



IAEA

International Atomic Energy Agency

Atoms for Peace

**INPRO Dialogue Forum on
Roadmaps for a Transition to Globally
Sustainable Nuclear Energy Systems
(11th INPRO Dialogue Forum)**

**IAEA Headquarters
Vienna, Austria**

20–23 October 2015

Ref. No.: I4-TM-50116

Information Sheet

A. Background

A.1. International Project on Innovative Nuclear Reactors and Fuel Cycles

The International Atomic Energy Agency's (IAEA's) International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) has the objective of helping to ensure that nuclear energy is available to contribute to meeting global energy needs of the 21st century in a sustainable manner [1]. INPRO is part of the integrated services of the IAEA provided to Member States considering initial development or expansion of nuclear energy programmes. INPRO's activities are focused on the concept of nuclear energy sustainability and support the development of long-range nuclear energy strategies in IAEA Member States.

INPRO has introduced the concept of a sustainable nuclear energy system [2]. This concept is based on the United Nations (UN) definition of sustainable development [3] as “development that meets the

needs of the present without compromising the ability of future generations to meet their own needs”, which is detailed into nuclear specific technical and institutional areas by the INPRO methodology for nuclear energy system assessment [2]. The INPRO Task 1 entitled “Global Scenarios” has the objective to develop, based on scientific and technical analyses, global and regional nuclear energy scenarios leading to a global vision of sustainable nuclear energy in the 21st century [1]. By developing those scenarios, INPRO helps both newcomers and existing nuclear countries to understand the key issues in a transition to future sustainable nuclear energy systems, as well as the role that innovations and collaboration among technology holders and technology users could play in such a transition.

A.2. Outputs of the Previous Studies

Existing nuclear energy systems, which are almost entirely based on thermal reactors operating in a once-through cycle, will continue to be the main contributor to nuclear energy production for at least several more decades. However, the results of multiple national and international studies show that the criteria for the highest levels of nuclear energy sustainability cannot be achieved without major innovations in reactor and nuclear fuel cycle technologies.

New reactors, nuclear fuels and fuel cycle technologies are under development and demonstration worldwide. Combining different reactor types and associated fuel chains creates a multiplicity of nuclear energy system arrangements potentially contributing to global sustainability of nuclear energy. Cooperation among countries in the nuclear fuel cycle would be essential to bring sustainability benefits from innovations in technology to all interested users. In order to create viable cooperation among countries, it becomes clear that national strategies will have to be harmonized with regional and global nuclear power architectures to make national nuclear energy systems more sustainable.

The economic studies carried out under the INPRO framework have shown that investments in research, development and demonstration for innovative technologies, such as fast reactors and a closed nuclear fuel cycle, are huge and provide reasonable payback times only in the case of a foreseen large scale deployment for such technologies [4]. Not all of the countries interested in nuclear energy will be able and also willing to afford such high investments. However, benefits associated with innovative technologies can be amplified, and brought to, many interested users through mutually beneficial cooperation among countries.

Reflecting upon this finding, the INPRO collaborative project “Global Architecture of Innovative Nuclear Energy Systems Based on Thermal and Fast Reactors Including a Closed Fuel Cycle” (GAINS) developed an international analytical framework for assessing transition scenarios to future sustainable nuclear energy systems and conducted sample analyses. The framework includes heterogeneous global models to capture countries’ different policies regarding the nuclear fuel cycle and to analyse available cooperation options. The heterogeneous model may involve certain degrees of cooperation between groups of countries (synergistic case) or it may involve no cooperation among countries (non-synergistic case).

The GAINS project has concluded that, although only a few countries may master innovative technologies of fast reactors and closed nuclear fuel cycles within this century, all others could benefit from this if they follow a synergistic approach, i.e. send their spent nuclear fuel for reprocessing and recycling in fast reactor programmes implemented by technology holder countries. In this way, progressive accumulation of spent nuclear fuel on a global or regional scale could be mitigated or even reversed. The synergistic approach could also secure natural uranium savings of up to 40%, compared to a heterogeneous non-synergistic case.

Synergies among the various existing and innovative nuclear energy technologies and options to amplify them through collaboration among countries in the fuel cycle were further examined in the INPRO collaborative project “Synergistic Nuclear Energy Regional Group Interactions Evaluated for

Sustainability” (SYNERGIES) [6] (final report pending). The SYNERGIES project concluded that synergistic approaches that would combine various nuclear energy system options deployed within different countries into a globally, more sustainable nuclear energy system, would/could be beneficial, though the drivers towards such development should primarily be induced by the current nuclear technology holders. In this, economic savings were identified as the primary driver for cooperation among countries. Synergistic collaborations among countries in the back end of the fuel cycle offer higher rates of capacity growth and larger capacity centralized fuel cycle enterprises which could help exploit the economy of learning and the economy of scale curves to support ‘win–win’ collaborative strategies through the resulting economic benefits for all.

A.3. INPRO Collaborative Project “Roadmaps for a Transition to Globally Sustainable Nuclear Energy Systems” (ROADMAPS)

While there are several ongoing national and international efforts on technology development for innovative nuclear reactors and fuel cycles, roadmaps for a transition to globally sustainable nuclear energy systems need further development. The INPRO collaborative project ROADMAPS, launched in November 2014, has the objective of developing a structured approach for achieving globally sustainable nuclear energy, in particular by providing models for international cooperation and a template for documenting actions, scope of work, and timeframes for specific collaborative efforts by particular stakeholders (the ‘roadmap template’) [7].

To make a meaningful contribution to growing energy needs in the 21st century, nuclear energy has to be available and affordable for all interested countries. ROADMAPS will address several ‘stages’ for nuclear energy system sustainability, starting from a system that enjoys public acceptance, contributes to the security of energy supply and meets the current requirements for safety, economics, environmental protection and non-proliferation, and leading to advanced systems in which all actinides are recycled and only fission products are finally disposed. The ROADMAPS project will employ a global perspective and provide guidance for regions or countries to develop their own more-specific roadmaps in a compatible format.

The roadmap template will address in detail the timelines, technologies, institutional mechanisms, and economic arrangements that will support a collaborative transition to globally sustainable nuclear energy systems, as well as the drivers and impediments to achieving them. The completed roadmaps will indicate, inter alia, where savings in time, effort and resources could be achieved through international collaboration. As these regional or country-level roadmaps are developed and linked, the composite may evolve into an integrated plan for achieving globally sustainable nuclear energy systems.

To achieve its objectives, the ROADMAPS project will integrate the outputs of GAINS, SYNERGIES and several other INPRO collaborative projects and, therefore, serve as an umbrella to facilitate Member States’ effective use of the outputs of INPRO projects. ROADMAPS will identify the gaps in international collaboration in developing globally sustainable nuclear energy systems so that solutions to close such gaps can be developed in future projects.

A.4. INPRO Dialogue Forum on ROADMAPS

The INPRO Dialogue Forums offer a platform for technology holders, technology users and other stakeholders to share information, perspectives and knowledge on issues related to sustainable nuclear energy development. The INPRO Dialogue Forums focus on topics and issues relevant to global nuclear energy sustainability in the 21st century, long term nuclear energy strategies, global and regional nuclear energy scenarios and the role of nuclear technology innovations. Information on the Dialogue Forums may be found at: <http://www.iaea.org/INPRO/DFs/index.html>.

The successful implementation of collaborative projects such as ROADMAPS is impossible without establishing a productive dialogue among the broad variety of stakeholders in technology holder, technology user and newcomer countries. For this reason, in June 2014, the 22nd INPRO Steering Committee meeting endorsed the organization of an INPRO Dialogue Forum on Roadmaps for a Transition to Globally Sustainable Nuclear Energy Systems to be held in October 2015.

The INPRO Dialogue Forum on Roadmaps for a Transition to Globally Sustainable Nuclear Energy Systems — which is the 11th INPRO Dialogue Forum — will be held from 20 to 23 October 2015 at the IAEA’s Headquarters in Vienna, Austria. Up to 60 participants are expected. The Dialogue Forum is being organized within the framework of INPRO Task 4 (“Policy and Dialogue”) and Task 1 (“Global Scenarios”), the remit of which is to develop, based on scientific and technical analysis, global and regional nuclear energy scenarios that lead to a global vision of sustainable nuclear energy in the 21st century. The Dialogue Forum is being organized with support from the Planning and Economic Studies Section and the Division of Nuclear Fuel Cycle and Waste Technology within the Department of Nuclear Energy, as well as with support from the Department of Safeguards. The Dialogue Forum will include lectures from the invited keynote speakers and IAEA staff, presentations by the invited participants from IAEA Member States, discussion of the outputs of the home assignments and responses to the questionnaires to be distributed prior to the Forum and discussions among participants representing interested Member States.

B. Objectives

The objectives of this Dialogue Forum are as follows:

- To support implementation of the ROADMAPS project by providing a review of the draft roadmap template and generating insight into its possible applications;
- To review the concept of nuclear energy sustainability stages and highlight current preferences of Member States regarding their positions and roles in the global nuclear energy system;
- To discuss options to amplify synergies among the various nuclear energy technologies by cooperation among countries in the nuclear fuel cycle, including the applicability of experience gained with the front-end fuel cycle services market to the back end of the fuel cycle;
- To discuss near and medium term actions needed to secure a pathway towards long term global sustainability of nuclear energy; and
- To review drivers for, and impediments to, collaboration among countries in the nuclear fuel cycle aiming at the achievement of globally sustainable nuclear energy.

C. Expected Outputs

The expected outputs of the Dialogue Forum are:

- Updated path forward for the ROADMAPS project, including the roadmap template and the concept of nuclear energy sustainability stages;
- Updated insights on options to amplify synergies among the various nuclear energy technologies by cooperation among countries in the nuclear fuel cycle; and

- Identified near and medium term actions needed to secure a pathway towards long term global sustainability of nuclear energy, and identified drivers for, and impediments to, collaboration among countries in the nuclear fuel cycle.

D. Participation

This Dialogue Forum is open up to around 80 participants — who should be decision-makers and senior technical experts working in Member State institutions, non-governmental organizations, the nuclear industry, utilities, universities, and research and development institutions that are involved in the planning or implementation of nuclear energy programmes, long term strategic planning and international cooperation for nuclear energy — from the following Member States: Algeria, Argentina, Armenia, Australia, Austria, Bangladesh, Belarus, Belgium, Brazil, Bulgaria, Canada, Chile, China, Croatia, Czech Republic, Egypt, Estonia, Finland, France, Germany, Ghana, Hungary, India, Indonesia, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Republic of Korea, Latvia, Lithuania, Malaysia, Mexico, Netherlands, Nigeria, Pakistan, Philippines, Poland, Romania, Russian Federation, Saudi Arabia, Serbia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Arab Emirates, United Kingdom, United States of America, the Bolivarian Republic of Venezuela, and Viet Nam. In addition, participants from the European Atomic Forum (FORATOM), the European Commission (EC), the Generation IV International Forum (GIF), the International Framework for Nuclear Energy Cooperation (IFNEC), the OECD's Multinational Design Evaluation Programme (MDEP), the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA), the Western European Nuclear Regulators Association (WENRA), the World Association of Nuclear Operators (WANO), and the World Nuclear Association (WNA) may also participate.

All persons wishing to participate in the Dialogue Forum are required to complete the attached Participation Form. Designations by a formal letter with the completed Participation Form attached should be submitted to the IAEA through the established official channels (e.g. Ministry of Foreign Affairs or National Atomic Energy Authority; or by an organization invited to participate), indicating as a reference number: I4-TM-50116. Designations should be submitted for the attention of the Scientific Secretaries of the Dialogue Forum, Mr Vladimir Kuznetsov and Ms Galina Fesenko (please see contact details in Section I below). The full names and complete contact details (including postal address, telephone/fax numbers, and email address) of designated participants should be provided. The designations with the completed Participation Forms attached should reach the IAEA not later than **21 August 2015**. They should be sent to the Scientific Secretaries of the Dialogue Forum by email to: V.Kuznetsov@iaea.org and G.Fesenko@iaea.org, with a copy to: K.Robinson-Onorati@iaea.org.

Prior to the Dialogue Forum, all participants will be requested to review the materials (roadmap template, concept of nuclear energy sustainability stages) and provide written answers to the questionnaires distributed before the Forum. The development of examples of application of the roadmap template with respect to a national nuclear energy programme or a case study, with their subsequent presentation at the forum, is strongly encouraged. In addition to this, participants may wish to deliver a presentation of their choice on a topic relevant to the objectives of the Dialogue Forum, which is strongly recommended. All participants are requested to be prepared to participate in the discussions initiated at the Forum.

When completing the Participation Form please indicate the title (even if it is only preliminary) of the presentation you are planning to give, state the topic(s) that would be addressed in your presentation, and provide a brief summary (about five to seven lines) on the content of the proposed presentation. The Scientific Secretaries may contact the presenters to discuss the content of the presentations. Also, in accordance with the IAEA's policy, all presentations and other files should be uploaded on a computer used at a meeting room in advance. Therefore, the presentations and any other

supplementary files should be sent to the Scientific Secretaries by email not later than **6 October 2015** (Microsoft PowerPoint files are preferable, although PDF format may be also used). When submitting the files electronically, please note that the size of a message should not exceed 5 MB.

The Dialogue Forum is, in principle, open to all officially designated persons. The IAEA, however, reserves the right to limit the participation due to limitations imposed by the available seating capacity. It is therefore recommended that the persons interested in attending the Dialogue Forum take the necessary steps to obtain their official designation as early as possible.

E. Scope, Format and Topics of the Dialogue Forum

The Dialogue Forum will consist of lectures and plenary/discussion sessions¹. The lectures will be delivered on the following topics:

- The UN concept of sustainable development and sustainability of nuclear energy systems;
- IAEA energy planning and the analytical framework for nuclear energy scenario modelling (jointly with the Planning and Economic Studies Section);
- Completed, ongoing and planned activities under INPRO Task 1 (“Global Scenarios”); their major findings (covering the GAINS, SYNERGIES and ROADMAPS projects);
- Major findings of the IAEA activities on cooperative solutions for waste repositories (in cooperation with the Division of Nuclear Fuel Cycle and Waste Technology);
- Major findings of the INPRO Dialogue Forum on Cooperative Approaches to the Back End of the Nuclear Fuel Cycle: Drivers and Legal, Institutional and Financial Impediments (10th INPRO Dialogue Forum);
- Safeguards perspective on cooperation among countries in the back end of the fuel cycle (in cooperation with the Department of Safeguards);
- Concept of nuclear energy sustainability stages;
- Draft roadmap template; and
- Lectures by representatives from other international organizations (International Energy Agency (IEA), Nuclear Energy Agency (OECD/NEA)) on topics relevant for the subject areas of the Dialogue Forum²;

The plenary sessions will feature presentations by the participants and keynote lectures. The discussions will be centred around the following areas:

- Concept of nuclear energy sustainability stages and preferences of Member States regarding their positions and roles in the global nuclear energy system;
- Synergies among the various nuclear energy technologies and options to amplify them by cooperation among countries in the nuclear fuel cycle;
- Experience of the front-end fuel cycle services market and its applicability to the back end of the fuel cycle;
- Drivers for, and impediments to, collaboration among countries in the nuclear fuel cycle aiming at the achievement of globally sustainable nuclear energy;

¹ Subject to change depending on the actual number and scope of the lectures and presentations.

² Subject to the arrangements with other organizations.

- The roadmap template and examples of its application; and
- Near and medium term actions needed to secure a pathway towards long term global sustainability of nuclear energy.

F. Working Language

The working language of the Dialogue Forum will be English with no interpretation provided. All communications, abstracts and papers must be submitted in that language.

G. Venue

The Dialogue Forum will commence on Tuesday, 20 October 2015, at 9.30 a.m. in Room M2 of the Vienna International Centre (VIC). Participants are requested to arrive at Checkpoint 1/Gate 1 of the VIC one hour before the start of the Dialogue Forum on the first day, in order to allow sufficient time for issuing of grounds passes, which are necessary for official visitors to the VIC.

H. Visas

Participants who need a visa for entering Austria should submit the necessary application to the nearest diplomatic or consular representative of Austria as early as possible.

I. Organization

Official correspondence with regard to the technical aspects of the meeting should be addressed to either of the Scientific Secretaries:

Mr Vladimir Kuznetsov
INPRO Section
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Fax: +43 1 26007

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Tel.: +43 1 2600 26716

Fax: +43 1 26007

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Official correspondence with regard to administrative issues should be addressed to the Administrative Secretary:

Ms Karron Robinson-Onorati
INPRO Section
Division of Nuclear Power
Department of Nuclear Energy
International Atomic Energy Agency
Vienna International Centre
PO Box 100
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AUSTRIA

Tel.: +43 1 2600 22885

Fax: +43 1 26007

Email: K.Robinson-Onorati@iaea.org

J. References

- [1] IAEA web page on the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO): <http://www.iaea.org/INPRO/>
- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, Guidance for the Application of an Assessment Methodology for Innovative Nuclear Energy Systems: INPRO Manual. IAEA-TECDOC-1575, Vienna (2008):
http://www-pub.iaea.org/MTCD/Publications/PDF/TE_1575_web.pdf
- [3] UNITED NATIONS, Our Common Future (Report to the General Assembly), World Commission on Environment and Development, United Nations, New York (1987).
- [4] INTERNATIONAL ATOMIC ENERGY AGENCY, Framework for Assessing Dynamic Nuclear Energy Systems for Sustainability, Final Report of the INPRO Collaborative Project on Global Architectures of Innovative Nuclear Energy Systems with Thermal and Fast Reactors and a Closed Nuclear Fuel Cycle (GAINS), IAEA Nuclear Energy Series No. NP-T-1.14, Vienna (2013):
<http://www-pub.iaea.org/books/IAEABooks/8873/Framework-for-Assessing-Dynamic-Nuclear-Energy-Systems-for-Sustainability-Final-Report-of-the-INPRO-Collaborative-Project-GAINS>

- [5] Analytical Framework for Analysis and Assessment of Transition Scenarios to Sustainable Nuclear Energy Systems, IAEA/INPRO Brochure (2014):
http://www.iaea.org/INPRO/download/news/2014/INPRO_GAINS_brochure.pdf
- [6] IAEA web page on the INPRO collaborative project SYNERGIES:
<http://www.iaea.org/INPRO/CPs/SYNERGIES/index.html>
- [7] IAEA web page on the INPRO collaborative project ROADMAPS:
<https://www.iaea.org/INPRO/CPs/ROADMAPS/index.html>



Participation Form

INPRO Dialogue Forum on Roadmaps for a Transition to Globally Sustainable Nuclear Energy Systems

IAEA Headquarters, Vienna, Austria

20–23 October 2015

This form should be completed by the participant electronically if possible (i.e. not by hand) and then sent to the competent official authority (e.g. Ministry of Foreign Affairs, Permanent Mission to the IAEA or National Atomic Energy Authority) for subsequent transmission to the International Atomic Energy Agency (IAEA), Vienna International Centre, PO Box 100, 1400 Vienna, Austria, either electronically by email to: Official.Mail@iaea.org or by fax to: +43 1 26007 (no hard copies needed). (Kindly send also a copy per email to: V.Kuznetsov@iaea.org; G.Fesenko@iaea.org and K.Robinson-Onorati@iaea.org).

Deadline for receipt by IAEA through official channels: 21 August 2015

The Government (designating authority) of the above-mentioned event.		designates the person indicated below for	
<input type="checkbox"/> Female	<input type="checkbox"/> Male	Date of birth:	
Family name (as in passport):		Place of birth:	
First name:		Nationality:	
Complete mailing address (office):		Passport No.:	
Institution name:		Date of issue:	
Street:		Place of issue:	
PO Box:	Post code:	Valid until:	
Town/City:		Telephone (office):	
Region/District:		Telephone (home):	
Country:		Fax:	
Airport/town nearest to residence:		Email:	
Main academic/technical qualification:		Web page:	
Language ability: (The designating authority confirms that the participant is proficient in the language in which the event is to be held)		<input type="checkbox"/> Yes	
Do you intend to give a presentation?			
<input type="checkbox"/> Yes <input type="checkbox"/> No			
Title of the presentation:			
A summary of the presentation is attached:			
<input type="checkbox"/> Yes <input type="checkbox"/> No			
Radiation surveillance			
Is the participant covered under a radiation surveillance programme?			
<input type="checkbox"/> Yes <input type="checkbox"/> No			
Financial support			
Please indicate if you are requesting financial support from the IAEA?			
<input type="checkbox"/> Yes <input type="checkbox"/> No			
Date		Name and title (printed) and signature of designating authority official	