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NUCLEAR ENERGY AGENCY
COMMITTEE FOR TECHNICAL AND ECONOMIC STUDIES ON NUCLEAR ENERGY DEVELOPMENT AND FUEL CYCLE

NDC – Final Programme of Work for 2019-2020

70th NDC meeting, 10-11 October 2018

This document is the final NDC Programme of Work (PoW) for 2019-2020 which the Nuclear Development Committee endorsed at its 70th meeting on 10-11 October 2018.

Dr. Sama BILBAO Y LEÓN
Head, Division of Nuclear Technology Development and Economics (NTE)
Sama.BILBAOYLEON@oecd-nea.org; +33 (0)1 73 21 29 50

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NOTE BY THE SECRETARIAT

Following feedback during the April 2018 Steering Committee the NEA Secretariat has suggested a new order and structure of the Output Results, based on the 2017-2022 Strategic Plan. In order to clarify NEA objectives and without any impact on the content, some substantial Output Results have been grouped and Intermediate Output Results have been updated accordingly.

This document describes the final NDC Programme of Work for 2019-2020 that the NDC was invited to endorse at its 70th meeting on 10-11 October 2018. The Committee agreed on the set of activities to go forward into the Programme of Work according to available resources within the Division of Nuclear Technology Development and Economics (NTE), taking also into account the carry-over activities from the previous Programmes of Work. Each activity details its background, objectives and scope.

DRAFT NDC 2019-2020 PROGRAMME OF WORK

OUTPUT RESULT 8. NUCLEAR TECHNOLOGIES DEVELOPMENT

OUTPUT RESULT 9. ECONOMICS AND RESOURCE ANALYSIS

OUTPUT RESULT 8

NUCLEAR TECHNOLOGIES DEVELOPMENT

Intermediate Output Result 8.1

Support to Other Parts of the OECD and Other Programmes

BACKGROUND

This activity seeks to ensure that nuclear issues are accurately reflected in more general policy activities of the OECD (e.g. working with the General Secretariat, the Environment Directorate and the Directorate for Science, Technology and Innovation) and in the broader energy work of the IEA. Over successive programmes of work, co-operation with the IEA in particular has been strengthened and it is expected that this will continue.

Most activities under this heading will be continuing from previous programmes of work. However, opportunities to strengthen co-operation with other parts of the OECD and the IEA will also be sought, for example, by contributing to the work of the OECD and the IEA on policy responses to climate change through NEA expertise on the potential role of nuclear energy. One particular ongoing role is NEA participation in IEA reviews of the energy policies of member countries which use nuclear energy. NEA also contributes to the IEA Tracking Clean Energy Progress (TCEP) that provides an assessment of whether technologies, energy savings and emissions reduction measures are on track to achieve the longer-term emissions objectives by 2060. Each year, NEA provides inputs to this publication on the progress in nuclear power toward these objectives, and the effort provides a useful opportunity to discuss and reinforce the benefits of nuclear power, the contribution it can make to clean energy goals, and policy measures and messages that are important to help achieve these. Joint IEA/NEA workshops on key issues will also continue to be pursued. Close collaboration with the IEA has also resulted in the increasing need to support the nuclear content of their publications, including the World Energy Outlook, World Energy Investment, Projected Costs of Electricity Generation and Energy Technology Perspectives.

OBJECTIVES AND SCOPE

Activities foreseen include:

- Participating on a regular basis (3 or 4 times per year) in IEA in-depth reviews of energy policy in member and non-member countries with nuclear programmes.
- Supporting the nuclear-related content of IEA publications, including the World Energy Outlook, World Energy Investment, Projected Costs of Electricity Generation and Energy Technology Perspectives (and its self-standing part entitled Tracking Clean Energy Progress).
- Contributing to the work of the OECD and the IEA on policy responses to climate change by providing expertise on the potential role of nuclear energy.
- Participating in IEA SLT and CERT meetings, to present relevant NEA activities and contribute to discussions on nuclear energy issues.
- Contributing nuclear data to the annual OECD Factbook, as well as reviewing energy-related issues in OECD economic reports.
- Participating on an ad hoc basis in relevant meetings and joint projects with the IEA and other OECD bodies.

PUBLICATIONS

Contributions to IEA in-depth reviews and other IEA and OECD reports and studies.

COLLABORATION

IEA, OECD and other NEA Divisions.

Intermediate Output Result 8.2
Advice to Policy Makers

BACKGROUND

There are many technical and economic reports written by the NDC, which provide detailed and well referenced information on issues of nuclear development across both economic and strategic issues related to the full fuel cycle. However, it has become clear that these documents are not always reaching the attention of policymakers, government advisers and journalists. It is intended to produce a series of smaller policy briefs, shorter pamphlets, extended summaries and brochures in a less technical format and aimed at informing this audience of the major outcomes from the work of the NDC.

OBJECTIVES AND SCOPE

The topics will be chosen in after discussion with the Committee and may span both current and previous NDC areas of work. Follow-up will be undertaken to understand if these documents are being well targeted and adding value.

PUBLICATIONS

Succinct policy briefs in a format to be determined by the NDC. As an example, extended summary report of NDC studies could be developed as separate policy briefs.

Another example could be the development of a policy brief (or an update of previous briefs) on the role of nuclear energy in low carbon systems, identifying criteria for determining an appropriate low-carbon mix of nuclear power and renewables for NEA member countries. In function of the precise evolution of the project brief, this project could include both a modelling component, as well as a discussion of the required policy instruments to ensure feasibility. The project could require additional funding (through voluntary contributions) to obtain the required modelling resources at the NEA.

COLLABORATION

IAEA, IEA, OECD and other NEA Divisions

Intermediate Output Result 8.3
Security of Supply of Medical Radioisotopes

This project has been transferred into the NDC the 2019-2020 PoW as a consequence of the expiration of the 4th Mandate of the HLG-MR, if a 5th Mandate is not established. Depending on the scope of work, additional Voluntary Contributions may be needed.

BACKGROUND

With the end of the activity of the High Level Group on the Security of supply of Medical Radioisotopes (HLG-MR) in December 2018, part of the work carried out by the Secretariat of the HLG-MR (previously funded by Voluntary Contributions) is to be integrated in the NDC PoW 2019-2020. The purpose of this output is to produce on an annual basis a Demand and Capacity projection report for the supply of molybdenum-99/technetium-99m for a 6-year moving time window period (e.g. next report for the 2019 – 2024 period). The report is to be based upon the same general methodology as the Demand and Capacity projection report series produced since 2014 and include the development and publication of 4 key Data Tables for:

1. Existing Irradiators,
2. Existing Processors,
3. Prospective Irradiators and
4. Prospective Processors.

The Data Tables and reports to be developed through surveying the main supply chain participants and prospective participants in a structured manner, and through maintaining a dialogue with those players about changes and adjustments to actual capacity and to the timelines of prospective projects. The report is to be produced as early in the calendar year as practical, with an objective of publication by the end of April each year.

Additionally to perform, if desired, a mid-year review of the same data to identify if significant events, or changes to plans warranted the consideration of an interim report.

To retain the ability to produce as needed ad hoc reports in response to identified, or prospective adverse events in the supply chain that could potentially lead to a near-term or medium-term supply shortage and to participate actively in the co-ordination of clear communication within the community in the case of such an event.

Maintain a database of contacts within interested NEA governments, the nuclear medicine user community, the medical isotope supply chain and other stakeholders and to use that for the collection of data, the distribution of reports and to serve as a communication channel in the event of the need to take ad hoc actions driven by market events.

To provide technical support where possible to third parties that maintain an interest in the monitoring and maintenance of the security of supply of medical isotopes, such as individual governments, the EC and EU Observatory, the IAEA and the Association of Isotope Producers and Equipment Suppliers (AIPES).

PUBLICATIONS

Demand and Capacity projection reports (2019 and 2020)

COLLABORATION

OECD Health Division

Intermediate Output Result 8.4
NI2050 Phase III

This project is carried-over from the 2017-2018 NDC PoW. The work plan has been consequently updated.

BACKGROUND

For nuclear energy to continue to be a main contributor to low-carbon energy supply over the long term, innovation in nuclear fission technologies is necessary. The objective of the NEA NI2050 Initiative (ongoing since the NDC PoW 2015-2016) is addressing possibilities towards accelerating R&D and market deployment of innovative nuclear technologies.

For large RD&D programmes and infrastructures, in most cases, classical financing might be difficult to find and this may hinder their realisation. National, public financing will be insufficient and incompatible with the timelines and processes for effective implementation. Innovation thus also needs to take place in this area. Co-operative approaches will be necessary as well, and it would be of interest therefore to analyse what co-operative strategies (technical co-operation modalities among all stakeholders, associated legal frameworks and financing mechanisms) are being used or are under development for large, low-carbon energy RD&D programmes and facilities. This will require interaction at the national and international levels, between the main stakeholders in the energy sector who are currently fully engaged in such development, for example between industry and research bodies, and public and regulatory authorities, with a mix of public and private financing. Lessons will be drawn to propose co-operation mechanisms for the programmes and infrastructures selected under NI2050. In addition, ways to integrate the implementation of the nuclear RD&D programmes and infrastructures into wider "low-carbon, technology diversified" mechanisms, existing or under development, may be discussed.

Work has proceeded under the Nuclear Innovation 2050 Initiative. Innovation roadmaps for ten priority topics selected by the NI2050 Advisory Panel are in final stage of production. They will constitute the main part of the NI2050 Report to be published in the course of 2018, signalling the end of the phase II (the finalised Phase I, composed of the nuclear R&D survey of 2015, will also be part of the NI2050 Report).

OBJECTIVES AND SCOPE

At this point, NI2050 will enter into a transition towards the phase III, where, for each priority topic, discussion will be engaged with a broader stakeholder's community, including in particular the regulators and the industry. This will happen on an ad-hoc basis, topic by topic, each at its own pace, and involving as appropriate existing NEA Expert Groups operating under the different Committees (NDC, CSNI/CNRA, NSC, RWMC). It will be aimed at producing Programmes of Action (with concrete projects scopes, timelines, necessary resources and infrastructures) to foster the innovation process and reduce time to market. Such Programmes will focus both on innovation in technology and on innovation in the qualification processes of such technology, where an international approach brings added value and offers an opportunity of opening the market base for resulting products. Once such Programmes become available they will be shared with Member Countries and Policy Makers to discuss possible ways and means for the effective implementation.

Within the context of NI2050, OECD/NEA is collaborating with EPRI, IAEA, KHNP and UK NLL in the organization of the "Innovation for the Future of Nuclear Energy - A Global Forum" that will take place at the Hwabaek International Convention Center (HICO), Gyeongju, South Korea on June 9 - 13, 2019. This event aims to determine how the nuclear industry can more rapidly implement innovative solutions in operating plants. It will bring nuclear plant leaders, regulators, and technology providers from around the world together in a collaborative environment with the aim of forming a common understanding of these opportunities and the barriers to their successful deployment

WORK PLAN

Phase II will conclude at the end of 2018, and Phase III will result in a final report at the end of 2020.

Intermediate Output Result 8.5
Advanced Reactor Systems and Future Energy Market Needs

This project is carried-over from the 2017-2018 NDC PoW. The work plan has been consequently updated. It also includes topics that were suggested by the NDC as "new" topics for the 2019-2020 PoW, such as flexibility and the role of small modular reactors in future energy systems. These topics could be expanded within the current mandate. Depending on the scope of work, additional Voluntary Contributions may be needed.

BACKGROUND

This study proposes to analyse to what extent reactors under development today, for instance small modular reactors or Generation IV reactor designs, could address the future energy market needs and conditions, as well as possible new environmental and regulatory constraints.

OBJECTIVES AND SCOPE

The study will look at both electricity and non-electric markets. For electricity markets, some experts anticipate that due to large penetrations of variable renewables, other sources of power generation will need to be much more flexible than today, capable of load-following with high ramp up/down rates. Others believe that due to demand smoothing and increased energy storage capacities, only limited load-following capabilities will be needed. Today, nuclear power plants have the capability to load follow, though the ramp up/down rates are much less than for peaking technologies such as gas. More advanced generation III reactor designs have greater flexibility than previous generations, and utility requirements actually specify flexibility capabilities (see EUR + also new EU grid code). It is not clear today what will be the flexibility capabilities of more innovative reactor designs such as those of Generation IV reactors which could be deployed in the 2030-2040 timeframe.

If the entire energy sector needs to be decarbonised, technologies that can produce low carbon heat will be required to substitute fossil-based heat. Nuclear power plants can provide both low carbon electricity and heat. The study will investigate what are the cogeneration capabilities of various advanced reactor designs, as well as the flexibility they may have to switch from electricity generation to heat production depending on electricity market conditions. Therefore, that part of the study can be considered as a follow-up to the nuclear cogeneration study (from the 2015-2016 NDC Programme of Work) and to the SMR market study. The concept of hybrid energy systems is an example of how future electricity and heat markets could operate – and the question addressed in the study will be to assess the most appropriate nuclear reactor technologies that can fit into such systems.

COLLABORATION

This study would be carried out with the support of a group of experts nominated by NDC members. Collaboration with the Generation IV International Forum can be envisaged, as well as with some industry representatives (for instance EPRI, WNA, EUR, etc.) and the IAEA, which has recently published a study on non-baseload operation of NPPs.

This topic could also be opened to participation by Chinese experts (to be agreed by the NEA Steering Committee).

WORK PLAN

The project was initiated in the second half of 2017. The final report will be published after two years, in early 2020.

Intermediate Output Result 8.6
Approaching Nuclear Power from a Social Science Perspective

BACKGROUND

Social aspects have become increasingly recognised as important, if not central, to the continued and future use of nuclear power. Topics such as communication, stakeholder involvement, risk perception and a number of others are frequent subjects of training, conferences, and workshops. These are typically viewed by decision or policy makers in the nuclear energy community as social factors that are over-lain on top of technical solutions and represent additional challenges or difficulties to be considered or managed. In reality, social factors are not ancillary but foundational to any policy making initiative that wishes to be comprehensive, inclusive, and supported by people.

The typical backgrounds often thought to be key to nuclear development (e.g., chemistry, engineering, physics) are unlikely to reveal significant breakthroughs in the social dimension. It is important for those tasked with developing technical solutions to accurately understand what their customers, stakeholders, and even society at large want and need from those systems. Therefore, building ever more complex technical systems to solve problems that may have fundamentally territorial, political, sociological or even psychological bases will bear little fruit. It is imperative to understand the social factors and dynamics at play and ensure that solutions are addressing those needs rather than trying to convince people that they need a preconceived technology solution.

OBJECTIVES AND SCOPE

This study will start by conducting a workshop with social science experts and practitioners to identify tools, methods, and concepts that have the potential for significant impact on the scientific and practical understanding of the relationship between nuclear power and society. The workshop will be planned and executed to assemble a purposely diversified panel of academics, policy experts, and practitioners that have worked on societal topics with applicability to nuclear, especially from other industries. Insights gained from the workshop will provide the basis for a recommendation to the NDC on potential next steps or related studies.

Central questions for the workshop will include:

— How can social sciences contribute to better decisions that account for the complexity of stakeholder interests, reduce risks of later unforeseen opposition and delays, or more realistically account for decision makers' internal bias or blind spots?

— How can social science be brought to bear to improve public interactions to avoid misconceptions and provide a more informed basis for making their own risk judgments?

This effort and these questions are aimed at achieving a better understanding of how to appropriately incorporate society's concerns or preferences into our methods and practices for engagement and decision making. After the initial workshop, a summary of the outcomes will be presented to the NDC who will then decide what subsequent actions may be warranted.

PUBLICATIONS

Summary of the workshop and major themes for NDC consideration.

OTHER RELEVANT STUDIES

HoNEST – History of Nuclear Energy and Society, a Horizon 2020 Research and Innovation Project under Euratom 2014-2018 research and training programme

COLLABORATION

The workshop will be organised by NEA staff from the Division of Nuclear Technology Development and Economics (NTE), and possibly in collaboration with other NEA Divisions.

WORK PLAN

Two years with final report at the end of 2020.

Intermediate Output Result 8.7
Nuclear Fuel Cycle: Strategies and Considerations for the Back-End

This project is carried-over from the 2017-2018 NDC PoW. The work plan has been consequently updated.

BACKGROUND

The NDC approved the mandate for this project in spring 2017. Since then, the Expert Group on Back-end Strategies (BEST) has convened three meetings and has developed a draft report summarizing its work. The scope of the study involves identifying and explaining, for a policy- or decision-maker audience, the drivers behind countries' decisions on fuel cycle options or paths. The group has excellent support from most member states and the countries involved represent a broad range of situations – large and small countries and nuclear programmes; those with nuclear power growing, stable, and phased or phasing out; countries focused on direct disposal, those undecided and exploring options, and those already recycling spent fuel at full scale. The final report,. Nuclear Fuel Cycle: Strategies and Considerations for the Back-end, is expected to be published early in 2019.

In 2013, the NEA published The Economics of the Back End of the Nuclear Fuel Cycle providing a comprehensive review of the relative costs of various nuclear fuel cycle options. Certainly, costs are an important consideration, yet they are clearly not the only consideration weighing into fuel cycle decisions. While some countries have selected a fuel cycle approach that fits their needs and are unwaveringly pursuing it, a number of countries are investigating multiple fuel cycle options, and it is not always clear the key question whose answer will enable a decision.

A number of NEA and other international organisations conduct activities related to the nuclear fuel cycle, but these activities typically focus on specific aspects (e.g., waste, non-proliferation) or are highly technical, and thus are not particularly intelligible to decision-makers and non-experts. Thus, a complimentary, comprehensive discussion is warranted on the other considerations that factor into countries' decisions on which nuclear fuel cycle option or options they will pursue.

OBJECTIVES AND SCOPE

This study proposes to catalogue the various nuclear fuel cycle options being investigated or pursued by member countries, with a particular interest in clearly capturing the aspects that differentiate them, that countries consider most important, or that make the options attractive or unattractive for application in a certain country. The study seeks to make use of existing studies, such as the U.S. Nuclear Fuel Cycle and Screening report, but to incorporate qualitative and quantitative aspects that are important to various countries.

The study will also examine the impacts of delayed decisions on fuel cycle options, i.e. maintaining a number of fuel cycle options without selecting one cycle or system. There are a number of benefits to maintaining a number of fuel cycle options, but there are also a number of drawbacks and also likely unintended consequences. Is there a point at which the undesirable results eclipse the intended benefits?

METHOD

This study would be carried out with the support of a group of experts, and performed in close collaboration with other NEA divisions with fuel cycle activities, in particular with the Nuclear Science Division (the Working Party on Scientific Issues of the Fuel Cycle).

Nominated Experts will meet on regular basis (~ twice a year) to:

- Discuss and define the detailed program of work
- Present country's contributions
- Carry out study

This group of experts should produce a report highlighting the main criteria influencing the choice of different nuclear fuel cycle options.

WORKPLAN

Two years with final report at the end of 2019.

Intermediate Output Result 8.8
Fuel Cycle Studies

BACKGROUND

Depending on availability of resources and level of interest from the NDC, studies on the nuclear fuel cycle could be carried out in two particular areas. The first study would focus on the economic, environmental and technological aspects of closed fuel cycles. The second study would review and analyse the role of international co-operation in solutions to the back end of the nuclear fuel cycle, as a follow up to previous studies carried out by the NDC. Depending on the availability of resources and the interest of the member countries, these studies could be integrated into the existing study on the back-end of the fuel cycle (Output 8.7) or be completed through Voluntary Contributions of the interested countries.

CLOSED FUEL CYCLE: ENVIRONMENTAL, ECONOMICAL AND TECHNOLOGICAL ASPECTS

Advanced nuclear fuel cycles offer promising scenarios for the development of nuclear power and improving the nuclear fuel behaviour, allowing minimization of the volume of radioactive wastes, and addressing environmental and radiation safety issues of storage in geological disposal sites.

The advanced nuclear fuel cycles include development of U, Pu multi-recycling in thermal and fast neutron reactors, full-scale recycling and burning of a long-lived minor actinides and fission products. While engineering study of technology is sufficiently advanced, economic features of full-scale introduction of this technology require greater attention.

It is proposed to consider (evaluate) the competitiveness of the closed fuel cycle (including economic, environmental and technological aspects) in comparison with traditional nuclear power technologies.

It would be useful to develop indicators for such a comparison. For example, in environmental assessments, three indicators are used: the level of consumption of natural resources per unit of electricity, the level of CO2 emissions and the level of disposed waste; LCOE is generally used as an economic indicator.

ROLE OF INTERNATIONAL COOPERATION IN THE SOLUTION OF BACK-END ISSUES

The growing amount of accumulated SNF is becoming a serious obstacle for nuclear power development. The solution of this issue is a key consideration towards the future of nuclear energy. State Corporation “Rosatom” assumes that back-end issues should be considered not for individual country but for global nuclear branch. There is no clear answer for the question now, which nuclear fuel cycle is better, and each country solves its problems by itself. State Corporation “Rosatom” proposes to study an option to develop international nuclear fuel cycle. There are various types of reactors (LWR, HWR, FBR, SMR) that have unique features and capabilities. At the same time, each of them incorporates specific advantages. For instance, FBRs can improve quality of plutonium from thermal-neutron reactors but HWRs can use regenerated uranium as fuel. It is rather complicated task to combine all types of reactors in common system. However, there are several advantages of such system:

- it is an option for efficient reprocessing of fissile materials;

- it is a chance to make nuclear power less dependent on uranium resources due to involvement of regenerated materials allowing to use restricted resources of natural uranium in efficient manner;
- it is a possibility to diminish the amount of radioactive wastes and risks of their disposal due to partitioning of minor actinides and their burning in FBR and molten salt reactors.

This idea assumes the most involvement of regenerated products back to nuclear fuel cycle. Various types of reactors under operation in different countries are beneficial for international cooperation in the nuclear fuel cycle area.

Intermediate Output Result 8.9

Technical Secretariat Support and Coordination for the Generation IV International Forum (GIF) Activities

This project is solely funded by Voluntary Contributions from GIF members.

NEA NTE serves as Technical Secretariat for the Generation IV International Forum (GIF). This work is completely supported by Voluntary Contributions. The Generation IV International Forum (GIF) is a co-operative international endeavour organised to carry out the research and development (R&D) needed to establish the feasibility and performance capabilities of the next generation of nuclear energy systems. The Generation IV International Forum has 14 members that are signatories to its founding document, the GIF Charter. Argentina, Brazil, Canada, France, Japan, Korea, South Africa, the United Kingdom and the United States signed the GIF Charter in July 2001. Subsequently, it was signed by Switzerland in 2002, Euratom in 2003, China and Russia in 2006, and Australia in 2016. The Framework Agreement overseeing the co-operative R&D activities was extended for ten years in February 2015 and has been signed or acceded to by eleven countries, including Australia in September 2017. Six systems are being developed in GIF: the gas-cooled fast reactor (GFR), the lead-cooled fast reactor (LFR), the molten salt reactor (MSR), the sodium-cooled fast reactor (SFR), the supercritical water cooled reactor (SCWR) and the very-high-temperature reactor (VHTR).

Intermediate Output Result 8.10

Technical Secretariat Support and Coordination for the International Framework for Nuclear Energy Cooperation (IFNEC) Initiatives

This project is solely funded by Voluntary Contributions from IFNEC members.

NEA NTE serves as Technical Secretariat for the International Framework for Nuclear Energy Cooperation (IFNEC). This work is completely supported by Voluntary Contributions. The International Framework for Nuclear Energy Cooperation provides a forum for co-operation among participating countries to explore mutually beneficial approaches to ensure that the use of nuclear energy for peaceful purposes proceeds in a manner that is efficient and meets the highest standards of safety, security and non-proliferation. Member countries do not give up any rights and voluntarily engage to share the effort and gain the benefits of the economical and peaceful use of nuclear energy. IFNEC membership includes 34 participant countries, 31 observer countries and 4 international observer organisations (the Nuclear Energy Agency, the International Atomic Energy Agency, the Generation IV International Forum and Euratom). There are currently two IFNEC working groups: the Infrastructure Development Working Group (IDWG) and the Reliable Nuclear Fuel Services Working Group (RNFSWG), as well as an Ad Hoc Nuclear Suppliers and Customer Countries Engagement Group.

OUTPUT RESULT 9.

ECONOMICS AND RESOURCE ANALYSIS

Intermediate Output Result 9.1
Uranium: Resources, Production and Demand

BACKGROUND

The report "Uranium: Resources, Production and Demand", commonly known as the "Red Book", is a biennial publication produced jointly with the IAEA under the responsibility of the NEA/IAEA sponsored Uranium Group. Twenty-six editions have been published since 1965. The Red Book is one of the Nuclear Energy Agency's (NEA) best known publications and is widely regarded as the authoritative source of information on the subject. Policy responses to the Fukushima accident and declining uranium prices raise questions about the evolving uranium supply/demand balance. Work is accomplished as a joint NEA/IAEA activity using a long-standing committee of member country/state experts known as the Uranium Group. This activity requires horizontal collaboration between the Division of Nuclear Development and the NEA Publication Unit. The Uranium Group decided at its 50th meeting to reduce the number of meetings to one each year (from three every two years) and collect data directly by updating country reports. The 2020 Red Book will be published by mid-2020.

OBJECTIVES AND SCOPE

The primary objective of the Uranium Group is to publish the 2020 edition of the Red Book and to improve efficiency of data collection by directly updating country reports to alleviate the work load for member countries, the co-Chairs and Secretariat. In addition, the Secretariat, under the guidance of the Uranium Group, will continue to participate in the development of the United Nations Framework Classification (UNFC) for fossil energy and mineral resources. The Uranium Group also supports DIAMO's School of Uranium Production (SUP) in the Czech Republic under the World Nuclear University (WNU) umbrella.

PUBLICATION

Uranium 2020: Resources, Production and Demand.

OTHER RELEVANT STUDIES

None

COLLABORATION

Work is accomplished as a joint NEA/IAEA activity using a long-standing Committee of member country/state experts known as the Uranium Group. This activity requires horizontal collaboration between the Division of Nuclear Technology Development and Economics and the NEA Publications Unit.

WORK PLAN

The Uranium Group will meet once every year and the 2020 Red Book will be published by mid-2020. The Secretariat will participate on an ad hoc basis in UNFC meetings and seek advice from the Uranium Group on the relevance of this evolving classification scheme on the presentation of uranium resources in the Red Book. The Secretariat will provide support to the SUP by serving on the management board, advising on the appropriateness of programmes and other issues.

Intermediate Output Result 9.2
Nuclear Energy Data

BACKGROUND

The report "Nuclear Energy Data", known as the "Brown Book", is an annual NEA publication that is a unique source of information provided by governmental nuclear energy organisations of OECD and NEA member countries. The objective is to produce an authoritative, official publication on OECD nuclear energy statistics in English and French and to support analyses in member countries and at NEA on the future of nuclear energy. The scope of data collection, harmonisation and publication cover most aspects of nuclear electricity generation and fuel cycle activities in OECD and NEA member countries. Country reports broaden the scope of the information by highlighting main events in the field of nuclear energy. Although data collection has proven increasingly challenging, the publication remains a valuable source of nuclear fuel cycle information for member countries. Data collection for the 2019 edition will start in early 2019 with publication expected in autumn 2019.

OBJECTIVES AND SCOPE

The objective is to produce an authoritative, official publication on OECD nuclear energy statistics in English and French and to support analyses in member countries and at NEA on the future of nuclear energy. The scope of data collection, harmonisation and publication cover all aspects of nuclear electricity generation and fuel cycle activities in OECD and NEA member countries. Country reports broaden the scope of the information by highlighting main events in the field of nuclear energy.

PUBLICATIONS

Nuclear Energy Data 2019 (due October 2019) and Nuclear Energy Data 2020 (due October 2020).

OTHER RELEVANT STUDIES

IAEA Reference Data Series No. 1 (RDS-1) - Energy, Electricity and Nuclear Power Estimates for the Period up to 2050, IAEA, Vienna.

COLLABORATION

The Secretariat may refer to data collected and published by the IAEA, when required (some country representatives do not complete the questionnaire, as requested). The Secretariat will also participate in the annual IAEA consultancy meeting "Nuclear Capacity Projections to 2050" to co-ordinate data used in the two publications.

WORK PLAN

Efforts will be made to broaden the number of respondents responding to the questionnaire. The Brown Book will continue to be published every year.

Intermediate Output Result 9.3

Contribution of Uranium Mining to Economic Development: Impacts on Local and National Economies

This project is carried-over from the 2017-2018 NDC PoW. The work plan has been consequently updated.

BACKGROUND

While the environmental and radioprotection issues of uranium mining are usually at the forefront of stakeholder engagement, there is usually little public discussion about the influence on economic development. A mining project can bring benefits to the local and national economies including economic development, jobs, investment in infrastructure, mining product exports, royalties and tax revenues, education and medical care.

OBJECTIVES AND SCOPE

Mining in general is a critical economic driver in many countries, accounting for a major percentage of foreign direct investment, mineral exports and government revenue. These contributions can act as an economic catalyst for supporting the development of communities, regions and whole economies.

The objective of the study is to enhance understanding of the potential contribution of Uranium Mining in the economic and social development. Are the Uranium activities managed to ensure a positive benefit to the local / national economies? Case studies in various countries will be examined to understand the uranium mining impact on economic development, jobs, infrastructure, education and medical care.

As there is a growing debate about the distribution of mineral wealth for the industry, this study could be a useful tool for the government policy makers and regulators, the industry and the local communities to ensure that the development potential of uranium mining can be maximised.

PUBLICATIONS

Contribution of Uranium Mining to Economic Development: Impacts on Local and National Economies

OTHER RELEVANT STUDIES

Social and Economic Impacts of Nuclear Power – impacts on job creation (forthcoming).

NEA (2014), Managing Environmental and Health Impacts of Uranium Mining.

COLLABORATION

This study would be carried out with the support of a group of experts nominated by NDC members and may be overseen by the WPNE. Collaboration with other parts of the OECD such as TAD/PTA (Trade and Agriculture Directorate) and CFE/RDT (Centre for Entrepreneurship, SME, Regions and Cities), international mining organisations (minerals other than uranium), as well as with some industry representatives can be envisaged.

WORK PLAN

The project was initiated in the 2nd half of 2017. The final report will be published in 2020.

Intermediate Output Result 9.4

Maintaining Low-Carbon Generation Capacity through LTO of Nuclear Power Plants: Economic, Technical and Policy Aspects

This project is carried-over from the 2017-2018 NDC PoW. The work plan has been consequently updated.

BACKGROUND

Nuclear power accounts for a significant share of low-carbon electricity production, more than half in many NEA member countries. The vast majority of currently operating nuclear power plants will be retired by 2050, and even much earlier if the plants are shut down after their original design lifetime. Extending the operating lifetime of reactors can be achieved through the replacement of components and upgrading of systems to ensure that retrofitted plants comply with enhanced safety requirements, including those developed after the Fukushima Daiichi accident. Licences to operate up to 60 years have been granted by the NRC in the United States to the majority of units, after extensive research on ageing of materials and components. The NRC has recently issued draft guidelines for the extension to 80 years of operation. Though technically feasible, the safe operation of nuclear power plants beyond their original design lifetime (Long Term Operation or LTO) faces several challenges, of economic and political nature. In recent months, a number of utilities in the United States and in Europe have announced anticipated closures of nuclear power plants, claiming that continued operation was not sufficiently profitable due to decreasing wholesale electricity prices and in some cases, the burden of specific taxes.

Extension of reactor operating lifetime is considered as an important option to maintain low-carbon generation capacity by several NEA member countries. The NEA report on the Economics of Long-term Operation of Nuclear Power Plants published in 2012 showed that long-term operation of nuclear power plants had significant economic advantages for most utilities envisaging LTO programmes. But the analysis did not fully account for the effect of decreasing wholesale electricity prices that have been witnessed in many countries, to some extent due to the introduction of renewable generation technologies (for instance in Europe), or to cheap fossil fuel (shale gas in the United States). The cost of retrofitting plants to meet ever increasing safety requirements also affects the economics of LTO. And, last but not least, decisions on the extension (or not) of the operating life of nuclear plants also has an economic impact on the cost and funding of waste management and decommissioning.

OBJECTIVES AND SCOPE

The study will review the economic and technical aspects of LTO of existing plants, taking into account the following items:

- The need for major investments in maintenance and refurbishment, including those brought about by regulatory changes, for instance increased safety requirements due to the Fukushima Daiichi accident;
- Changes in O&M costs (e.g., higher personnel costs or similar) ;
- Changes in market conditions, e.g., decline in wholesale electricity or decreasing capacity factors due to competing technologies (subsidised renewables, cheap fossil fuels), tax regimes, absence or ineffective carbon pricing;

- The impact of the operational lifetime on the costs and funding of waste management and decommissioning.

The owners of NPPs will make decisions on extending the lifetime of their plants and continued operation based on these factors, and the overall competitiveness of their nuclear plants within the overall generation mix. At the same time, governments are developing policies to decarbonise their energy systems, and in particular the electricity mix.

The study will analyse what role extending the lifetime of existing plants has in ensuring the success of these objectives, and will identify what policies would be needed to ensure that existing plants continue to provide low carbon baseload electricity until either new plants are built or alternative low carbon baseload technologies are developed.

COLLABORATION

This study would be carried out with the support of a group of experts nominated by NDC members. Collaboration with the IEA (for instance the ETP team that makes assumptions on LTO in various countries as part of their 2DS analysis), as well as industry representatives (WNA, FORATOM, EPRI, CRIEPI, EUR, etc.) can be envisaged.

WORK PLAN

The project was initiated in the second half of 2018. The final report will be published after two years, in 2020.

Intermediate Output Result 9.5

Reducing the Costs of Nuclear Power Generation

This project is carried-over from the 2017-2018 NDC PoW. The work plan has been consequently updated.

BACKGROUND

Much has been written on the costs of nuclear power, with a large body of the academic literature focusing on the existence of learning by doing, standardisation benefits and economies of scale as means for reducing the construction costs of nuclear reactors. Over the last few years, the construction of first-of-a-kind Gen III reactors has resulted in important initial costs overrun and delays, especially in Europe. However, the comparison between the 2005, 2010 and 2015 Projected Costs of Generating Electricity seem to indicate that this initial phase of construction costs increase may be behind us and that construction costs reduction may be achievable over the next decade or two.

In parallel, operational costs for existing nuclear reactors is becoming an increasingly important issue, given the very low electricity prices in several parts of the world, often in line with the rapid penetration of renewables. Several recent examples have shown that some aging reactors may be at risk of early closure or operators may decide not to consider life extension due to this market environment. In a number of OECD countries, this raises the question of how operational costs of existing reactors could be further reduced, either through increased performance (fuel reliability, outage duration) or direct costs reduction.

Finally, the topic of fiscal aspects (including a large set of taxes) and safety requirements has also to be considered.

OBJECTIVES AND SCOPE

The objective of the report will be to study the potential for nuclear costs reductions in the future, both for construction of new reactors and operation of existing ones. This will include looking at broad evolutions and good practices in terms of (i) industrial structure, (ii) market competition and (iii) supply chain arrangements as well as how (iv) reactor design (and innovation) and construction workflow management (in relation with suppliers and Safety Authorities) could lead to further costs reductions. The role of (v) safety regulation and (vi) fiscal rules could also be investigated.

From a policy perspective, a useful output of this study could be to highlight the present efforts ongoing in this area, the necessary conditions and order of magnitude of costs reductions, and the time horizon when this could take place.

This task could be undertaken with the assistance of an Expert Group, overseen by the WPNE. In addition, this study could build on some ongoing initiatives from costs reductions, such as NEI on operation costs that would be used as case studies (see: http://www.utilitydive.com/news/nuclear-industry-targets-30-cost-reduction-by-2018-to-remain-competitive/410592/). Recent reports from the NEA will also be relevant (for example, the 2015 Nuclear New Build: Insights into Financing and Project Management).

WORK PLAN

The project was initiated in the second half of 2018. The final report will be published after two years, in 2020.

Intermediate Output Result 9.6
Projected Costs of Electricity Generation: 2020 Edition

BACKGROUND

During the 2019-20 biennium, the NEA will prepare the 9th edition of the well-regarded reference study on the Projected Costs of Generating Electricity. This will require careful methodological preparatory work to allow for a meaningful new edition reflecting several new key determinants of electricity generating costs. Studies on the projected costs of generating electricity in participating OECD Member countries as well as in selected non-Member countries are published by the NEA roughly every five years in collaboration with its sister agency, the International Energy Agency (IEA).

The Projected Cost studies provide the levelised plan-level costs of generating electricity (LCOE) with different technologies in different countries. Information on carefully selected parameters on the costs of generating electricity received from Member countries is processed by a common methodology in order to allow for comparisons both across technologies and across countries. The unique combination of information validated by Member countries and a shared and transparent methodology yielding widely accepted generation cost figures established the Projected Cost series as an important reference for modellers, experts and energy policy makers.

For reasons outlined below the LCOE methodology used in all previous Projected Cost studies is experiencing a number of challenges. Occasionally, even its wholesale substitution is suggested. As a general approach, however, the NEA Secretariat as well as Member country experts consider that substituting the existing LCOE with a single comprehensive alternative metric is neither feasible nor desirable. LCOE, despite its increasingly obvious shortcomings, remains a metric with which experts and policymakers are familiar and comfortable. The NEA is thus preparing a two-pronged strategy that combines an evolution of the standard LCOE methodology (referred to in the following as LCOE+) with the provision of a set of complementary indicators on electricity generating costs (referred to in the following as INFO+). The objective is to combine thus the transparency and user-friendliness of the LCOE-methodology with a broader picture of generating costs in a manner that is meaningful for modellers and policymakers.

The work of NEA and IEA staff on the last two editions of the Projected Cost studies was supervised by a dedicated Electricity Generating Cost (EGC) Group. The EGC Expert Group was composed by members of the NEA Working Party on Nuclear Economics (WPNE) and the IEA Standing Committee on Long-Term Cooperation (SLT) as well as by individual experts nominated by Member countries and the NEA and IEA Secretariats. This arrangement has worked well and will also be adopted for the 2020 Edition.

CHALLENGES TO THE LCOE METHODOLOGY

The methodology employed in all previous Projected Cost studies was the levelised cost of electricity (LCOE). The LCOE methodology always possessed a number of important advantages but had also a number of drawbacks. The latter have become more significant in recent years due to the structural changes taking place in the electricity sectors of OECD countries, the most important of which is the deployment of important amounts of variable renewable energies (VRE) such as wind and solar PV. The LCOE methodology was originally developed to meet the needs of regulators to assess the cost of technologies providing baseload power in rate-regulated electricity markets. The objectives were (a) to rank different available technologies for power production by average lifetime cost given a high and stable utilisation rate and (b) to assess the level of electricity tariffs required to remunerate these technologies, including an appropriate return on investment.

The LCOE represents the average lifetime cost for providing a unit of output (MWh) for a given load factor, often the maximal load factor achievable by the power plant or a common value typical of baseload plants. This simple metric allows for a straightforward comparison of technologies with different sizes, different lifetimes and different expenditure profiles. The LCOE methodology goes hand-in-hand with the notion of "baseload" power production, i.e., electricity produced by large centralised power plants based on mature technologies running around the clock. Their output can be considered a homogenous good, electricity, whose economic value is independent of the time of production or the precise location of the plant. Combining this assumption with the financial certainty provided by a regulated tariff allowed using the same capital costs for different technologies.

The LCOE methodology is relatively simple, transparent (in particular with respect to its assumptions, all of which can be made explicit in a manner that is meaningful even to the non-expert reader) and allows for comparability not only across technologies but also across countries. In addition, the input data for basic LCOE computations is essentially limited to overnight costs, duration of construction, technical lifetimes, fuel and O&M costs. This allows to move forward relatively quickly even with large samples. It is, however, possible to add different cost items rather easily, as long as they are related to the individual plant.

These qualities have led to using the LCOE technologies for cost comparisons in deregulated electricity markets as well. While this is standard practice, it poses a methodological issue. In particular, in deregulated markets different technologies are exposed to different financial risks. Such technology-specific risk relates primarily to the ability to hedge against quantity and price risk for electricity output (including bankruptcy risk) and price risk for inputs. Higher risks imply that investors demand higher requested rates of return. However, meaningful cost comparisons demand common assumptions regarding capital costs. There is such an inherent tension between comparability and realism. A similar argument applies to load factors. A gas-fired peaking power plant is unlikely to work the same number of annual hours as a nuclear baseload power plant, precisely in order to take benefit from its flexibility facing changing prices. For reasons of comparability, however, previous editions of the Projected Costs series have stuck to established convention and maintained the fiction that both gas plants and nuclear power plants worked the same number of hours and required the same costs of capital.

Ultimately, the Projected Cost series proceeded on the assumption that baseload power is still a relevant concept and that power generation technologies are ultimately substitutable. If this assumption was already challenged in deregulated markets in general, it became untenable with significant share of production from VREs receiving out-of-market support in various forms. This is for two main reasons:

- VREs cannot be easily compared in a meaningful way to dispatchable technologies as (a) their load factors are location-specific, (b) their deployment is usually independent of costs and prices and (c) they create a number of system costs that are not accounted for in plant-level LCOE.
- VREs, which have zero short-term marginal costs, displace existing production and thus affect their load factors and their average LCOE costs. In other words, even

the LCOE of classic, dispatchable technologies will depend on the share of VREs in electricity production.

These observations result in two major facts. First, technologies are no longer directly comparable to each other but fulfil different functions is an ever-more complex electricity system. This was already true for deregulated markets and, in fact, to some extent even for regulated markets before the advent of VREs. VREs and the accompanying changes in the working of electricity markets, however, strongly exacerbate this tendency. Thus qualities such as flexibility, dispatchability or capacity provision are of great importance to the overall profitability of electricity producers, in addition to their ability to churn out large quantities of electricity at low cost.

Second, the value of a technology is no longer independent of the system in which it is deployed. A nuclear power plant with a load factor of 85% is still a sensible proposition in a system with VREs providing 10% of electricity supply. It may become a stretch of the imagination at a 25% share and is an unrealistic proposition at a 50% share of VRE. These figures are themselves a function of country-specific conditions such as the shape of the load curve, the overall generation mix, in particular available hydroelectric resources and storage, or the ability of industry to engage in demand response.

Continuing the twin fictions that (a) electricity generating costs are comparable across technologies and across countries according to a common set of assumptions and that (b) they are independent of the surrounding electricity system would thus not result in a meaningful new edition of the Projected Cost series. The "Way Forward" below describes a two-pronged strategy to attractiveness and relevance of the series.

THE WAY FORWARD

Despite the challenges indicated above, there seems currently still a sufficiently high level of social demand for a reliable reference publication on the cost of electricity generation. We thus propose to go forward at least with preparatory methodological work on a new edition of the Projected Cost series. The required methodological work will demand careful preparation both at the institutional and the conceptual level. Below proposals are made for both aspects of the work.

THE INSTITUTIONAL ASPECT

A fundamental revision of the methodology of the Projected Cost series not only requires a thorough and systematic conceptual discussion by a group of duly qualified experts. It requires also an acceptance by member countries and the wider public to welcome results in a form different from earlier editions. A new EGC Expert Group should be convened as early as possible. Some preparatory work during the second half of 2018 seems also necessary. This could take place in the form of a workshop on methodological issues. Preparatory discussion with IEA colleagues is indispensable and is under way.

For the constitution of the EGC Expert Group, both, WPNE and NDC, as well as the IEA SLT, will be asked to nominate experts. In addition, the NEA and IEA Secretariats will make early contact with a small number of individual experts. Given the high visibility of the Projected Cost studies, it might be useful to accompany already the start of the work with a press release or another form of public announcement indicating the principal methodological changes to expect.

CONCEPTUAL ASPECTS

The revision of the methodology of the Projected Cost series should be properly the task of the EGC Expert Group. This will require extensive discussion and careful preparation. While any details of the methodological revision have yet to be developed, during preliminary consultations a consensus was identifiable that it is not desirable for practical reasons (historical consistency, institutional capacity in Member countries) as well as for methodological reasons (no immediate options are available) to substitute LCOE with one single alternative metric.

In order to facilitate future discussions, the NEA Secretariat proposes to structure the revisions around two major building blocks. The first building block would consist of an augmented LCOE methodology, which is referred to for simplicity's sake as LCOE+. Calculations with a LCOE+ methodology would still be based on a limited set of generation cost data, which would be provided by OECD member countries and selected non-Member countries on the basis of a questionnaire. The resulting country-specific data would then be processed by the NEA and the IEA Secretariats according to a common set of assumptions. The latter will previously have been discussed and validated by the EGC Expert Group.

The second building block would consist of a set of additional cost-relevant parameters of relevant generation technologies that is referred to as INFO+. These parameters, for instance the system costs of different generation technologies in function of a specific reference system, would not be reported by Member countries. They would instead be calculated entirely by the NEA and IEA Secretariats on the basis of assumptions that would have been defined by the EGC Expert Group. The results of any INFO+ computations would be reported alongside the LCOE+ results. It will be for the EGC Expert Group to decide whether for communication purposes a single comprehensive number (LCOE+ plus INFO+) should be reported for each technology. If Member countries so wish, LCOE methodology with identical load factors and discount rates over the full lifetime could be reported alongside.

As far as the evolutions of the LCOE+ methodology are concerned, the following questions require discussion:

1. Should across-the board inter-technology comparisons based on a common discount rate and a common load-factor be abandoned? Nuclear, gas and renewables, for instance, have very different functions in modern electricity systems. What are the costs and benefits of using technology-specific costs of capital and as well as technology-specific load factors?
2. Even for individual technologies, should the concept of a single discount rate over the whole lifetime of a plant be maintained? The financial risks and the cost of capital can be very different during the phases of construction, operations and, perhaps decommissioning and waste disposal. Clearly, any decision on this will have to strike a balance between differentiation and realism on the one hand and transparency and readability on the other.
3. Including a number of additional "generating technologies" relevant for modern electricity systems and likely to be available by 2025. These may include investments for nuclear long-term operations (LTO), carbon capture and storage (CCS) as well as the cost of battery storage and even certain forms of demand response (DR). Methodological issues in cost accounting for storage and DR are challenging but should be ultimately manageable. The point is not to strive for completeness but to strike a balance between the ability to provide meaningful cost numbers and the need

to include options that are likely to play a significant role in the electricity system in the medium-term.

The complementary information referred to as INFO+ will be based on a mix of questionnaire results, expert opinion and in-house modelling by the NEA and IEA Secretariats. It is important to note that INFO+ data will not be country-specific. Given the dependence of much of INFO+ data on the surrounding electricity system, a common reference system (e.g., for illustration only, 1/3 nuclear, 1/3 gas and 1/3 renewables) would need to be defined by the EGC Expert Group. The reference system could also be used to validate technology-specific load factors. INFO+ data should include the following cost items:

- System costs on the basis of the reference system
- Ramp rates and flexibility metrics
- Capacity credit based on the reference system
- Net cost of new entry (net CONE) based on the reference system
- The value factor of wind and solar PV based on the reference system.

Based on reference system, also options for costs recovery for different services in different markets will be reported. The EGC Expert Group will need to carefully consider in which form LCOE+ data and INFO+ data will be presented at the level of the technology as well as at the level of the individual country.

All of this work must be undertaken in spirit that recognises that perfection is the enemy of the good. No methodological adjustment will capture all aspects of a country's electricity system. Improving the relevance of the Projected Costs studies does not mean pushing the waterfront or re-writing electricity economics. The objective must be to arrive at a limited set of meaningful indicators that can be provided by Member countries without requiring specialised expertise and at reasonable cost. The pertinence, feasibility and acceptability of these indicators will decide whether the Projected Costs series will remain the widely-used reference for policy-makers, modellers and electricity market experts that it currently is.

WORK PLAN

The overall project including the methodological work, the completion of the questionnaires and the processing of the obtained information will take at least two years. Projected Costs of Generating Electricity: 2020 Edition will thus be prepared for publication in mid-2020. Exceptionally for an activity for the 2019-2020 POW, preparatory work for this joint NEA/IEA project will already start in late 2018. The EGC Expert Group will probably need to meet at least four times during this period. The first meeting could take the form of an open international workshop on the methodology of cost estimation in the electricity sector in Fall 2018.

Intermediate Output Result 9.7

Ensuring the Adequacy of Funding Arrangements for Decommissioning and Spent Nuclear Fuel Disposal

This project is carried-over from the 2017-2018 NDC PoW. The work plan has been consequently updated.

BACKGROUND

Due to the ageing of the existing reactor fleet, the decommissioning of nuclear power plants is inevitably assuming a growing share of the nuclear industry. More than 40 years of nuclear power production also means that large amounts of spent nuclear fuel need be stored and eventually disposed. Decommissioning and spent fuel management are thus urgent challenges that need to be addressed now. The key issues here are not technical but financial. Financial adequacy in this context has three major aspects. First, are the original cost estimates still valid in the light of recent evolutions? Second, are the financial risks of the invested funds adequately hedged to provide sufficient liquidity even under conditions of a reversal in the fortunes of the electricity industry or a degradation of overall investment conditions? Third, are the funds for decommissioning and waste disposal sufficiently protected in cases where either ownership of the original nuclear operator changes or the party holding liability goes bankrupt? Much of the information on the set-up and management of reserve funds is subject to parliamentary approval and hence publicly available.

Recent NDD publications, most notably Costs of Decommissioning Nuclear Power Plants (2016, forthcoming) and The Economics of the Back-End of the Nuclear Fuel Cycle (2013) have provided indications of the costs of decommissioning as well as spent fuel treatment. This study will confront the results of these studies with the existing funding arrangements in NEA member countries to assess their adequacy and long-term economic sustainability. The latter point concerns in particular the regulations concerning the constitution of funds over time, the conditions for the re-investment of those funds, their liquidity and riskiness, as well as the governance put in place to oversee investment and disbursement.

OBJECTIVES AND SCOPE

The study will provide a county by country assessment of the adequacy and long-term economic sustainability of Funding Arrangements for Decommissioning, Spent Nuclear Fuel Storage and Disposal in NEA Countries. The aim is only to identify any areas where current arrangements might be sub-optimal, but also to provide general guidelines for policymakers on minimum requirements and international best practice in this area.

PUBLICATION

The main output will be a final report to be completed by 2019.

OTHER RELEVANT STUDIES

Costs of Decommissioning Nuclear Power Plants (2016, forthcoming),

The Economics of the Back-End of the Nuclear Fuel Cycle (2013).

COLLABORATION

The study offers scope for collaboration with the NEA Office of Legal Counsel and the NEA Division of Radiological Protection and radioactive Waste Management, as well as an opportunity for information exchange with the IAEA and the European Commission Decommissioning Funding Group (DFG).

WORK PLAN

The project will be supervised by the WPNE. Member countries will be contacted mid-way through the project by way of a questionnaire. However, the questionnaire will be pre-completed by the Secretariat on the basis of publicly available information. Member countries will be asked to verify, adapt and comment on the information in the questionnaire, rather than to provide it themselves.

Intermediate Output Result 9.8
Issues and Implications of Extended Storage of Spent Nuclear Fuel

This project is carried-over from the 2015-2016 NDC PoW. The work plan has been consequently updated.

BACKGROUND

This project was first identified in the 2015-2016 PoW, but the scope of the study was not well delineated. The project was reframed in 2017, and its scope was limited to only the economic issues associated to the extended storage of spent nuclear fuel and the Expert Group was renamed to stress its focus of work. The Expert Group has met twice while parallel groups in RAD and SAF have been preparing reports on questionnaires to member country representatives on extended SNF storage; the WNA Working Group on Sustainable Used Fuel Management has been preparing a questionnaire for its membership; and the IAEA has been investigating aspects (e.g., transportation) associated with long-term management of spent/used nuclear fuel.

Extended intermediate storage of spent nuclear fuel (SNF) has become an increasingly adopted practice, and operational periods of 60 years or longer are being considered. This is sometimes due to the long time frames needed for the deployment of final repositories, but can also be considered as a strategic choice. In a few cases, political and social hurdles have challenged the establishment of a national strategy for SNF, with significant policy shifts over time, with other factors influencing continued long-term storage (including the small volumes of waste accumulated in the country, difficulties with transport or site selection, or inadequacy of available funding).

Long-term interim storage gives rise to multi-faceted and cross-cutting implications:

- Technological – There are key needs for detecting, understanding, and evaluating the extent of degradation mechanisms, which depend upon the type of storage, the type of fuel, and the degree of burn-up. There is an emerging need to introduce ageing management programmes.
- Safety, security and environment related – There are added requirements partly linked to SNF degradation that can affect safe storage and transport. Prolonged periods of interim storage in multiple facilities can pose other security and safety issues, for instance, criticality-related issues (e.g., among others, the requirement for increased fuel storage density at reactor sites). Also, there are added requirements of regulatory assessment and oversight of periodical safety reviews and associated ageing management programmes. These couple to the needs triggered by problems with fuel pools during the Fukushima accident, to reassess the safety and adequacy of interim storage arrangements.
- Regulatory – The demonstration of compliance with specific regulatory requirements deriving from the above. The potential need for multiple license renewals of existing spent fuel storage facilities (initial licences have been granted for 20 years to 40 years).
- Economic – Costs escalations due to delays as opposed to early implementation of disposal solutions. Financial responsibilities and generational timeframes to which costs are allocated.

- Non-technical aspects of ageing – including knowledge management or long-term aspects of management systems.
- Social – Public concerns and civil society requirements regarding long-term stewardship of high-level radioactive waste.

COLLABORATION

IAEA, EC, NEA Radioactive Waste Management Committee (RWMC), Committee on the Safety of Nuclear Installations (CSNI).

WORK PLAN

An Expert Group comprising representatives of the nuclear industry, government agencies and nuclear research organisations has been established to conduct the study.

The work was interrupted in mid-2018, but it is expected to be restarted with the secretariat support of a new NEA staff member in early 2019. The Expert Group plans to work on determining the relevant variables and parameters for an economic model to assess costs and risks associated with various extended SNF storage options.

PUBLICATIONS

The main output will be a final report to be completed by 2019.

SUMMARY TABLE

Output	Title	Technology	Economics	Expert Group (E), Secretariat (S) or Uranium Group (UG)	WPNE oversight	CO Carry Over / Expected Completion Date
Output Result 8: Nuclear Technologies Development						
8.1	Support to Other Parts of the OECD and Other Programmes	X	X	S		Continuous
8.2	Advice to Policy Makers	X	X	S		Continuous
8.3	Security of Supply of Medical Radioisotopes	X	X	S		Continuous
8.4	NI2050 Phase III	X	X	S		CO / 2020
8.5	Advanced Reactor Systems and Future Energy Market Needs	X	X	E	X	CO / 2020
8.6	Approaching Nuclear Power from a Social Science Perspective			E		2020
8.7	Nuclear Fuel Cycle Strategies and Considerations	X	X	E		CO / 2019
8.8	Fuel Cycle Studies	X	X	E		2020
8.9	Technical Secretariat Support and Coordination for GIF Activities	X	X	S		Continuous
8.10	Technical Secretariat Support and Coordination for IFNEC Activities	X	X	S		Continuous
Output Result 9: Economics and Resource Analysis						
9.1	Uranium: Resources, Production and Demand	X	X	UG		2020
9.2	Nuclear Energy Data			S		2019, 2020
9.3	Contribution of Uranium Mining to Economic Development : Local and National Economies		X	E		CO / 2020
9.4	Maintaining Low Carbon Generation Capacity through LTO of Nuclear Power Plants: Economic, Technical & Policy Aspects	X	X	E	X	CO / 2020
9.5	Reducing the Costs of Nuclear Power Generation		X	E	X	CO / 2020
9.6	Projected Costs of Electricity Generation 2020		X	E	X	2020
9.7	Ensuring the Adequacy of Funding Arrangements for Decommissioning and Spent Fuel Disposal		X	S	X	CO/2019
9.8	Issues and Implication of Extended Storage of Spent Nuclear Fuel		E	E		CO / 2019