the Parliament has already chosen to seriously expand nuclear power in the Netherlands and as political decision-makers you are expected to recommend one of the two main fuel cycles for the production of nuclear power. As you will read in the following pages, these fuel cycles seriously differ in terms of their consequences for the people belonging to different generations. The question is now what you would choose based on the provided explanation. In answering this question, you need to at least be aware of the following sub-questions.

- How did you weight the interest of different generations?
- Would you consider the (potential) future technological possibilities in your recommendation?
- Which generation is benefiting most from your recommended fuel cycle?
- How would you rank environmental, public health, security and economic issues?

The aim of this exercise is to gain an insight into the possibilities and limits of argumentation to reach agreement on ethical problems in technological issues. In principle a thesis should be defended by real enthusiasts. However, as a person who defends a thesis should in principle be aware of the counterarguments, we invite you to exercise with defending an opinion that is not necessarily yours.

"Assuming that nuclear energy is one of the future energy options, the closed fuel cycle should be applied rather than the open fuel cycle in the production of nuclear energy."

The group will be split up as follows. One group (4-5 people) is formed by the enthusiasts of the thesis; a similar group will be the detractors. We aim at discussing the thesis by exchanging arguments that should be founded by technical information. There is also a group (4-5 people) of arbitrators that keep track of valid argumentation and fallacies. Here follows the set-up of the exercise:

1) The pro- and con-group both get 5 minutes to explain and argue for their position with respect to the thesis; no interruptions.
2) In a second round of twice 5 minutes, both parties get the chance to respond to the arguments of the other group; again no interruptions in this round.
3) The group of arbitrators, who has been silent so far, state their observations. The discussion-parties should take those remarks into consideration in the open-floor discussion.
4) After a coffee break, in the next round, the floor will be open for discussion. The arbitrators can now point out violations immediately. At this stage (20 minutes) the goal is to achieve agreement. Note that there is no guarantee that agreement about the whole issue will be reached. In case of remaining disagreement, isolate the points of disagreement and try to obtain agreement on your points of disagreement.
5) The last quarter of will be an evaluation to reflect on the whole discussion and the rules of reasoning and argumentation. If points of disagreement remain (which is usually the case) then try to answer te question whether the remaining disagreement is due to a lack of time or other factors that in principle could be repaired; or whether the disagreement is of a more fundamental nature that might not even be resolved in an ideal situation. You can here also consider how relatively homogeneous your group is. E.g., do you expect the political decision-making to substantially differ with your discussion?
3.1. To Recycle or Not to Recycle?1

3.1.1. Introduction

The worldwide need for energy is growing. The International Energy Agency foresees a 60% increase in energy need in the world between 2004 and 2030 and most of this expansion is expected to be met by fossil fuel [1]. Fossil fuels are not an attractive option, however, for reasons concerning the availability of resources and climate change. An increased need for alternative energy sources is therefore expected in the upcoming decades, e.g. wind energy, solar energy, but also nuclear energy. After being ruled out in many countries following the Chernobyl disaster in 1986, nuclear energy has recently made a serious comeback in the public and political debates about the future of energy. Many people consider nuclear energy at least as a serious alternative for the transition period between fossil fuels and sustainable energy sources. According to the World Nuclear Association, there were 435 operative nuclear reactors in January 2007; The United States, France, Japan and Russia together possess the vast majority of the operative reactors producing 370 GWe. As a whole, nuclear energy provides almost 16% of worldwide energy supply [2, 3].

The main advantage of nuclear energy—compared to fossil fuels—is its capability of producing a large amount of energy with relatively small amounts of fuel and a very small production of greenhouse gases. However, nuclear energy has serious drawbacks, such as accident risks, security concerns, proliferation threats, and nuclear waste. The waste problem is perhaps the Achilles’ heel of nuclear energy as it remains radiotoxic for thousands of years [4].

Discussions about nuclear waste management must be related to the production of nuclear energy, as the most hazardous waste is produced during energy production. The question guiding this paper is whether spent fuel1 is to be disposed of directly or to be reused in the fuel cycle, referred to as the open and closed fuel cycle, respectively [5]. This issue is still topical after more than four decades of widely deployment of nuclear energy. In an open fuel cycle, uranium is irradiated once and the spent fuel is considered as waste to be disposed of directly. This waste remains radiotoxic for approximately 200,000 years; the period in which the radiotoxicity of spent fuel will equal that of the amount of natural uranium used to produce the fuel. Radiotoxicity is defined as the biological impact of radioactive nuclides on human health, in case they are digested or inhaled; these effects are indicated in sievert (Sv) or millisieverts (mSv). The closed fuel cycle reuses spent fuel after irradiation to produce energy and diminishes its toxicity and volume substantially. This fuel cycle has many long-term benefits, but it also creates extra short-term risks.

The question rises here how to deal with spent fuel in a proper way, taking the needs and interests of this generation and future generations into account. We should not foreclose options for future generations and should manage the waste in a such way that “will not impose undue burdens on future generations” [6, 7]. In this paper we approach “undue burdens” in the light of fuel cycles and propose intergenerational justice as a framework in order to choose between the fuel cycle: are we willing to transfer all risks of spent fuel to future generations, or do we find it more just to diminish risks and hazards of our waste to the maximum extent and accept, consequently, some additional risks to the present generation. We discuss the idea of having right towards future generation and the concept of intergenerational justice. We further present the two fuel cycles and identify the associated risks with these fuel cycles. In the following chapter, we focus on

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1 The following text is drawn from the article ’To Recycle or Not to Recycle, An Intergenerational Approach to Nuclear Fuel Cycles’ (Taebi, B., and J. L. Kloosterman 2008. To Recycle or Not to Recycle? An Intergenerational Approach to Nuclear Fuel Cycles. Science and Engineering Ethics 14 (2):177-200.)
conflicting values in choosing between them and reduce all trade-offs to a chief trade-off between the present and future generations. The next chapter provides a few underlying assumptions and possible counter-arguments.

Whether nuclear energy is desirable or indispensable as an energy source in the future is a controversial issue, which is beyond the scope of this paper. At the same time, applying nuclear energy through different fuel cycles raises a number of ethical concerns and moral dilemmas; on those issues we focus here. Moreover, the existing spent fuel all around the world is an urgent problem that needs to be dealt with. 280,000 tons of spent fuel had been discharged globally by the end of 2004, of which one-third has been recycled, leaving 190,000 tons of spent fuel stored; the growth rate is estimated on 10,500 tons a year [8, 9]. The choice between the open and closed fuel cycle has significant influence on this growth. These intergenerational discussions are also crucial for the future of research investments on waste management issues. Partitioning and transmutation (P&T) is a new technology for further diminishing the waste radiotoxicity. P&T is still in its infancy and needs serious investments to be further developed [10, 11]; these investment are justified if and only if one chooses the closed fuel cycle, of which the P&T could be considered as an extension.

3.1.2. Future rights, present obligations: intergenerational justice
Increasing concerns about depleting the Earth’s resources and damaging the environment have invoked a new debate on justice across generations or intergenerational justice. This concept of justice was first introduced by John Rawls in 1971 as intergenerational distributive justice, which stands for an equal allocation of social benefits and burdens [12]. Justice for future implies that today’s people have obligations towards their descendants [13, 14] and these obligations entail certain rights for the future [15–17]. These assumed rights have been challenged by some philosophers: “...the ascription of rights is probably to be made to actual persons—not possible persons” [18] and non-existing future people cannot be said to have rights, as our action and inaction define their composition and identity [19]; this is referred to as the Derek Parfit’s ‘non-identity-problem’. Other objections against these alleged rights are expressed as the inability to predict future properly, the ignorance of the need and desire for future as well as the contingent nature of future. There have been a variety of arguments provided in the literature to these objections [20–23]: William Grey has proposed “impersonal principles subject to retroactive person-affecting constraints” [24] and Wilfred Beckerman has argued that we should provide future people with the minimum opportunity for a “decent and civilised society” [25].

Although these fundamental discussions about right and obligation towards future people are very relevant, in this paper we will focus on the application of these assumed future rights to environmental policy and more specifically nuclear waste. In the last decades the climate change has given rise to serious concerns for the future [26, 27]. Do we have a duty to future generations [21, chap. 5] and if so what does this duty entail [28] and how should we realize it [29]?

Anticipating technological progress in a rapidly developing world and being concerned about future generations, the World Commission of Environment and Development introduced the concept of sustainable development in 1987. This moment designates the introduction of intergenerational concerns in environmental policy. This Brundtland definition—named after commission’s chairperson—states that the key to sustainable development is an equitable sharing of benefits and burdens between generations “[...] that meets the needs of the present without compromising the ability of future generations to meet their own needs” [30]. The United Nations Conference on Environment and Development in Rio de Janeiro in 1992 (Earth Summit) not only endorsed this concept of sustainable development
formally among 178 national governments, it also explicitly included the concept of equity in its principles [31, Principle 3].

The sustainability principle implies that there is a conflict of interest between the present and future generations. In an anthology edited by Andrew Dobson, the concept of sustainable development is evaluated in the light of intergenerational justice [32]. Wilfred Beckerman believes that the problems future people encounter have existed for millennia and states that our main obligation towards future people is “moving towards just institution and a ‘decent’ society”, which encompasses future generations as well [33, p. 91]. Brian Barry investigates whether sustainability is a “necessary or a sufficient condition of intergenerational distributive justice”. Barry emphasizes the obligations we have towards future generations and says that “measures intended to improve the prospects of future generations [...] do not represent optional benevolence on our part but are demanded by elementary considerations of justice” [34, 35]. Bryan Norton perceives of sustainability as “an obligation not to diminish the opportunity of future generations to achieve well-being at least equal to their predecessors.” He further presents a model in order to compare well-being across time [36]. The “contested meaning of sustainability” in technology is comprehensively discussed by Aidan Davison [37].

What does the forgoing discussion about rights and obligations entail for nuclear fuel cycles, considering the fact that spent fuel life-time concerns a period between 1,000 and 200,000 years? The Nuclear Energy Agency (NEA) introduces sustainability in one of its studies [11]. In this paper we adapt this definition both conceptually and practically and introduce intergenerational justice as a framework to choose between the fuel cycles. Intergenerational concerns have already been expressed about nuclear waste [38–40], but mainly with respect to the choice for final disposal of long living radioactive waste.

3.1.3. Nuclear Fuel Cycles: Open and Closed
The characteristic difference in the fuel cycles is how spent fuel is dealt with after irradiation. Two main approaches to spent fuel outline the main dissimilarity between these cycles: (1) the direct isolation of the material from the environment for a long period of time in which it remains radiotoxic and (2) ‘destroying’ or converting the very long-lived radionuclides to shorter lived material [5]. The first approach represents the open fuel cycle in the production of energy. The closed fuel cycle is in accordance with the second approach. Here below we will elaborate on these two fuel cycles.

Open Fuel Cycle (OFC): Once-through Option
In the OFC, the lesser isotope of uranium (235U) is fissioned—split—in light water reactors (LWR) to produce energy; 90% of all operative nuclear reactors to produce energy are LWRs. Natural uranium contains two main isotopes, which constitute 235U and 238U. Only the first isotope (235U) is fissile and is used in LWRs as fuel, but it only constitutes 0.7% of natural uranium. This low concentration is not sufficient in nuclear reactors, the concentration of 235U is therefore deliberately enhanced to a minimum of 3% through a process called uranium enrichment [4].

Irradiating uranium produces other materials, including plutonium (239Pu), which is a very long-lived radioactive isotope. Apart from plutonium-239, other fissile and non-fissile plutonium isotopes as well as minor actinides will be formed during irradiation. Actinides are elements with similar chemical properties: uranium and plutonium are the major constituents in spent fuel and are called major actinides; neptunium (Np), americium (Am), and curium (Cm) are produced in much smaller quantities and are called minor actinides. The presence of actinides in spent fuel