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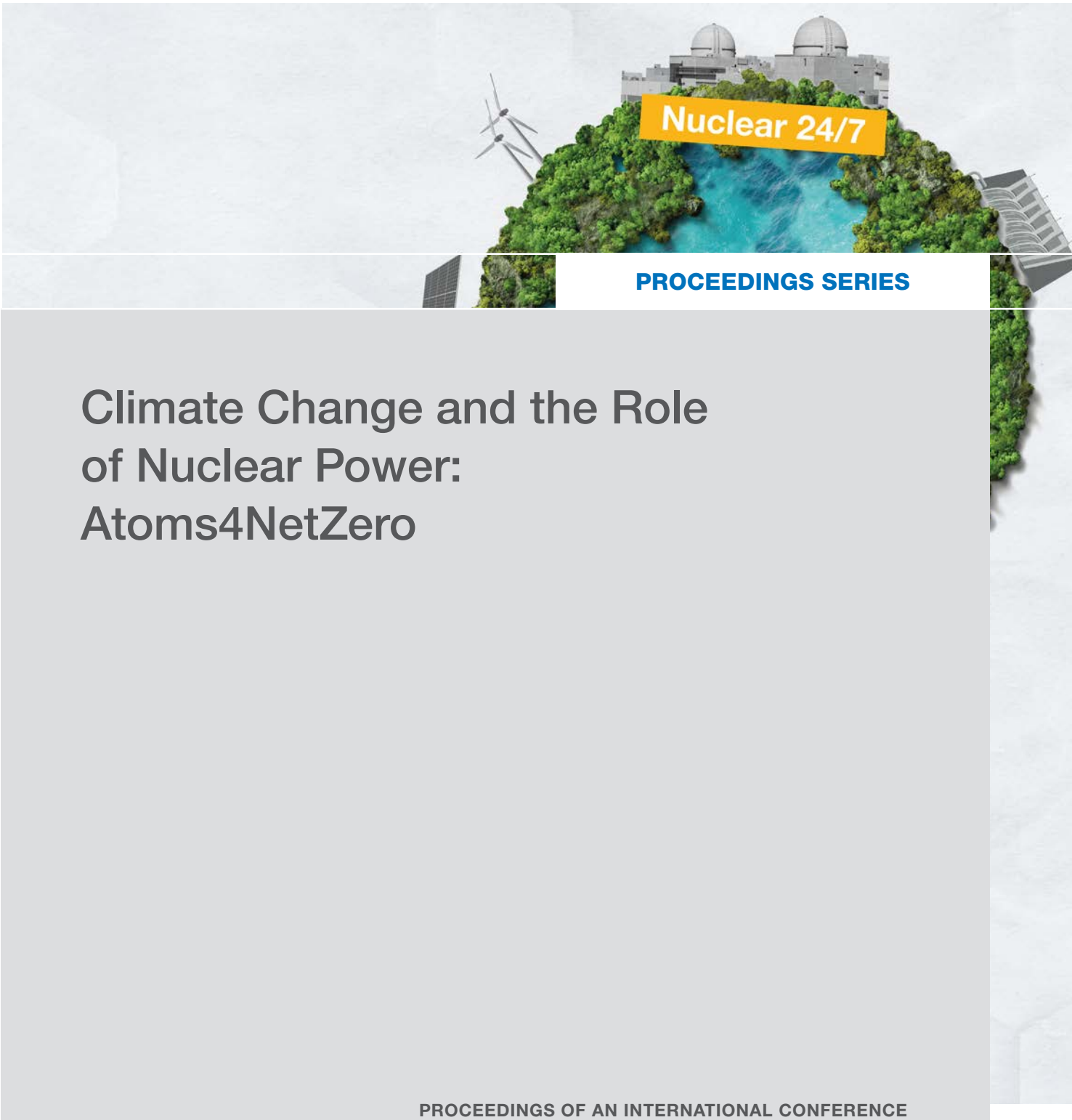

PROCEEDINGS SERIES

Climate Change and the Role of Nuclear Power: Atoms4NetZero

PROCEEDINGS OF AN INTERNATIONAL CONFERENCE
Vienna, Austria, 9–13 October 2023

CLIMATE CHANGE AND THE ROLE OF NUCLEAR POWER: ATOMS4NETZERO

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The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world''.

PROCEEDINGS SERIES

CLIMATE CHANGE AND THE ROLE OF NUCLEAR POWER: ATOMS4NETZERO

PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE ORGANIZED BY THE INTERNATIONAL ATOMIC ENERGY AGENCY AND HELD IN VIENNA, 9–13 OCTOBER 2023

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2025

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FOREWORD

Climate change is one of the most pressing challenges facing the world today. Nuclear power can play a crucial role in reducing greenhouse gas emissions globally, while at the same time helping to meet the increasing energy demand of the world's growing population and supporting sustainable development efforts. As a low emission energy source, nuclear power can significantly contribute to climate action by providing electricity, district heating and high temperature heat for industrial processes — all with minimal greenhouse gas emissions.

To achieve the goals established in the 2015 Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC), a substantial increase in the deployment of low carbon energy technologies is needed. Nuclear power, as a large scale, reliable and concentrated source of energy, has the potential to support both climate change mitigation and broader socioeconomic development goals. Its role was highlighted in the 2018 Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C. In 2023, the 28th United Nations Climate Change Conference (COP28) Global Stocktake explicitly called for accelerating nuclear energy deployment alongside other low emission technologies, marking a historic first for the inclusion of nuclear energy in a negotiated outcome. Furthermore, on the margins of COP28, a pledge was launched to triple nuclear energy capacity by 2050, initially endorsed by 22 countries and now endorsed by more than 30 countries.

The IAEA plays a key role in supporting interested Member States in improving their understanding of how nuclear power can contribute to achieving the United Nations climate change targets and Sustainable Development Goals. It provides guidance and assistance for the safe, secure and safeguarded use of nuclear technology and for developing national energy strategies and policies. These efforts are closely aligned with the IAEA's statutory objective "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

To this end, the IAEA organized the Second International Conference on Climate Change and the Role of Nuclear Power, from 9 to 13 October 2023 in Vienna. The conference provided a platform to examine how nuclear power fits into climate strategies and net zero transitions; to discuss sector specific challenges; and to explore solutions through approaches such as innovation, improved economics, supportive policies and stakeholder involvement. It also fostered dialogue between the nuclear sector and broader policy and technical communities. Key themes of the conference included the energy sector's role in climate mitigation; the climate resilience of energy systems; the potential of current, evolutionary and innovative nuclear power systems; integration with renewable energy systems; environments that fully harness the potential of nuclear power; and the importance of international cooperation and stakeholder engagement.

The conference was organized by the IAEA with the participation of IAEA Member States and international partners, including leading international organizations involved with climate change and the United Nations Sustainable Development Goals, such as the International Energy Agency (IEA), the Organization for Security and Co-operation in Europe (OSCE), the United Nations Department of Economic and Social Affairs (UNDESA), the United Nations Economic Commission for Europe (UNECE), the United Nations Industrial Development Organization (UNIDO), the World Meteorological Organization (WMO) and the World Nuclear Association (WNA).

These proceedings provide a summary of the plenary sessions, technical sessions and side events, along with the full texts of statements delivered during the opening, closing and high level plenary sessions of the conference. All submitted presentations and full papers are available on-line as separate supplementary files.

The IAEA extends its appreciation to the members of the International Scientific Programme Committee and the Secretariat of the Conference for their efforts in organizing and convening the conference. The IAEA officers responsible for this publication were W. Huang, H. Paillere, B. Lazerwitz and M. Papadopoulou of the Department of Nuclear Energy.

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1. OVERVIEW

1.1. INTRODUCTION

To reach climate change goals, including those established in the Paris Agreement, a significant deployment of low-carbon energy technologies is required. Nuclear power has the potential to accelerate the achievement of the Paris Agreement mitigation goals and contribute to the transition towards net zero energy systems. As a large-scale, reliable, dispatchable, and concentrated source of energy, it can also help address the ongoing disruptions in global energy supply and the subsequent energy crisis and support global sustainable development.

The world has witnessed an increasing recognition of the role of nuclear energy amid growing concerns over climate change and energy security in recent years. Efforts to highlight the nexus between nuclear power and climate change have been made not only within the nuclear community but in the broader international arena as well, including in the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP), UN High-Level Dialogue on Energy (HLDE), Clean Energy Ministerial (CEM), Davos Economic Forum (DEF), among others. This trend in the global debate over energy and the environment has been captured and reflected in IAEA annual projections of the potential growth of nuclear power up to 2050, which have increased by 10% on a year-to-year basis in the last two consecutive years (2021 and 2022).

To respond to the increasing interest in nuclear power's contribution to the fight against climate change and further elaborate on the role of nuclear power in net zero transitions, the IAEA organized the second International Conference on Climate Change and the Role of Nuclear Power from 9 to 13 October 2023 in Vienna. The conference served to elaborate on the attributes of nuclear power in the context of climate change and net zero transitions, discuss the main challenges facing the nuclear sector and explore solutions for tapping the full potential of nuclear power through incentivizing innovation, establishing an enabling environment, improving economics, and encouraging stakeholder engagement. It also served as a platform for the nuclear community to establish a dialogue with the non-nuclear community at policy and technical levels.

1.2. SUMMARY OF THE CONFERENCE

The conference's discussions focused on the current challenges and opportunities facing nuclear energy in the context of combatting global climate change and clean energy transitions. Also discussed were options to unleash the potential of nuclear energy in net zero pathways to 2050.

More than 500 participants from 88 IAEA Member States and 33 invited organizations attended the conference. Several ministers and senior officials from IAEA Member States including China, France, Japan, Pakistan, Poland, United Arab Emirates, United States of America, and United Kingdom, among others, represented their countries. Heads or senior representatives of international organizations such as the International Energy Agency (IEA), World Meteorology Organization (WMO), the United Nations Department of Economic and Social Affairs (UN DESA), the United Nations Industrial Development Organization (UNIDO), World Nuclear Association (WNA), World Association of Nuclear Operators (WANO), the Latin American Energy Organization (OLADE), Nuclear Energy Agency of the Organization for Economic Co-operation and Development (OECD-NEA), European Bank for Reconstruction and Development (EBRD), and the Organization for Security and Co-operation in Europe (OSCE),

along with other nuclear industry leaders, contributed to the high-level panel discussions. More than a hundred experts and relevant stakeholders actively participated in the technical discussions and presented their scientific studies and research.

Thematic topics of the conference included:

- Actions and initiatives to meet the objectives of the Paris Agreement and the role of nuclear power in their attainment;
- Highlighting the role of women and youth in the fight against climate change;
- Innovative technologies and small modular reactors (SMRs);
- The role of nuclear in the context of low-carbon hydrogen;
- Sustainable finance frameworks for nuclear power;
- Synergies and complementarities between nuclear power and renewable energies;
- Initiatives for ensuring stakeholder engagement in the development and implementation of nuclear power strategies.

The conference programme consisted of opening and closing sessions, high-level panel sessions with invited keynote addresses, technical sessions with panel discussions, side events, interactive e-posters, and exhibitions. On the first day, Monday 9 October, in addition to the opening session, four high-level panel sessions were held, together with high-level statements and video messages from high-level officials from Member States and Heads of international organizations. On the following three days, high-level panel sessions consisting of Davos-style discussions focused on four topical themes were arranged in the morning and the afternoon, followed in each case by three technical sessions held in parallel. Parallel sessions featured presentations selected from submitted abstracts/papers. E-poster exhibition sessions took place during coffee breaks in the morning and afternoon of the second, third, and fourth days of the conference. On the last day, Friday 13 October, one special session on nuclear power to support a Just Transition in the Global South was arranged. The summary of the conference president was presented in the closing plenary session at the end of the conference.

The 18 technical sessions with 91 oral presentations were grouped around four parallel technical tracks:

- Track 1: Positioning Nuclear Power in the Global Clean Energy Transition;
- Track 2: Establishing an enabling environment for nuclear power;
- Track 3: Releasing the full potential of nuclear energy;
- Track 4: Mainstreaming nuclear power as a sustainable, low-carbon energy source.

1.3. OBJECTIVES AND STRUCTURE OF THE PROCEEDINGS

Designed to provide an output of the second conference on Climate Change and the role of Nuclear Power, the proceedings are expected to serve as a valuable source of information for a wide audience including decisionmakers, regulators, experts, scholars, public and other stakeholders from Member States and international organizations involved in nuclear energy, climate change, environment, economics, and sustainable development.

This publication contains high-level statements delivered at the conference, summaries of high-level panels, side events and the special session on nuclear power to support a Just Transition in the Global South, as well as conclusions including the summary of the conference president.

2. HIGH-LEVEL STATEMENTS

2.1. CHINA ENERGY AUTHORITY (CAEA)

Statement as provided, verbatim.

Z. Keijan
Chairman
China Atomic Energy Authority (CAEA)
China

Distinguished HE Ambassador Alkaabi, DG Grossi, Ladies and Gentlemen:

Good morning everyone! It is my great pleasure to lead the Chinese delegation to attend the Second International Conference on Climate Change and the Role of Nuclear Energy. As the Climate Ambition Summit 2023 has just concluded and the COP 28 is about to be held, the International Atomic Energy Agency holds this conference, which demonstrates the actions and measures taken by the global nuclear industry to jointly plan for nuclear energy development and respond to the challenge of climate change. On behalf of the China Atomic Energy Authority, I would like to congratulate you on the successful convening of this conference!

China is an active advocate and staunch activist in addressing climate change. It advocates that all countries should promote the implementation of the United Nations Framework Convention on Climate Change and its Paris Agreement in accordance with the principle of common but differentiated responsibilities, actively respond to climate change, and promote green and low-carbon transition and build a clean and beautiful world together. In the past ten years, it has supported an average annual economic growth of 6.5% with an average annual energy consumption growth rate of 3%; its carbon dioxide emissions per unit of GDP have dropped by 36.7%, non-fossil energy power generation installed capacity exceeds over 50%, and the annual power generation of nuclear power ranks the second in the world.

The Chinese government adheres to the new development concepts of innovation, coordination, green, openness and co-sharing, and regards nuclear energy as an important option to build a clean and low-carbon energy system and achieve the goal of carbon peak and carbon neutrality.

First, we insist on innovative development. 5 units of China's independent third-generation nuclear power ‘Hualong One’ have been put into operation at home and abroad. The world's first fourth-generation high-temperature gas-cooled reactor demonstration project was successfully connected to the grid. The first multi-purpose land-based commercial modular small reactor ‘Linglong 1’ completed the hoisting of the reactor core module. R&D and applications of nuclear energy in areas of district heat, industrial process heat, seawater desalination etc. are making new progress.

Second, we adhere to coordinated development. China has established a complete nuclear industrial chain infrastructure and technical capabilities ranging from uranium resource development, nuclear fuel supply, nuclear equipment manufacturing, nuclear engineering construction, nuclear waste treatment, and nuclear technology application. China has put in place a coordinated and effective nuclear safety, nuclear security, nuclear emergency regulations and standards, law enforcement and technical support systems.

Third, we adhere to green development. China has built several low- and medium-level solid waste disposal sites, and the first underground laboratory for geological disposal of high-level radioactive waste is under construction. In 2022, the cumulative power generation of nuclear

power in mainland China was 41.78 trillion kilowatt-hours, equivalent to the reduction of burning 120 million tons of standard coal and the reduction of 310 million tons of carbon dioxide emissions.

Fourth, we adhere to open development. China has cooperated with the United States, France, Russia and other countries to successively build AP1000, EPR, VVER and other nuclear power reactor types, China actively participates in major international scientific projects such as the International Thermonuclear Fusion Experimental Reactor, and actively carries out nuclear cooperation with other countries, especially developing countries, making important contributions to the world's nuclear scientific and technological progress and sustainable development .

Fifth, we adhere to shared development and the concept of global development, actively responds to Director General Grossi's initiatives such as 'Atoms4Net Zero' and 'NHSI', Through the implementation of the Chinese Government Atomic Energy Scholarship Project, and support the inter-regional technical cooperation project 2021 'Nuclear Energy Infrastructure and Talent Training in Emerging Nuclear Power Countries' , we have provide training to other developing countries, sharing experience and providing public goods with fruitful results.

Ladies and gentlemen,

It is undoubted that nuclear energy could play an indispensable role in combating climate change and achieving net zero. The Chinese government insists on actively developing nuclear energy in a safe and orderly manner, and has planned to reach 70 million kilowatts installed capacity of nuclear power in operation by 2025 and 150 million kilowatts by 2035. Meanwhile, global nuclear energy development is also faced with challenges such as politicization of technical cooperation, synergy, and competition with renewable energy, as well as financing, safety and security, decommissioning, and waste disposal. China is willing to work with all parties to make greater contributions to nuclear energy in addressing climate change and building a clean and beautiful world. To this end, I would like to make three suggestions:

First, let's jointly create a fair and just environment for development. Peaceful use of nuclear energy is a legitimate right enjoyed by all member States. We firmly oppose politicizing the peaceful use of nuclear energy and interfering with normal international cooperation by building barriers or walls and double standards. We call on the international community to adhere to inclusiveness and mutual support, expand technical support and assistance to developing countries, so that nuclear energy could better benefit people's livelihood and economic development.

Second, let's jointly build a development pattern of collaborative innovation. Facing the opportunities and challenges of nuclear energy development, communication helps us forward while isolation only leads to retreat. We need to strengthen openness and cooperation, promote common development, bring together scientific, technological, and human resources from all countries, work on early solutions to global challenges such as radioactive waste disposal and controllable nuclear fusion, and provide more advanced, safer, and more economical options to address climate change and achieve sustainable development of nuclear energy.

Third, let's jointly abide by the principle of safety first. The dual goals of security and development are like two wings of a bird and two wheels of an engine. We must uphold a common, comprehensive, cooperative, and sustainable security concept, strengthen nuclear

safety and security efforts, earnestly fulfil relevant national responsibilities and international obligations, work together to respond to conventional and non-conventional security challenges, and consolidate the foundation for the safe development of global nuclear energy industry.

Thank you.

2.2. UNITED STATES OF AMERICA (USA)

Statement as transcribed, verbatim:

L.S.H. Holgate
Ambassador to the Vienna Office of the United Nations and to the International Atomic Energy Agency
United States of America (USA)

Distinguished representatives and colleagues,

I welcome this opportunity to join you today to make a statement on behalf of the United States on this important conference.

We cannot, however, ignore what is happening in Israel at this time. The US unequivocally condemns the appalling attacks by Hamas terrorist against Israel, including civilians and civilian communities. There is never any justification for terrorism. We stand in solidarity with the Government and people of Israel and extend our condolences for the Israeli lives lost in these attacks. The US supports Israel's right to defend itself.

Dear colleagues,

We are facing unprecedented climate impacts that must be addressed. Fortunately, advances in nuclear science and technology are giving us the critical tools to address the world's climate, energy, health, and agricultural needs, and thereby how countries around the world achieve the UN sustainable development goals.

The United States embraces the important role that safe and secure nuclear power can play in providing zero carbon, reliable, electricity, in a way that promotes sustainable development while mitigating the effects of climate change. We welcome the Agency's activities in supporting interested Member States in incorporating nuclear power in their national energy planning in a sustainable way that adheres to the highest standards of safety, security, and safeguards.

The United States promotes these highest standards through close cooperation with IAEA, technology developers, regulators, and future operators to incorporate safeguards and security by design features into new reactors. In addition, as a compliment to the IAEA, and consistent with its milestone approach, we fund and host a number of bilateral support programmes, focused on developing safety, security, and safeguards capabilities for future regulators and operators of this critical infrastructure. We recommend you visit the US exhibit booth to learn more about these programmes.

As we grapple with the climate crisis, we also need to consider the need for decarbonization in sectors beyond electricity in order to meet net zero objectives. We appreciate the development of innovative nuclear power technologies, including advanced and small modular reactors, which can be helpful in fully leveraging the peaceful uses of nuclear technology to help decarbonize industrial and transport sectors.

The IAEA's Atoms4NetZero initiative is an opportunity for a wider range of stakeholders to exchange expertise on how nuclear energy can contribute to decarbonizing these sectors. The energy scenario modelling being done by the IAEA under this initiative will help us better assess the potential positive impacts of nuclear power in reducing dependence on fossil fuels more broadly.

Looking ahead to the upcoming UN Conference on Climate Change, or COP28, The United States is joining the United Arab Emirates and others seeking 3 Times Nuclear, a pledge to work together to advance the global aspiration of tripling nuclear energy capacity between 2020 and 2050. This is even more ambitious that Dr Birol's ambitious equation that he gave us earlier this morning. We encourage all countries to join us in this multilateral pledge and advance at COP28 and commit to domestic actions to secure the safe and responsible operation of nuclear power plants within all our borders, in line with the highest standards of safety, sustainability, security, and non-proliferation. We must also be sure that nuclear's essential role is appropriately reflected in the final document for COP28.

We are committed to mobilizing investments in nuclear power, including through innovative financing mechanisms, supporting resilient supply chains needed for the life cycle of advanced power reactors, and assisting countries that are seeking to embark on, or expand, their national nuclear power programmes, by helping develop robust national infrastructures for nuclear power. The United States recognizes that, by contributing globally to clean energy security, nuclear energy can help expand economic opportunities worldwide, achieve progress towards climate change goals, and advance to the fulfilment of the UN sustainable development goals.

This conference will be an opportunity to review progress and discuss what more can be done to address outstanding challenges shared on national plans and commit to work together collaboratively and draw attention to the enormous potential of nuclear energy.

We look forward to a productive conference.

Thank you very much.

2.3. UNITED NATION DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS (UNDESA)

Statement as transcribed, verbatim:

J. Li
Under-Secretary-General
United Nations Department of Economic and Social Affairs (UNDESA)

Excellencies,

Distinguished participants,

Ladies and gentlemen,

I would like to thank the International Atomic Energy Agency (IAEA) for inviting me to address the Second International Conference on Climate Change and the role of Nuclear Power.

With only seven years left to achieve the Sustainable Development Goals, we are in danger of breaking the promise of the 2030 Agenda. Only about 15% of our assessable SDG targets are on track. At the same time, the climate crisis is spiral and out of control. If the current trends continue, we will exceed the 1.5 degrees tipping point by 2035, but there is hope. Just last month, at the SDG Summit and Climate Ambitious Summit, the world leaders demonstrated their resolved to accelerate action and foster a much-needed Rescue Plan for People and the Planet. They committed to bold and ambitious, accelerated, just, and transformative actions aimed at effecting a systemic shift to support a better and greener future for everyone, everywhere.

Excellencies,

Ladies and gentlemen,

Nuclear energy holds the potential to play a significant part in realizing this vision. Nuclear power contributes to immense reductions today, and can do more in the future, especially when compared to gas or coal alternatives. Nuclear technology also benefits a multitude of sectors, it helps in the diagnosis and treatment of cancer and other major diseases, prevents the food from spoiling, and creates new crop varieties. Whether these contributions expand in the future will however depend on how countries evaluate nuclear power technologies, against rapidly growing renewables and other clean alternatives, in shaping green energy transition.

A comprehensive assessment of the long-term management of nuclear waste and nuclear safety as well as the cost-competitiveness of nuclear power will also be critical. In this regard, IAEA's continued leadership will be crucial in informing a just, inclusive, and equitable energy transition. As the Secretariat of UN Energy, the Department of Economic and Social Affairs, is committed to strengthening its cooperation with all UN Energy members, including the IAEA.

Let us start together the way towards a sustainable and equitable world for us, and for future generations.

Thank you.

2.4. ORGANIZATION FOR SECURITY AND CO-OPERATION IN EUROPE (OSCE)

Statement as transcribed, verbatim:
N. Nuredini
Special Representative of the Chairman-in-Office on Climate Change
Organization for Security and Co-operation in Europe (OSCE)

Dear distinguished participants,

The world faces an urgent challenge.

Addressing the global climate crisis reaching net zero emissions prevent potential catastrophic events of climate change.

To achieve this ambitious goal, we must act with all potential avenues, in order to deploy a combination of renewable energy sources and energy efficiency measures. In order to fill our needs, we need to look at transformative technologies, among them nuclear power, which is sometimes contentious but potentially is a pivotal mechanism in the energy mix.

The objective to achieve net zero cannot be achieved by one country. The IPCC has made abundantly clear that limiting global warming to 1.5 degrees Celsius is essential to avoid catastrophic consequences and achieving this goal requires an intensified reduction in greenhouse gas emissions, and ultimately net zero, by mid-century. This challenge, which is already creating very adverse effects on our livelihoods and security over the world, demands a comprehensive, multifaceted approach. In order for us to be successful, we must address this and look at all options.

At the 2021 OSCE Ministerial Council in Stockholm, a decision was taken to strengthen cooperation to address the challenges caused by climate change and calls for the participant States to intensify their dialogue and cooperation towards climate resilience adaptation and mitigation, including through climate risk analysis, early warning, joint research, joint investment, access to information and best practices in the area of technology and innovation.

The current Chairman-in-Office has made abundantly clear that this remains a priority. This has become a must as impacts have been felt around the world. Extreme weather events have become more frequent, more severe, and more widespread, affecting the lives of millions of people and their security. Severe impacts in human health, ecosystems, and natural resources, particularly water, are becoming more and more visible. National economies are disrupted with strong impacts in energy, agriculture, forestry, tourism, and the financial sector, which are among the sectors that are likely to be even more affected by the impacts of climate change.

As it brings a number of direct and indirect consequences to a safe and security landscape, climate change is considered a threat multiplier. Adaptation is an important issue to be addressed in order to protect security. However, we need to commit on mitigation. We need to further invest more in resource targets and secure the future of coming generations. That, in essence, is very dependent on how we can achieve clean energy.

Considering the world population is growing, and we wish our economies to do as well, our energy consumptions' needs will grow. We went through a pandemic, and upon recovery, we started an energy crisis, especially in Europe. We noticed that energy diversification, and the energy mix, was not broad enough, and in some cases, was very dependent on single sources, which further created disruption and scarcity.

Yes, our future needs to be focused and invest on renewable energy, and we need to keep on that path. However, the challenge recurrently faced is to make it viable the intermittences of renewable energies' production and the key question of storage.

We need to find other solutions to balance the energy grids. We need to find options such as green hydrogen, lithium, or SMRs being spoken about today. The key is to have safe, secure, accessible, and affordable energy for all of us.

I thank you for your attention.

3. KEYNOTE SPEECH BY SUSAN EISENHOWER

Ms Susan Eisenhower, granddaughter of US President Dwight D. Eisenhower, was invited to deliver a keynote speech as the year 2023 marked the 70th anniversary of President Eisenhower's 'Atoms for Peace' speech to the United Nations General Assembly in New York. President Eisenhower's speech inspired the creation of the IAEA, which was founded in 1957.

Keynote speech as transcribed, verbatim:

First of all, let me say that it is a tremendous honour to be able to speak to you today on this important subject.

This year we are celebrating the 70th anniversary of 'Atoms for Peace', a speech given by my grandfather, President Dwight D. Eisenhower, On December 8th 1953, and is a special treat for me to be able to reflect on that because now I have worked on non-proliferation in my own career, and I have spent a considerable amount of my career working on nuclear energy, including serving as co-chair of the Nuclear Energy Advisory Council.

Looking back at those 70 years of the 'Atoms for Peace' speech it is useful to think about the context of that speech. The world was in a very fearful state at that time, if you could imagine, and it is hard for us today because it seems so far away in time, but less than a decade before that speech was given, the atomic bomb had been dropped in Japan. Then in August of 1953, just months before the speech was given, USSR tested hydrogen bomb technology. As you can imagine, this shocked the international community as they had broken America's monopoly on the hydrogen bomb technology, suggesting, as it turned out of course, that there would be an arms race with this tremendously destructive technology.

Dwight Eisenhower wanted to reduce the fear around the atom. He had been in Columbia University before running for President, and he felt very strongly about the extraordinary opportunity that the atom could bring to human betterment, the Physics Department of the Columbia University played a significant role in inducing him earlier on due to the developments that were already underway. Eisenhower, being a great strategist, wanted to do several things with the speech. First of all, he wanted to bring to the table nuclear issues, partly due to the hydrogen bomb developed by the USSR, but, more importantly, he wanted to bring the economic potential of the atom to the developing world.

At the same time, he had a domestic agenda too, he wanted to demonstrate, not just to the United States taxpayers that the money invested in this field could have benefits for them. Not just in the production of electricity, but also in the use for agriculture and medicine, and so many people today are alive because of what has been undertaken in the nuclear medicine field along the last decades. Eisenhower wanted to assure that the atoms were not just for war-deterrence purposes, but more importantly, for the rest of the world. He begun what we call Atoms for Peace conferences, and at the Atoms for Peace conference in 1958 the United States and the Soviet Union declassified fusion science, opening the way for future developments that could actually, in the future, save the planet. Had it not been for these early efforts to move the international community in this direction, we might be much further behind in the development of fusion and all of the benefits that might bring at some point in the future.

At the same time, in the speech he envisioned the International Atomic Energy Agency (IAEA) to advance these benefits while safeguarding and managing a rigorous non-proliferation regime. Therefore, there was a sense of urgency in 1953 but I'd like to underscore the fact that today we have a similar sense of urgency, if not greater. I think the Summer of 2023 is going to be

remembered as one of the Summers that turned out to be a tipping point in the minds of people around the globe. Examples such as the wildfires in Canada, which had a big impact on me, as the smoke from Canada reached my own property in Gettysburg, Pennsylvania, and brought me a sense of desperation, as it happened to many people around the world. But it's not just wildfires what we experienced this summer, people continued to suffer from water shortages, desertification, and flooding, which has become a landmark problem, to the point that we are seeing insurance companies taking matters in their own hands by refusing to insure certain parts of the United States.

The rate if the global sea level rise is accelerating, and the world glacier monitoring services outline the fact that liquid water in the 1980s rose by 6.7 inches to 33 inches for the 2010-2018 period. You can imagine that figure is getting larger by the day. Ice lost from the Greenland ice sheet increased seven-fold over the same period and Arctic lost nearly quadruple from 51 billion tons per year between 1992 2001 to 199 billion tons per year from 2012 to 2016. It is fair to say that many of the effects of climate change are moving more quickly that even what the scientific community had originally anticipated.

Nevertheless, despite all these very clear and present dangers from climate change, nuclear technology is increasingly being seen as an indispensable tool to mitigate climate change and to meet our goals as outlined by the Paris Agreement and other international objectives. New areas include the capacity of nuclear energy to produce hydrogen, heat, and electricity and, therefore, working on hard-to-abate sectors of heavy industry including cement steel, chemicals such as plastic, heavy transports such as road-tracking, or container shipping in aviation. Intriguing in a climate change context, is nuclear's capacity to desalinate water.

A point that is not being emphasized enough is how sustainable nuclear power is in bad weather conditions, and this is a very important point to continue to make because some renewable energies will need the reliance of nuclear power as the weather becomes more unstable and more violent at times.

Electricity generation is responsible for close to 40% of global CO2 emissions produced by the energy sector. The other 60% is generated primarily through the use of fossil fuels in industry, heating of buildings and transport. These hard-to-abate sectors will need low-carbon fuels such as hydrogen. This is a very exciting area for this field. Regrettably, I think very few people in the general public understand this potential, and because these advantages are barely known to the public at large it does create real challenges, both politically and geo-politically.

While nuclear was represented at COP for the first time recently and will again have a presence at COP28, and it is clear that support in growing, particularly among young people, is not growing fast enough in my opinion. The crisis in Ukraine is of particular concern, and the related lack of energy security in many countries. This is extending the lives of existing nuclear power plants and planning the start of building new ones. But there are still considerable roadblocks for this vision to become a reality.

In this context, much more has to be done quickly, as 550 Gigawatts of nuclear capacity is needed by 2050. Therefore, we have to be able to mobilize a set of arguments bringing our case not just to the public but to the leaders who lead that public. We must, I believe, do this first, by demonstrating to the public and policymakers, that we are addressing their concerns or, you might say, their pre-conceived ideas.

Very few people realize how safe nuclear power. We need to plan for and demonstrate the managing of spent fuel. We also need a rigorous campaign around the safety and advantages of new reactors. Many people in the business understand that.

It will also be valid starting the discussion on incentives for financing, and incentives for siting of repositories, and we are going to have to make a case of the advantages of long-term sustainable investments. Finally, we must continue as international community to strengthen our safeguards and, again, the cooperation of nations in reducing non-proliferation.

In short, we need to have the world's high-ranked leaders to commit themselves to a global strategy for the peaceful uses of the atoms. The one thing that made the 1953 speech into a reality is that the President of the United States was the greatest promoter of nuclear power and what it could do for electricity, agriculture, and medicine. We need to be at that level if we want to be successful in turning the international community towards this unprecedented opportunity to clearly establish a roadmap for climate change mitigation. To achieve this goal, we are going to need unprecedented international cooperation.

As a matter of fact, the IAEA has been at the forefront of both the promotion of nuclear energy and mitigating the proliferation risks and other risks that are now with us. As the Director General of the IAEA, Mr Grossi, has said, in a time of global uncertainty, anxiety, and fear, the world must come together and recommit to nuclear non-proliferation, and to promote cooperation in the peaceful uses of nuclear energy, the war in Ukraine exposed the inescapable implications of our interdependences.

We need to turn more into a sustainable energy mix in which nuclear is playing a valuable role. It is the only choice that actually mitigates global warming to the necessary degree. Nuclear has never been safer and, in sum, what we need is a nuclear power strategy for our own countries as well as for the global community.

Let me end by saying once again that the IAEA has an exceptional record in its soon-to-be 70 years of operations, and we should express our gratitude to this indispensable agency that has done so much to make the world a better place, and it has in my view showed what President Eisenhower called the fearful of the atomic dilemma. Eisenhower also remarked "if a danger exists in the world, it is a danger shared by all. Equally, if hope exists in the mind of one nation, that hope should be shared by all". Let's be for establishing a roadmap for nuclear power and the capacities to bring a diverse and versatile array of tools in mitigating climate change.

Atoms for Peace brought about the miraculous benefits of the atom to the world, that was Dwight D. Eisenhower's vision. Facing the catastrophic effects of climate change Atoms4NetZero is now our imperative.

Thank you very much.

4. SUMMARIES OF HIGH-LEVEL PANELS

4.1. HIGH-LEVEL PANEL 1: CLIMATE ACTIONS TO MEET THE OBJECTIVES OF THE PARIS AGREEMENT

Chairperson
J. Donovan (IAEA)

Keynote Speaker
F. Birol — Executive Director (IEA)

Panellists
A. Pannier-Runacher — Minister for Energy Transition (France)
R.M. Grossi — Director General (IAEA)
M. Al Hamadi — Managing Director and Chief Executive Officer (ENEC)

The panel discussion highlighted the resurgence of nuclear energy worldwide and its crucial role in meeting climate targets. Panellists emphasized the need for expanded grid capacity, which currently hampers nuclear integration, as well as the imperative need for investment in nuclear energy to complement renewable energy's growth. Finally, the global shift towards nuclear energy and its vital role in achieving climate goals was underscored.

The summaries of interventions in High Level Panel 1 are given below.

Mr Birol noted that nuclear energy is making a comeback globally, both in the developing world and in advanced economies, driven by two major factors: first, many countries are taking climate change seriously and understand that addressing climate challenges will be much more costly and less secure without nuclear power; and secondly, from February 2022, the start of the energy crisis reminded governments how important it is to generate electricity at home with reliable technologies. Countries like United Arab Emirates and China are becoming strong advocates for nuclear power. Mr Birol nominated three important avenues for nuclear in the coming years: continuing to build traditional large nuclear power plants; lifetime extension of existing nuclear power plants, which is a very cheap source of clean energy generation; and innovation, including small modular reactors (SMRs). He also noted that electricity will play a larger role in the future, and therefore, we need to generate massive amounts of electricity, and nuclear energy should play a key role. However, nuclear's role should go beyond electricity generation to include heating and clean hydrogen production. Financing is extremely important, and not everything can be left to markets; there is a need for support from governments and a role for international financial institutions to support the nuclear industry.

Ms Pannier-Runacher explained that France is ready to extend the lifetime of nuclear power plants, and plans to work on new reactors and support innovation and R&D to facilitate the incorporation of SMRs into the grid in the coming years to ensure the capacities and capabilities of French nuclear industries. That means public financing, the adoption of a complete roadmap with milestones, and partnerships with the private sector, as well as building alliances with other countries to accelerate the roadmap; in this regard, France has launched a Nuclear Alliance at the European level. Ms Pannier-Runacher noted that cooperation between countries can accelerate the achievement of net zero through the right people and the right investment.

Mr Grossi reflected upon how it is encouraging that we are discussing these issues and bringing our distinct perspectives, and that we are all thinking about the problem and identifying what we can put on the table to fix it and make things work. The IAEA's role is providing an indispensable service at a normative level through its inspection function, which is critical for all the issues being discussed today to become a reality. He emphasized the need to have nuclear energy that is safe, reliable, and part of the solution. This is where the IAEA can work even closer with our Member States and can listen to and learn from industry. There are encouraging signs at the global level, and this means we will have to deliver accordingly. This will require deliberate decisions from policymakers, industry, and the investment community.

In the discussions, Mr Birol noted that energy markets will not, on their own, achieve climate change mitigation objectives. Policymakers will need to support the role of nuclear in global markets. He stated that in the next 30 years, the bulk of emissions and electricity demand will come from emerging economies. He pondered whether the nuclear industry will be successful in bringing SMRs to the market in a timely manner and at reasonable cost, stating that this would be a gamechanger. He reminded the audience that there is a chance for SMRs to be commercially viable in the next 7–10 years and emphasized that this could be a major opportunity for emerging economies to deploy SMRs in tandem with renewables to achieve decarbonization objectives.

Mr Al Hamadi spoke of the need to address energy demand and climate change in a systematic manner by integrating nuclear, renewables and every source of clean energy. He noted that the UAE managed to install nuclear power plants and renewables in the past decade and will soon be able to produce 40 terawatt-hours of nuclear electricity annually, equivalent to 25% of UAE electricity supply. He emphasized the need for advanced reactors to provide load following services and high temperature heat in order to effectively meet energy demand and mitigate climate change.

4.2. HIGH-LEVEL PANEL 2: CLIMATE EMERGENCY AND THE ROLE OF NUCLEAR ENERGY

Chairperson
I. Pletukhina (Hunton Andrews Kurth)

Keynote Speaker
P. Taalas — Secretary-General (WMO)

Panellists
A. Guibourgé-Czetwertyński — Deputy Minister of Climate Change and Environment (Poland)
S. Bilbao y Leon — Director General (WNA)
Y. Kamada — Deputy to the Director-General (ITER)
D. Cameron — Head of the Nuclear Technology Development and Economics Division (NEA)

The panel discussed the increasing vulnerability of the energy sector to extreme climate events, and implications for the nuclear energy sector. The need to triple global nuclear capacity by 2050 to meet decarbonization targets using advanced technologies was emphasized by panellists, and small modular reactors (SMRs) were mentioned as an example of technology that can help to achieve this ambitious goal. The complementary role of nuclear power alongside other low-carbon options in the energy transition was underlined, together with the need for policy reforms and regulatory frameworks that can adapt and incentivize emerging technologies while responding to market demands.

The summaries of interventions in High Level Panel 2 are given below.

Mr Taalas spoke on the impacts of climate change, highlighting that 2023 is likely to be the warmest year on record. He noted the dramatic loss in the mass of glaciers, which might completely disappear by the end of this century, as well as the increasing frequency of floods,

heat waves and droughts. Science and research demonstrate that it is cheaper to mitigate the negative effects of climate change than adapt. Mr Taalas also noted similarities between communicating about climate change and nuclear power to the general public.

Mr Guibourgé-Czetwertyński explained that nuclear is complementary to renewables in building a zero-emissions energy system in Poland, by guaranteeing stable delivery of electricity at a predictable price, which is key for competitiveness for energy intensive industries and for end users. International cooperation is key for Poland's nuclear development.

Ms Bilbao y Leon noted that the share of low-carbon energy sources is the same today as in 1986, indicating that the global community is not treating climate change as the emergency it is. She called for efforts to keep the existing fleet online to continue to avoid carbon emissions and work to triple the world's nuclear capacity by 2050 with both large reactors and small modular reactors. Ms Bilbao y Leon reminded the audience that, while the Global North is very focused on decarbonization, the energy transition is very different for the Global South. In some cases, this means a transition from no energy to energy, which is a completely different paradigm, and one in which nuclear energy brings enormous opportunities. She stated that most of the growth in energy demand will come from the Global South and nuclear energy needs to be there.

Mr Kamada discussed the potential of fusion energy, particularly its ability to utilize abundant fuel resources like seawater. He reminded the audience of challenges in compacting fusion technology and reaching ITER's goal to demonstrate integrated fusion technology and generate 500 MW. In this context, he emphasized, international collaboration in fusion advancement and the need for standardized fusion regulations across countries are key to make the fusion reactor compact and ready for deployment by the 2040s.

Ms Cameron named financing and market design as the two biggest challenges facing nuclear energy. She noted that there exists a need for markets to value secure, reliable, dispatchable power and heat, and that to design appropriate energy markets requires systems level thinking. Levelized cost and spot markets do not incentivize decarbonization or security of supply, and using these mechanisms alone leads to bad decisions.

4.3. HIGH-LEVEL PANEL 3: DECARBONIZATION BEYOND POWER

Chairperson
F. Rayment (National Nuclear Laboratory, United Kingdom)

Keynote Speaker
C. Zou — Deputy to the Director General (UNIDO)

Panellists
T. Mitchell — Chairman (WANO)
M. Korsnick — President and Chief Executive Office (NEI)
D. Nordgren — Vice President, Generation Fleet Development (Vattenfall)
H. Paillere — Section Head (IAEA)

This session explored how to facilitate collaboration between the nuclear energy industry and the steel and mining sectors on the path to decarbonization. Panellists reflected on how to

leverage the private sector, policy options to incentivize emissions reductions, and the potential for job creation in the nuclear industry, especially during the transition from coal. The importance of the IAEA's Atoms4NetZero initiative was underscored as it highlights the application of nuclear energy as a source of heat for various purposes, including hydrogen production, steel manufacturing, and district heating, in addition to electricity generation.

The summaries of interventions in High Level Panel 3 are given below.

Mr Zou stated that deep decarbonization will be possible through global solidarity and collaboration, including consensus on a definition of low-carbon products to support sustainable development. Integration of low-carbon energy sources is in alignment with the goals of the Paris Agreement. He also emphasized the need for constant efforts to control greenhouse emissions in the industrial sector. Industry accounts for one third of global emissions, and one quarter of the global GDP. Unless industry lowers its emissions and shifts towards climate neutrality, we will struggle to achieve climate goals. Mr Zou noted that almost half of industry emissions come from very energy intensive sectors (steel, cement, and concrete), which account for 15% of global emissions. Urbanization and industrialization, particularly in the Global South, will keep pushing emissions up, and in order to align with the objectives of the Paris Agreement, these sectors need to reduce their emissions by 50% by 2030, and by 90% by 2050.

Mr Mitchell noted that the ability of nuclear reactors to make clean energy is fully demonstrated, and it is primarily a question of application and advocacy. Working in cooperation with each industry sector is key to understanding specific requirements, for example temperature and pressure, and incorporating nuclear into the energy mix. Mr Mitchell placed high importance on the sharing of extensive operating experience and training best practices as nuclear deployment grows and changes to meet net zero. He emphasized the need for international cooperation, including all relevant stakeholders, to bring forward all the things that must be done from the decision to build and operate a nuclear power plant through all the steps along the way. He remarked that there is a community, a solid base of operation to learn from and, at least on behalf of WANO, there is the willingness to promote nuclear safety and reliability across all geographic boundaries through cooperation.

Ms Korsnick noted that nuclear has gone from merely "tolerable" within the public perception to today being recognized as an unsung hero of the decarbonization movement. She emphasized that the challenge going forward will be more concerned with deploying nuclear technology quickly and at scale. She highlighted the fact that nuclear can be located directly adjacent to end users (like industrial facilities, hydrogen production plants, etc.) which opens a lot of doors to decarbonize beyond the power sector. She remarked that there are a lot of uses for nuclear, and now new doors are opening and, at least from the perspective of the USA, national labs have been doing excellent research and development over many years and they are now partnering with the private sector. Ms Korsnick concluded that the nuclear innovation pipeline is full, and that innovation pipeline is coming to the marketplace, and that is what we will see play out in the next 5 to 10 years.

Mr Nordgren identified high interest costs as one of the biggest hurdles to deploying nuclear at the scale needed. Governmental support — and particularly prioritizing the reduction of financing costs — is needed to assist the deployment of nuclear as a long term, low-carbon investment. In terms of risks, Mr Nordgren commented on risks in construction and market risks, particularly if utilities are not well-connected with the consumer side. He also remarked

that safety requirements should remain standardized and not differ for different stakeholders/countries over time.

Mr Paillere noted the large disconnect between what nuclear technology can deliver and how this potential is portrayed in climate change scenarios that inform policymakers. The IAEA's Atoms4NetZero initiative is designed to support modelling efforts to capture decarbonization beyond the power sector using nuclear energy. He also reminded the audience that nuclear is the one of the few low-carbon sources of the three energy vectors needed to reach net zero: electricity, heat, and hydrogen. He highlighted the huge untapped potential for nuclear to deliver on the net zero transition.

4.4. HIGH-LEVEL PANEL 4: NUCLEAR AND RENEWABLES

Chairperson
C. Berrigan (Nuclear Energy Institute)

Keynote Speaker
G. Maiulini — Chief of Cabinet (OLADE)

Panellists
S. Bragg-Sitton — Division Director (INL)
H. Hayafune — Deputy Director-General (JAEA)
C. Lewandowski — Vice-President and Group Senior Executive (EDF)

The high-level panel focused on options for integrating nuclear and renewable energy sources for a sustainable future, including how nuclear power plants provide flexibility, to complement renewable generation, to the grid. Existing uncertainties and complexities about climate were also discussed. Growth in electricity demand was identified as a key focus area, particularly for industrial needs and the possibility of utilizing nuclear energy to meet heat and steam requirements.

The summaries of interventions in High Level Panel 4 are given below.

Mr Maiulini remarked on the complementary roles of renewable and nuclear energy in Latin America and the Caribbean, and he noted that the value of nuclear energy is recognized in the region. He also observed challenges in the region in financing the energy transition and identified a potential for carbon markets to finance nuclear infrastructure to complement the renewable potential of Latin America and the Caribbean. He highlighted the need for pragmatism in Latin America and the Caribbean: for nuclear energy to be seen as part of the energy landscape in this region, it needs to make a difference for the people and development.

Ms Bragg-Sitton noted three key challenges to decarbonization: first, identifying clean, resilient, and reliable sources of electricity; second, finding sources high quality heat that can replace fossil fuels; and third, developing clean resources for the production of highly efficient energy carriers such as hydrogen. She reported on US initiatives on integrated/hybrid energy systems, including demonstration projects for nuclear-renewable hydrogen production.

Mr Hayafune stated that integration of nuclear and renewables can help balance the grid. He reported on Japan's efforts in development of fast reactors with heat storage, as well as high-

temperature gas reactors with hydrogen production, to support renewables and realize a low-carbon energy mix.

Mr Lewandowski observed that the complementary nature of nuclear and renewable energy is evident in France, with nuclear plants providing flexibility and reliability. He emphasized that there is an ongoing need for low-carbon thermal generation capacity to deal with extended periods of low renewable output, which are difficult to manage with batteries alone (which are better suited to short term energy gaps). In this context, Mr Lewandowski noted that studies show a balanced nuclear-renewable mix would be cheaper than a renewables-only mix, due to lower network costs.

4.5. HIGH-LEVEL PANEL 5: IMPROVING NUCLEAR'S COMPETITIVENESS

Chairperson
K. Gogan (TerraPraxis)

Panellists
J. Gu — President (CNNC)
X. Ursat — Chief Executive (EDF)
L. Odeh — Chief Commercial Officer (URENCO)
K.B. Sagheer — Member of the Pakistan Atomic Energy Commission (PAEC)

Panellists discussed the benefits of standardization and serial deployment of nuclear power plants, as well as ensuring a sufficient and skilled workforce. The necessity of international collaboration on licensing and safety standards for SMRs and the need for public policy support to advance financing options and spur private sector engagement were also highlighted as key areas to be explored in the short and medium term. Continuous investment in research and development (R&D) ensures competitiveness in the market both now and in the future. It was mentioned that, through standardization and serialization, the cost of construction and operation could be reduced. Other key elements for competitiveness include a complete nuclear fuel cycle and reliable manufacturing supply chain. A systematic development of human resources (HR) supported by comprehensive training programmes and training facilities was also emphasized.

The summaries of interventions in High Level Panel 5 are given below.

Mr Gu reported that there are currently 55 units in operation and 33 units under construction in China. He stated that the Chinese government approves 6 to 8 units new builds per year, and that the construction schedule and quality are carefully controlled, contributing to the projects remaining within budget. He emphasized large investment in the Internet of Things (IoT) and R&D as a key factor for increasing competitiveness and achieving good results in recent decades, together with creating a complete supply chain. He noted that the main challenge for the future is ensuring sufficient HR capability for technicians and workers, especially given that CNCC projects will need more than 10 000 new hires per year to support projects.

Mr Ursat stated that long term operation (LTO) of existing nuclear power plants is the most competitive way to generate power. He noted that for new reactors, serial deployment can help boost competitiveness (such as the commitment of France to a minimum of 6 and up to 14 new EPR reactors), and that standardization of internal plant components and equipment can aid competitiveness and simplify licensing. He reported that in France, it is estimated that 10 000

new hires per year up to 2030 will be needed to sufficiently deliver on the country's nuclear commitments.

Mr Odeh stated that policymakers need mechanisms to enable investment in nuclear power plants — for example, through regulated markets or financial regulation on plant ownership. The importance of including nuclear in sustainable taxonomies and public–private partnerships to encourage investment was noted. Mr Odeh reminded the audience that this year, 2024, will see elections in key nuclear markets like the UK, US, and EU. He also discussed the challenges of investing in new fuels for technologies like SMRs and advanced reactors in the context of the consideration of a large number of SMR designs which require different fuel types, making anticipating future demand for specific fuels difficult.

A question was raised by Mr Sagheer as to whether we have any choice but to deploy nuclear and renewables to meet net zero. He stated that if this choice does not reflect economic competitiveness, then markets should be reconsidered to allow this choice to be competitive. He emphasized the importance of relying on domestic HR capacity for assessments and planning activities like site selection. He stated that addressing human resources (HR) issues is essential, such as providing training for the nuclear workforce from an early stage in development, as Pakistan does through its reactor school. He highlighted the need for governments and financial institutions to collaborate to advance the industry by increasing the use of SMRs and new technologies through repetition, which can help make nuclear power economically competitive.

4.6. HIGH-LEVEL PANEL 6: NUCLEAR AND SUSTAINABLE FINANCE

Chairperson
J. Parsons (MIT)

Invited Speaker
B. Lindauer — European Bank for Reconstruction (EBRD)

Keynote Speaker
J. Parsons — Senior Lecturer (MIT)

Panellists
J. Johnson — Communications and Advocacy Director (NuclearEurope)
I. Pavlovic — Head of Energy Transition and Natural Resources Industry (Natixis)
K. Schaferova — ESG Lead, Sizewell C (SZC)
G. Borovas — Head of Nuclear, Hunton Andrews Kurth
I. Pletukhina — Associate, Hunton Andrews Kurth
D. Dean — Chairman, International Bank for Nuclear Infrastructure (IBNI)

The panel discussed nuclear energy being included in the EU's taxonomy for sustainable activities. This was noted as a major accomplishment that gives investors more certainty and access to funding. The establishment of a multilateral nuclear infrastructure bank could help facilitate investments at the scale and speed needed to achieve net zero emissions by 2050. Such a source of funding could help reduce risks and attract investors to nuclear projects. Other potential sources of capital mentioned by panellists include energy-intensive industries with commitments to decarbonize their supply chains. The panel emphasized the need for early engagement between nuclear project developers and banks. Discussions should be held on how

risks can be mitigated through measures including standardization of designs, repetition of the same design for multiple projects, and implementation of robust safety regulations.

The summaries of interventions in High Level Panel 6 are given below.

Mr Lindauer stated that EBRD is currently the only multilateral bank with an extensive nuclear program, but acknowledged that their nuclear projects so far have mainly consisted of donor-funded safety programs focusing on decommissioning and clean-up of Soviet-era nuclear facilities. He stated that EBRD sees potential to support projects that extend the operating lifetimes of existing nuclear plants in member countries, which would help ensure the safe long-term operation of those plants. He reported that the EBRD is reviewing its energy policies based on requests from member states to consider funding nuclear projects as part of the transition to low-carbon energy.

Mr Parsons stated that large cost overruns and construction delays on some LWR projects in Western countries have undermined investor confidence in nuclear energy, and that reducing construction risk is essential to attract investors. The discussion about governments taking on some project risks was mentioned. However, Mr Parsons noted that this only moves the risk, rather than reducing it, and emphasized that risk still needs to be reduced before new nuclear can attract financing. He called for the implementation of policies to reduce market risk and ensure that new plants will earn a sufficient and stable revenue. He noted that renewables benefit from out-of-market payments (like power purchase agreements) rather than being exposed to spot market prices, which sends incorrect pricing signals to the rest of the market.

Ms Johnson stated that the inclusion of nuclear in the EU taxonomy is a positive signal and perceived reduction in political/regulatory risk for new build projects. She noted that by defining technologies that help achieve net zero, the taxonomy indicates to banks and investors which technologies can be supported. Ms Johnson mentioned that the taxonomy will require large companies to disclose if their operations and supply chains align with taxonomy standards, which could affect companies' ability to attract investment. However, she also noted that the taxonomy creates an opportunity for nuclear to gain support from new potential sources of funding. She stated that the important outcomes of nuclear energy's inclusion in the EU taxonomy are that it provides more certain long-term signals to investors and clarity on how other EU funds (e.g. loans or grants) are distributed to member states and companies.

Mr Pavlovic emphasized that PPP models like those used in Finland and France align interests between nuclear producers and large industrial electricity consumers, which could help mitigate volume risk. He highlighted the potential for emerging solutions like using excess electricity from nuclear/renewables to produce hydrogen to add value to excess electricity production. He stated that including nuclear in the EU taxonomy provides Member States and companies the ability to tap into green bond markets, which is one of several financing approaches being considered in Europe, such as France directing public savings towards nuclear projects.

Ms Schaferova stated that perceived risks from investors about new nuclear projects stem more from lack of experience than actual risks, which can be mitigated through communication. She highlighted the 'series effect' method of risk reduction which will be performed at Sizewell C through the replication of the designs already being built for the four planned units. She emphasized that this approach allows project designers to benefit from lessons learned by repeating the same proven design and provides more certainty about the project budget.

Mr Borovas emphasized the importance of explaining nuclear project risks and mitigation strategies to commercial banks. He stated that repetition of projects through construction in series can help address first-of-a-kind risks for new technologies like SMRs. He underscored the need for project risk and cost overruns must be discussed, understood, and estimated in order to minimize costs when engaging with banks.

Ms Pletukhina stated that reputational risks (i.e. negative public perception) are a major concern for banks when considering nuclear projects. She stressed the importance of early engagement with banks to explain nuclear project risks and how they will be mitigated, and stated that project risk and cost overruns must be understood to minimize costs to banks. She emphasized that costs alone do not provide full context for assessing projects without also considering a contract that balances risks, and stated that effective contracts outline responsibilities for issues like changes, site evaluations, and other factors.

Mr Dean stated that IBNI offers a comprehensive solution to address multiple barriers impeding capital flows into nuclear energy, which will address issues including sustainable finance, policy risk, regulatory risk and ESG frameworks. He also stated that IBNI aims to de-risk the nuclear sector and enable a level of market confidence by providing nuclear-specific expertise, standards, and criteria, establishing binding policy agreements between member states supporting nuclear energy as a long-term part of their decarbonization strategies, and serving as the largest issuer of nuclear-specific high grade (AAA rated) bonds sold to global market investors.

4.7. HIGH-LEVEL PANEL 7: INNOVATIVE TECHNOLOGIES AND SMALL MODULAR REACTORS

Chairperson
A. des Cloizeaux (IAEA)

Panellists
Z. Petrovicova — Head of unit, (DG ENER), European Commission
C. Gully — Director, (CNA)
M. B. Tyobeka — Vice-Chancellor, North-West University (South Africa)
O. M. Peixoto — Vice President, (ABDAN)

Drawing from national perspectives from Canada, Brazil and South Africa, the panel emphasized the importance of a robust safety and security framework in anticipation of the global diffusion of SMRs. The reduced construction time and costs associated with SMRs compared to large reactors were mentioned as advantages of the technology. Panellists highlighted the role of learning, modularization, and economies of scale in production in reducing costs and construction times. Panellists agreed that clear communication of the benefits of SMRs to stakeholders is essential in order to avoid potential rejection from the public due to negative publicity not based on scientific evidence.

The summaries of interventions in High Level Panel 7 are given below.

Ms Petrovicova reminded the audience that Europe aims to achieve 55% decarbonisation by 2030. She stated that in order to do so, they have established a European SMR pre-partnership to facilitate SMR deployment despite facing challenges related to diverse regulatory

frameworks, supply chain bottlenecks, human resource limitations, a lack of operational experiences, financing, licensing, and varying degrees of member state interest.

Mr Gully stated that Canada released an SMR roadmap in 2018 and emphasized that the challenge for Canada lies in gaining social acceptance of nuclear power technology. He added that each Canadian province independently controls its energy market, which makes it hard to have a holistic national policy on nuclear energy development. However, he also stated that a joint effort between policymakers and academicians led to an action plan in 2020 to inform the public and advocate for government action. He mentioned that site selection is a lengthy process, yet delivering on time and within budget is a primary objective.

Mr Tyobeka stated that access to energy remains a significant issue across Africa, and SMRs could provide a solution to Africa's energy crisis. He reminded the audience that SMRs can be built in series and installed where needed; they can also potentially address challenges like water scarcity with the aid of desalination and energy crises. Mr Tyobeka highlighted the need for explicit licensing frameworks to achieve this and emphasized that collaboration and multilateral approaches are essential for smooth implementation, particularly in newcomer countries developing nuclear technology.

Mr Peixoto reported that in Latin America, only three countries have established nuclear programmes, despite over 30 countries having significant potential interest in nuclear power, especially with SMRs. He emphasized that nuclear energy is the future, but challenges related to financing, human resource requirements and regulatory frameworks need to be bridged. In this regard, he stated, clear and supportive frameworks are needed for the nuclear industry, and regulatory, social, and safety concerns for successful implementation must be addressed.

4.8. HIGH-LEVEL PANEL 8: NUCLEAR AND LOW-CARBON HYDROGEN

Chairperson
E. Teplinsky (Pillsbury)

Keynote Speaker
P. Schwager — Division Chief (UNIDO)

Panellists
H. Hayafune — Deputy Director-General (JAEA)
P. Stohr — Director (CEA)
A.J. Maxwell — Senior Nuclear Expert (CATF)
A. Goicea — Policy Director (NuclearEurope)

The panel discussed the opportunities and challenges associated with low-carbon hydrogen production. The panel explored potential use cases for hydrogen to be an agent of decarbonization, considering that today only 1% of the hydrogen produced in the world as of 2023 is produced using low-carbon energy, while 99% is produced using fossil fuels. Panellists emphasized nuclear hydrogen initiatives as one way to efficiently produce low-carbon hydrogen at scale. Ways to produce hydrogen from nuclear energy, including from both electrolysis and heat-based methods, were mentioned.

The summaries of interventions in High Level Panel 8 are given below.

Ms Schwager emphasized the importance of low-carbon hydrogen as a clean energy carrier. She reported that the IPCC estimates that between 3000 and 8000 gigawatts (GW)[1] of clean hydrogen production capacity will be needed by 2050 utilising different types of energy sources. She underscored the importance of ensuring that developing countries have a share in clean hydrogen production benefits, and stated that they can fund it through exports while keeping a portion for domestic use. She highlighted the need to produce hydrogen with clean technology, as 99% of current hydrogen production relies on fossil fuels.

Mr Hayafune highlighted the importance of coupling the technical programme of hydrogen production (which produces hazards and wastes) with nuclear systems. He reported that JAEA is trying to couple the different systems and expressed hope that significant results will be seen after 6 years. Mr Hayafune also highlighted the importance of the business model for nuclear hydrogen production, and expressed that JAEA is looking forward to seeing the impact of nuclear in hydrogen production and, particularly, in more beneficial business models for hydrogen, and global regulation should apply internationally on this issue.

Mr Stohr highlighted the importance of addressing the type of regulation which will apply to a new kind of hydrogen plant. He expressed the need for separate regulation for different types of nuclear power plants. Mr Stohr stated that we will need to incorporate hydrogen into the energy mix, and nuclear is a great option to produce low-carbon hydrogen with competitive prices.

Mr Maxwell contextualized hydrogen production for the audience, reminding it that globally more than 70 million tonnes[2] are produced per annum, out of which less than 1% is green. He posed a question to the audience regarding the scalability of green hydrogen from its current <1% production to significant. He remarked that in terms of safety, if there is one industry in the world that should be able to develop a plan for green hydrogen generation and manage the hazards, including the safety blast over pressure, it has to be the nuclear industry.

Mr Goicea stressed the need to employ all possible sources for hydrogen production. He emphasized the need for clear guidance and clear legislation to support it and stated that this is the way to achieve such ambitious [climate] targets. He remarked that by using nuclear for hydrogen production we will be helping domestic production, but acknowledged that imports might be challenging. He reminded the audience that in the EU, about a benefit from the Green New Deal is that there are no colours associated to hydrogen production, as the Deal only talks about clean hydrogen and low-carbon hydrogen.

4.9. HIGH-LEVEL PANEL 9: NUCLEAR SAFETY AND CLIMATE RESILIENCE

Chairperson
P. Contri (IAEA)

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[1] The International Institute for Applied Systems Analysis' AR6 Scenario Explorer and Database indicates that most estimates for the demand for clean hydrogen production capacity in 2050 fall between 0 and around 2500 GW. INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS, AR6 Scenario Explorer and Database hosted by IIASA (2022), https://data.ene.iiasa.ac.at/ar6/#/login?redirect=%2Fworkspaces

[2] The IEA reports that, as of 2022, 95 million tons of hydrogen are produced per annum. INTERNATIONAL ENERGY AGENCY, Global Hydrogen Review 2023, International Energy Agency, Paris (2023), https://www.iea.org/reports/global-hydrogen-review-2023

Keynote Speaker
B. Crowell — Commissioner (USA)

Panellists
J.C. Niel — Director General (IRSN)
R. Boscolo — Climate and Energy Leader (WMO)
C. Viktorsson — Director General (FARN)

The high-level panel addressed the impact of climate change on nuclear safety and reactor resilience. The panel emphasized the importance of developing new tools for assessing potential climate scenarios, including droughts, floods, seismic events, and ageing nuclear infrastructure, to determine the need for national hazard preparedness. Overall, the panel emphasized the importance of collecting historical data and continuous monitoring in order to inform proactive measures and emphasized the importance of international cooperation in ensuring the safety and resilience of nuclear installations in the face of climate change challenges.

The summaries of interventions in High Level Panel 9 are given below.

Mr Crowell stated that ensuring nuclear reactor resilience to climate change impacts is crucial for nuclear power to fully realize its potential as a carbon-free energy source. He stressed that reactors must be licensed and operate in a way that recognizes climate impacts that are already occurring, as events are intensifying more quickly than anticipated. Mr Crowell reported that the NRC addresses climate change through its safety and environmental review processes, which evaluate external hazards like flooding, wind, and seismic events that are increasing in frequency and intensity.

Mr Niel stated that historical data on natural hazards will be less useful for determining future climate change-related hazards, as their intensity and combinations may differ with climate change. He emphasized the need for gaining new knowledge and evaluation methods, and stated that collaboration, such as work IRSN is doing with universities to analyse historical documents to supplement measurement data, is vital. He stated that existing plants have demonstrated resilience to current climate conditions, but innovative designs like SMRs will require reassessing hazards like aging infrastructure impacts under climate change. He called for a systemic and holistic approach considering potential impacts on human/organizational factors from climate change.

Ms Boscolo reported that WMO collects and analyses global meteorological and hydrological data that is important for assessing climate hazards to nuclear plants. She explained that this data spans historical, contemporary, and future timescales from observations and modelling, and expressed that WMO has been interacting with nuclear operators to understand what timescale data is most important for different safety analyses, like site selection or periodic reviews. She mentioned that tools already exist through WMO's Climate Information Platform and Climate Watch that provide location-specific climate data and indicators that could be used to calculate hazards and support decision-making but noted that the nuclear industry's specific data and analysis needs are not fully met. She called for more work to develop tailored data sets and tools through continued discussion between WMO and the nuclear community. She stated that collaboration at the national level, like in the UAE, between nuclear regulators and national meteorological organizations produces synergies and best practices that could be shared internationally.

Mr Viktorsson noted that different countries represent different cases of adaptation and resilience measures taken to adapt to the surrounding environment and conditions. He explained that when first assessing the Barakah site in 2009, the environmental conditions of high heat, humidity and dust presented challenges for siting a nuclear plant, and stated that extensive expert analysis was conducted. He emphasized the need for periodic safety reviews like those required every 5 years for Barakah to ensure safety as conditions change rapidly. He explained that in the case of Fukushima, stress tests were introduced after the accident to evaluate the plant's ability to withstand external events and identify any 'cliff edge' effects. He stated that major construction efforts were undertaken to ensure adequate cooling water intake and mixing even during extreme heat, like dredging 4 kilometres of shoreline. He expressed that with many new reactors planned globally, international cooperation will be vital to safely introduce nuclear power to regions without experience assessing climate impacts.

4.10. HIGH-LEVEL PANEL 10: EFFECTIVE STAKEHOLDER ENGAGEMENT COMMUNICATION STRATEGIES: YES IN MY BACKYARD

Chairperson
J. Donovan (IAEA)

Panellists
V. Faudon — Director-General (SFEN)
R. Ghoneim — Chief Energy and Climate (UNIDO)
A. Harjanne — Green Party (Finland)
K. Cunningham — PhD. Student (MIT)

The discussion highlighted the importance of effective communication and stakeholder engagement for low-carbon energy projects like nuclear energy and renewables. The following areas were identified as key for promoting an inclusive, science-based approach to energy policy decisions:

- Knowing your audience and being sympathetic to lower levels of technical knowledge/understanding;
- Respecting different points of view in order to understand factors underlying push-back;
- Providing information in an engaging manner, underlining more humanized ways of communicating;
- Pointing audiences towards reliable sources of information rather than debating and addressing scepticism by providing holistic and balanced information to put negative impacts into context and increased awareness regarding benefits;

Responding to broader concerns and needs of stakeholders (i.e. beyond core concerns about the technology), e.g. water use, impact on local road traffic, supplying specific energy needs of community; avoid arrogance and improve science communication in the nuclear community.

Additionally, it was emphasized that addressing the financing gap is crucial, and lobbying efforts, particularly in developing countries, can play a pivotal role in advancing nuclear energy solutions. This collaborative approach could foster cooperation rather than competition in achieving net zero goals.

The summaries of interventions in High Level Panel 10 are given below.

Valerie shared her experience in France, which has laws requiring public debates for large energy projects. She recently participated in debates about the government's plans to build six new EPR reactors. She said future projects like SMRs may face more opposition if sited in non-nuclear industrial areas rather than existing nuclear sites. She emphasized the importance of understanding local stakeholders' questions and concerns when planning projects. She also noted that while some opposition exists, French public opinion has become very pro-nuclear due to concerns about energy independence and security.

Discussed her organization's experience in the renewables energy sector with UNIDO Member States. She acknowledged the scepticism that can arise from communities towards large wind or solar farms. She emphasized the importance of finding economic incentives for host communities and maximizing land use through innovations like agrivoltaics. She also stressed the need for transparency around technologies' embodied carbon and environmental impacts. Additionally, she highlighted UNIDO's focus on enabling industry decarbonization and fostering innovation to drive local solutions. She said more policy support is needed to help first movers adopt new low-carbon technologies and lower their costs.

Highlighted Finland's evolving stance on nuclear energy within the country's Green Party. He noted the party has become more pragmatic over time. While internal opposition remains, the majority now support nuclear as part of a sustainable energy portfolio. He highlighted Finland's need to decarbonize district heating systems and potential role for small modular reactors in providing heat and power. As a city council member, he expressed openness to siting an SMR near residences to replace coal plants. He also mentioned public support for nuclear in Finland has been rising and SMRs could address concerns about large reactor development.

Shared how she became interested in nuclear energy after a study abroad trip where she advocated for including nuclear in Iceland's energy mix. She started making educational TikTok videos that gained millions of views, helping her amass over 100,000 followers. She uses cheeky techniques like jokes, dances, and self-deprecating humour to connect with younger audiences and humanize the industry. She emphasized the importance of understanding different perspectives and addressing concerns with empathy. She receives messages from students interested in nuclear careers due to her videos. She proposed incorporating science communication training into nuclear engineering degrees to better engage the public on complex issues.

5. SUMMARIES OF SIDE EVENTS AND SPECIAL SESSION

5.1. WOMEN CONFRONT CLIMATE CHANGE

Chairperson
A. des Cloizeaux (IAEA)

Chairperson
A. El Refaei (IAEA)

Panellists
G. Voigt — Former President (WIN Global)
M. Korsnick — President and CEO (NEI)
S. Bilbao y Leon — Director General (WNA)

F. Rayment — Chief Science and Technology Officer (NNL)
A. Cunha da Silva — Innovation Project Lead (WEC)

The event focused on the crucial role of women and gender equality in addressing climate change. It emphasized the imperative of empowering and involving women at all levels of nuclear power development and climate action to combat climate change effectively.

The summaries of interventions are given below.

In opening remarks, Ms Gabi Voigt highlighted WiN Global's advocacy for diversity, gender inclusivity, and environmental sustainability since its inception in 1992. She reported that with 35 000 members across 145 countries, WiN Global actively engages skilled women in nuclear, climate change, and sustainability efforts, contributing to decarbonization.

Ms Voigt underlined that women are being pushed out of career development in every field, including nuclear. She also mentioned key strategic actions that the world cannot ignore, including fostering women's engagement in the road to decarbonization, promoting WiN Global as a network of experts, and increasing WiN Global's participation and influence in all forums addressing nuclear issues that affect society and the public perception.

Ms Fiona Rayment emphasized the importance of recruiting individuals from various backgrounds to ensure a diverse and inclusive nuclear workforce. She acknowledged that the current 20% female representation in the UK's nuclear workforce is insufficient.

Ms Sama Bilbao y Leon underlined the issue of equity, emphasizing that, from a historical perspective, one of the key factors for emancipation of women has been access to electricity at home, as electricity reduces time and effort required for household chores, enabling women to pursue career development. She mentioned that, as of 2023, particularly in the Global South, many women lack access to basic electricity and, in that sense, the role of nuclear facilitating clean energy to these areas would, ultimately, have a strong positive impact in the lives of women in these countries.

Ms Maria Korsnick reminded the audience that women represent around 20% of the nuclear industry's workforce, and that there exists a need for collective efforts to increase that figure. Ms Korsnick emphasized that opportunities within nuclear are vast as nuclear power becomes more and more relevant in the context of full decarbonization, climate change, energy security, and the related substantial increase in the workforce.

Ms Alice Cunha da Silva highlighted that women face limitations in contributing to climate initiatives, especially in patriarchal societies with added care responsibilities. Moreover, the pandemic exacerbated issues such as domestic violence and limited access to education, particularly in the Global South.

5.2. CNNC'S SOLUTION ON MITIGATING CLIMATE CHANGE

Chairperson
S. Lixin (CNNC)

Opening remarks
L. Song — Ambassador Plenipotentiary and Extraordinary (China)

Panellists
J. Gu — President (CNNC)
W. Kai — Vice President (CNNC)
W. Mo — Research Director (CNNC)
X. Weizhu — Director of R&D (CNNC)

The event served to present initiatives and best practices implemented by the China National Nuclear Corporation (CNNC) in its efforts to fight climate change. In his opening remarks, H.E. Ambassador Song mentioned that nuclear power has become a reliable and clean source of power, as well as an effective solution to combat climate change and facilitate the transition to low-carbon energy systems. He underlined the importance of nuclear energy for China in realizing the goal of carbon neutrality. He noted that, in the last four decades, CNNC built over 80 nuclear power units of different designs, in China and abroad.

The summaries of interventions are given below.

Mr Gu Jun highlighted CNNC's commitment to clean energy production by developing a long-term plan to help achieve China's sustainable development goals, based on its over 40 years of experience constructing nuclear power plants. He also noted that CNNC is promoting multiple uses of nuclear power in the petrochemical and metallurgical industries, among others. He expressed his hopes for strengthened cooperation with partners for a green, low-carbon, and sustainable future.

Mr Wang Kai presented CNNC's capacity as the 'one-stop' solution that can assist China in achieving its goal of utilizing nuclear power for common objectives. He stated that nuclear energy has obvious advantages such as low-carbon emissions, high energy density and stable baseload capacity. He described the technical features and parameters of Generation IV high temperature gas cooled reactors (HTGRs), such as inherent safety, online refuelling, modular design, and an expected design lifetime of 60 years. He also noted the multiple potential applications of HTGR's, such as hydrogen production, desalination, providing process heat to the petrochemical industry, and centralized heating and power generation.

Ms Wang Mo presented a broad view of nuclear power development in China. At the global level, Ms Mo mentioned that to achieve a net zero scenario by 2050, nuclear power capacity would need to double from current levels. She also noted that the carbon intensity of nuclear power is extremely low (only 12 grams of carbon dioxide produced per kilowatt-hour, throughout the full life cycle). She stated that nuclear energy can be considered cost effective, especially with large scale utilization, and it can drive economic growth effectively when coupled with other industrial projects. She provided an overview of China's energy structure and trends toward low-carbon sources. China's stages of nuclear energy development, including Generation III reactors, advanced reactors in development, and plans through 2035 were also outlined.

Mr Xu Weizhu presented on multiple applications of nuclear power, highlighting SMRs as a suitable technology due to their potential to serve small electrical grids and increase renewable energy connection to grids. He noted that SMRs are also suitable for district heating, process heating supply and seawater desalination, according to different country conditions and scenarios. Mr Weizhu also discussed prospective applications, such as the use of ACP100 SMRs for floating nuclear power units, as well as HGTRs which could potentially provide a

complete set of power and energy solutions for the petrochemical industry to meet all its needs for heat, electricity, and hydrogen.

5.3. HOW CAN CLIMATE SCENARIO MODELLING INFLUENCE NUCLEAR INVESTMENTS?

Chairperson
H. Paillere (IAEA)

Panellists
K. Lee — Head of Policy and Industry (WNA)
F. Dassa — Head of International Relations (EDF)
M. Bowen — Senior Research Scholar (Columbia University)
B. Santhouse-James — UNFCCC's Youth Constituency (YOUNGO)

This side event broadly discussed climate scenarios and energy system models and their use in informing nuclear investment decisions.

The summaries of interventions are given below.

Mr King Lee described the role of the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) in developing reference climate scenarios for analysing climate risks. He also highlighted NGFS's development of 'reference scenarios' to assess climate risks to the economy and financial system. Mr Lee explained the sustainability disclosure standards being developed by the International Financial Reporting Standards (IFRS) Foundation, including IFRS S1 and S2. He emphasized the importance of using climate related scenario analysis to evaluate climate resilience. He discussed the collaboration between the World Nuclear Association and the International Sustainability Standards Board (ISSB) in establishing global standards and the Glasgow Financial Alliance for Net Zero (GFANZ)'s provision of guidance on net zero transition planning for financial institutions.

Mr Francois Dassa discussed the limitations of existing models commonly used in energy and finance in considering essential components of electricity system costs, such as generation and network (grid) costs. He emphasized the need for a total system cost approach to recognize the value of nuclear, citing a comparative economic study on the electricity system by French grid operator Réseau de Transport d'Électricité (RTE). He explained that the study revealed that designing scenarios with higher shares of nuclear power in the electricity generation mix resulted in lower total system costs.

Mr Matt Bowen summarized published research on the views of the financial community regarding nuclear's inclusion/exclusion from climate finance taxonomies. He noted that none of the top 30 globally systemically important banks had nuclear explicitly included in their sustainability frameworks, with the rest not specifying their treatment of nuclear. He suggested that environmental groups remain neutral on inclusion of nuclear in these taxonomies, or they should focus more efforts on traditional fossil fuel use.

Finally, Mr Ben Santhouse-James emphasized building energy literacy among young people so that nuclear is valued equally and given a level playing field with renewables. He highlighted the need for a new generation of investors/modellers who understand the science/nuances of nuclear and who are willing to engage stakeholders on improving models. The importance of

considering intergenerational justice principles when investing in nuclear energy to solve the transition to net zero was emphasized. He also stressed the necessity of adjusting discount rates for nuclear projects and addressing construction risks at the outset. He advocated for a systems approach to cost in climate finance modelling and scenarios, as well as a technology neutral approach when considering low-carbon energy solutions and their financing.

The event provided valuable insights into the intersection of climate scenario modelling and nuclear investments, emphasizing the need for comprehensive and inclusive strategies to ensure a sustainable energy future.

5.4. REIMAGINING COAL COMMUNITIES

Chairperson
S. McPhee Charrez (NICE Future)

Opening remarks
G. Stanke (Miss America)

Panellists
S. B. Sitton — Division Director (INL)
C. Tomlin — Senior Technical Leader (EPRI)
J. Goodman — Senior Advisor (NNSA)
E. W. Wandera — Senior Corporate Affairs (KenGen)
K. Cutler — Senior Strategist for Nuclear Innovation (US Department of State)

The event explored different facets of reimagining coal communities in the transition away from fossil fuels. Chairperson Ms Sarah McPhee Charrez opened the session by presenting the Nuclear Innovation Clean Energy (NICE) Future initiative, focused on integrating nuclear and renewable energies while supporting social equity and economic empowerment.

The summaries of interventions are given below.

In her opening remarks, Ms Grace Stanke delivered a video message where she explained how the perception about nuclear is changing in a positive way, particularly in connection with the political support for nuclear innovation and connection between innovation and the people, the relevance of nuclear mentors and putting the people first.

Mr Caleb Tomlin presented considerations and opportunities related to coal to nuclear. He explained that, by 2050, 50% of global coal generation capacity — around 1000 GW — is set to retire, which would affect up to 2.5 million skilled workers at 2400 individual sites across 79 countries. He added that the nuclear sector is ideally suited to supporting workers and communities at many of these sites, capitalizing on the existing transmission infrastructure, cooling water availability, access to skilled workers, land use permits, and use of heavy transport. Mr Tomlin also mentioned that coal to nuclear projects require significant planning for workforce development to mitigate risks of an inadequate skilled workforce.

Ms Shannon Bragg-Sitton provided an overview of US activities on the transition from coal to nuclear energy. She elaborated on specific US States interested in coal transitions and mentioned recent studies, including pilot studies with non-nuclear utilities — for example, by INL's Gateway for Accelerated Innovation in Nuclear (GAIN) initiative in EPRI's technical

report *From Coal to Nuclear: A Practical Guide for Developing Nuclear Energy Facilities in Coal Plant Communities*. Ms Bragg-Sitton underlined the importance of the Coal to Nuclear Research Group, which integrates relevant stakeholders on this issue in the US and serves as a platform to facilitate discussion to align individual efforts.

Mr Emmanuel Wandera presented Kenya's energy story, focusing on the evolution of the national energy mix, which is dominated by geothermal, hydro, solar and wind. He mentioned that despite Kenya's coal deposits, plans to deploy coal generation were scrapped due to lobbying and legal battles due to low public acceptance. The Government's energy plan includes a transition to 100% renewable energy sources by 2030.

Ms Kirsten Cutler presented Project Phoenix, an initiative for coal to SMR conversions. She explained that Project Phoenix aims to accelerate the global clean energy transition by providing technical assistance to support decision making on pursuing the conversion of one or more coal fired power plants to secure and safe zero carbon SMRs.

Mr Jac Goodman introduced a series of options to facilitate peaceful uses and expansion of nuclear energy. He highlighted that effective safety, security, and safeguards measures backed by a robust non-proliferation regime are critical to realizing the benefits that advanced nuclear technology can deliver. Likewise, he mentioned that strengthening security and safeguards features will boost advanced reactor (AR) and SMR commercial viability and make technology more accessible to international markets.

5.5. CLEAN HYDROGEN FROM NUCLEAR FOR ENABLING NETZERO

Chairperson
A. Constantin (IAEA)

Panellists
T. Lulashnyk — Ambassador of Canada to the IAEA
L. Jacobs — Vice President (Ontario Tech)
E. Teplinsky — Global Energy Industry Leader (Pillsbury)
S. B. Sitton — Division Director (INL)
C. Gully — Director (CAN)
C. Martin — Director (Westinghouse Electric Company)
A. Des Cloizeaux — Director (IAEA)

The event delved into diverse aspects of nuclear hydrogen production and its role in shaping a sustainable future, as well as the use of surplus electricity to support decarbonization in the short term, along with the use of advanced reactors and small modular reactors and their role as part of integrated energy systems as a longer-term solution.

The summaries of interventions are given below.

In his opening remarks, H.E. Ambassador Lulashnyk mentioned the importance of nuclear energy for hydrogen production in the pathway towards a future with net zero emissions, offering alternatives for decarbonization and green fuel. He emphasized Canada's commitment to nuclear technology development prioritizing safety, security, and environmental sustainability.

During the debate, Mr Cameron Martin underscored the potential to utilize former reactors or secondary sites to support hydrogen production, such as solid oxide electrolyser cell (SOEC) technology. He emphasized that the relevance of this relied on enabling decarbonization through nuclear power. However, he also mentioned that social acceptance and economics associated with electrolysis pose major challenges to the technologies' consolidation. In this regard, he remarked on existing cooperation between Westinghouse Electric Company and national laboratories such as the Idaho National Laboratory (INL) to explore cost reductions along the processes.

Ms Elina Teplinsky highlighted the Nuclear Hydrogen Initiative, which is looking into how to catalyse the hydrogen market considering that the large clean energy generation capacity required to achieve decarbonization objectives through clean hydrogen can only be achieved through the integration of the nuclear industry.

Ms Shannon Bragg-Sitton mentioned the importance of scaling up existing initiatives in a time and cost-efficient manner. She also remarked the relevance of integrating systems with the high-quality heat that can be provided by nuclear, supported by detailed modelling and simulation tools for technical and economic assessments, as well as optimization of these nuclear integrated hydrogen production systems, considering the variability of the different markets as more and more renewable integrate into the grid.

Mr Christopher Gully highlighted the role of the Canadian Nuclear Association (CNA) in engaging with the hydrogen industry to facilitate sharing of information and lessons learned.

Mr Les Jacobs delved into how Ontario Tech University became a leading centre of research on nuclear hydrogen in Canada. He discussed about the importance of the labour force, and the fundamental role played by universities in building the workforce, and the connections established between Canadian universities such as Ontario Tech and the nuclear industry to address human resource challenges. He talked about developments in the Canadian context in hydrogen applications in commercial transportation.

In her closing remarks, Ms Aline des Cloizeaux underscored the importance of collaboration, innovation, and forward-thinking strategy to address the climate change crisis, as well as the potential of clean hydrogen for decarbonization. Hydrogen, she added, promises a more sustainable future.

5.6. RIVER BASED NUCLEAR POWER PLANTS: HOW TO OPERATE SUSTAINABLE IN THE FACE OF CLIMATE CHANGE

Chairperson
D. Ohayon (EDF)

Panellists
K. Perche — Deputy Head of DIPDE Department (EDF)
H. Cordier — Senior Expert (EDF)
S. Parey — Senior Engineer (EDF)

This event discussed the challenges river-based nuclear power plants face from climate change. The side event served to share the experience of Électricité de France (EDF) in terms of design

specifics and environmental impact management for both the existing reactor fleet and nuclear new builds.

The summaries of interventions are given below.

Mr Didier Ohayon introduced the subject highlighting the fact that climate change is already accelerating, and nuclear plants must be adapted to handle future conditions like increasingly frequent heatwaves. He emphasized that this requires development and implementation of very specific knowhow in terms of technical and environmental impact assessments to operate and construct river-based nuclear power plants sustainably. Mr Ohayon presented EDF's existing initiatives in this area. He also underlined EDF's role as the world's largest nuclear operator, and remarked that, as of ending 2023, France is operating 56 reactors across 18 sites, and is developing new EPR reactors domestically and abroad. Finally, he mentioned EDF's ongoing research and initiatives to quantitatively characterize aquatic biodiversity responses to changes in water temperature and to provide more scientific evidence to support and objectively feed reflections into the development of appropriate responses to exceptional climate events affecting river environments.

Ms Sylvie Parey discussed EDF's efforts to anticipate climate change impacts on nuclear power plants, including conducting climate research, acting as an interface between scientists and the company to access and analyse climate data and models, and downscaled climate projections to assess local impacts, and statistical analysis of observations to help quantify future weather extremes under climate change scenarios. She also mentioned EDF's impact models of heat waves, hydrology, water quality and power generation, which serve to estimate hazard levels over different time horizons. She stated that these results guide EDF's actions to improve the resilience of the environment surrounding nuclear facilities facing combined pressures from operations and climate change.

Mr Herve Cordier discussed adaptation and safety issues related to nuclear power plants close to rivers. He mentioned the following key elements to ensure safety: 1) define safety goals from the very beginning of the design; 2) identify risks; 3) quantify risk intensity for every considered hazard; 4) design and implement protection measures; and 5) monitor and collect operational and design feedback. Mr Cordier also mentioned that adaptation solutions already exist at an industrial level, but anticipating future conditions is critical to selecting appropriate plant designs.

Ms Karine Perche presented the important link between nuclear power plants and biodiversity, and the challenges that arise from climate change, underscoring that nuclear power plants interact with the environment during their life cycle through land transformation, water consumption, gaseous and liquid discharges, thermal plume and noise and light pollution. She mentioned that climate change makes ecosystems more vulnerable due to changes in hydroclimatic parameters like temperature and river flows. She emphasized that EDF conducts extensive environmental monitoring of sites to understand the impacts and ensure regulatory compliance. She stated that it is essential to understand the pressures exerted by nuclear facilities on the environment, to work to reduce these pressures systemically, and to anticipate the possible future evolution of the ecosystem in response to climate change.

5.7. ATOMS4NETZERO NEXTGEN

Chairperson

B. Lazerwitz (IAEA)

Welcome address
W. Huang (IAEA)

Panellists
B. Viswanathan — Energy Analyst (SE4All)
A. Cunha da Silva — Innovation Project Lead (WEC)
K. Cunningham — PhD. Student (MIT)
B. Santhouse-James — UNFCCC's Youth Constituency (YOUNGO)

The event explored ways to engage the younger generation in the nuclear sector. In his welcoming remarks, Mr Wei Huang mentioned that there are currently around 1.8 billion young people in the world. He emphasized that these young people form a unique force to drive positive societal change, including innovative solutions to climate action, as they will bear the consequences of climate change if immediate action is not taken to achieve a net zero world.

The summaries of interventions are given below.

Ms Alice Cunha da Silva shared how her experiences and opportunities through international organizations like the IAEA have led to her own choice to pursue a career in the nuclear sector. She shared about a new professional development program called Leaders for Nuclear being launched by the International Youth Nuclear Congress. The program aims to empower young professionals through collaboration with other organizations and a focus on cross-cutting topics like climate change, leadership, and communication skills. She added that inclusive participation will attract talent in the nuclear space. She mentioned that participation of youth in decision making processes should be an essential part of the solution to climate change. She also noted the importance of generational diversity in tackling challenges related to the development of nuclear power.

Mr Balasubramanian Viswanathan discussed the scale of the energy transition required, citing an IEA report that calls for tripling R&D capacity and doubling energy efficiency to reach net zero by 2050. Mr Viswanathan then spoke about the UN's Energy Compacts initiative, which allows all stakeholders to share commitments and support each other. He encouraged engagement with the 24/7 Carbon-Free Energy Compact that aims to produce energy without carbon sources, with nuclear as a critical part of the solution. Mr Viswanathan emphasized the need for collective action and involvement of all actors to achieve SDG7 by 2050 given the immense scale of the transition required.

Mr Ben Santhouse-James agreed with other panellists that young people worldwide want secure, affordable energy and to minimize local environmental impacts, even if sustainability is secondary for some. Ben acknowledged there is a vocal minority opposed to nuclear energy and emphasized the need for two-way dialogue to understand opposing views and find consensus. He sees optimism in the growing number of young people entering fields like policy, engineering, and academia who want careers making a big impact on emissions. Ben also expressed optimism that interest in energy systems and nuclear energy specifically is rising among youth. He believes public attitudes, especially among young leaders, are shifting to increasingly recognize nuclear as part of the climate solution. Finally, Ben called for more technical experts to engage with youth-led climate groups and advocated collaboration to achieve an energy system fit for the future.

Ms Kaylee Cunningham stressed the high demand for human resources in the nuclear sector, and cited a US Department of Energy report that found the country needs 375 000 additional nuclear workers by 2050 to help decarbonize industry. Ms Cunningham explained how Generation Z has faced constant information overload due to social media and technology. This has made it difficult to engage Generation Z on issues and get them to care. However, she is using TikTok to communicate about nuclear in a strategic way, with videos and trends to make it more engaging. Kaylee believes social media can help rebrand the industry and potentially excite young people about clean energy careers. She emphasized the need to humanize nuclear professionals' work and make the industry look exciting and cutting-edge again to attract the talent required for future growth.

5.8. SPECIAL SESSION: NUCLEAR POWER TO SUPPORT JUST TRANSITION IN THE GLOBAL SOUTH

Chairperson
E. Mathet (IAEA)

Panellists
A. S. Naqvi — Executive Director (CISS)
A. N. Kwashie — Director General (NRA Ghana)
E. W. Wandera — Senior Corporate Affairs (KenGen)
M. B. Tyobeka — Vice-Chancellor (North-West University)

A special session was organized on the last day of the conference to discuss the Just Transition in the Global South. Speakers from Ghana, Pakistan, South Africa, and Kenya shared their country's experiences and challenges with transitioning to cleaner energy sources while ensuring economic development and social justice. The event delved into the need to balance fossil fuel use with decarbonization goals, preserve jobs through replacing coal plants with nuclear or other technologies, develop regional cooperation on energy projects, and address financing and human resource challenges to support a Just Transition. The action items focused on policy measures around job creation, access to energy, and leveraging nuclear power to support climate goals in a socially equitable way. Mr Emmanuel Wandera emphasized that the Just Transition in the Global South means climate and energy justice. He stated that climate change impacts are already very real and affecting lives today. For the Global South, the transition is urgent and a matter of survival. He also highlighted that nuclear energy could help countries achieve energy security and climate goals. He stated that nuclear is one of the best options for the Global South to achieve climate targets based on the need for decarbonized baseload power and energy security.

The summaries of interventions are given below.

Mr Nii Kwashie added that, for most countries in the Global South, the key is to achieve sustainable economic and industrial development, and the related transition from fossil fuels to clean energies. He emphasized the need to balance development and the energy transition. In this regard, he mentioned the new energy policy recently adopted by Ghana, which cites the Just Transition as one of the main goals, in addition to the country’s inter-ministerial committee, which will ensure a cross-cutting approach. He mentioned that Ghana is working to minimize job losses and promote gender equity as part of its Just Transition plans. Key challenges for

Ghana include developing sufficient human resources to manage new technologies and implementing innovative financing schemes.

Mr Ali Sarwar Naqvi, former Ambassador of Pakistan, discussed challenges connected to the Just Transition, including domestic public opinion that is prejudiced against nuclear energy. He showcased the example of Pakistan in its efforts to transition to nuclear energy generation and the related challenges, social and political, due to being one of the earliest adopters of nuclear energy.

Professor Mr Bismarck Tyobeka focused on the situation in Africa, mentioning that the energy transition is first and foremost about development and addressing poverty in the continent, and the need to encompass social justice, infrastructure, and energy development. He mentioned that over 600 million people in Africa lack electricity access. For Africa to move to clean energy, he noted, infrastructure development, capacity building and financial support must be implemented.

6. CONCLUSIONS OF THE CONFERENCE

The report of the President of the Conference, H.E. Mr Hamad Alkaabi, Permanent Representative of the United Arab Emirates (UAE) to the IAEA summarized the major findings and conclusions from the respective panel discussions and presentations at the Second International Conference on Climate Change and the role of Nuclear Power.

6.1. REPORT OF THE CONFERENCE'S PRESIDENT

H.E. Mr Hamad Alkaabi
Permanent Representative of the United Arab Emirates to the IAEA

Excellencies, ladies and gentlemen,

After four and a half days of intensive discussion, we are approaching the end of the *2nd International Conference on Climate Change and the Role of Nuclear Power*. I would like to express my sincere gratitude to all speakers, panellists and participants that have joined us here in Vienna and virtually for your valuable contribution to this conference organized by the IAEA.

The climate crisis or rather, the climate emergency, is a call for actions to reduce greenhouse gas emissions rapidly and accelerate the clean energy transition. These actions have become imperative to achieving the Sustainable Development Goals and keeping global warming below 1.5 degrees Celsius, as agreed in the Paris Agreement. Against this backdrop, we observe growing global interest in nuclear energy as part of the climate solution. This was manifested in the enthusiastic and active participation we've witnessed in this conference. I have been told that in total, more than 540 participants from 81 Member States and 26 International Organizations were in attendance this week. Over 115 papers were submitted to the conference, of which 93 were presented orally and 22 were contributed as posters or E-posters.

This week has been full of activity - ten high-level panels, one high-level segment, one special session and 18 technical sessions were conducted, in addition to seven side events featuring different topics organized by Member States, nuclear industry, NGOs and the IAEA Secretariat.

A number of ministers and senior officials from IAEA Member States were in attendance, including China, France, Japan, Pakistan, Poland, United Arab Emirates, United States of America, United Kingdon, among others. Heads or senior representatives of international organizations such as the International Energy Agency, World Meterology Organizaion, the United Nations Department of Economic and Social Affairs, the United Nations Industrial Development Organization, World Nuclear Association, World Association of Nuclear Operators, the Latin American Energy Organization, Nuclear Energy Agency of the Organization for Economic Co-operation and Development, European Bank for Restruction and Development, Organization for Security and Co-operation in Europe, along with other nuclear industry leaders, have given keynote speeches or contributed to the high-level panel discussions. A number of experts and different stakeholders actively participated in the technical disscussions and presented their scientific studies and research.

Discussions have focused on the current challenges and opportunities facing nuclear energy in the context of combating global climate change and clean energy transitions. They have also taken a deep dive into some key issues related to how to unleash the potential of nuclear energy in net zero

Conversations this week were around four themes, Let me try my best to summarize the key findings of each:

Let us start with Theme One: Positioning Nuclear Power in the Global Clean Energy Transition.

We discussed the various social and economic development indicators of nuclear energy compared to other energy generating technologies. Attributes such as low-carbon emissions, high energy density, dispatchability, relatively small land footprint and low critical mineral consumption per kilowatt-hour of energy produced, all represent advantages of nuclear energy over other low-carbon energy sources that need to be valued orrecognized appropriately to ensure its competitiveness.

At at time when the world is urged to ramp up climate ambitions and accelerate GHG emissions reductions, nuclear energy is gaining recognition for its role in the global climate battle. Nuclear energy's important role has been reflected in 14 countries' Nationally Determined Contributions (NDC) and 20 countries' long term low GHG emissions development Strategies (LTS) under the Paris Agreement. Nuclear energy's contribution to SDG 7 is also highlighted in a number of Energy Compacts submitted under the High-Level Dialogue on Energy, including the IAEA Energy Compact.

The most recent IAEA high case projection released on Monday, the 2023 update of the IEA Net Zero Roadmap report released in September and the majority of low-carbon pathways in the IPCC 6th Assessment report call for a significant increase in nuclear energy capacity by 2050 to meet climate and energy security objectives. A doubling or more of the current nuclear capacity by the middle of this century is widely seen as needed to support transitions to net zero.

These actions illustrate a growing understanding in the global community of the key role nuclear has played and will play together with other low-carbon enegy technolgies including renewables to meet the goals of the Paris Agreement. While the attributes of nuclear are gaining wider recognition, the nuclear community should not be complacent. Instead, we should take more ambitious action on various aspects in ensuring that those expectations will be achieved.

Let me move to Theme Two: Establishing an Enabling Environment for Nuclear Power.

In order achieve the objectives of those ambitious projections and studies, the nuclear community must undertake collective efforts to enable the large scale deployment of nuclear energy. We must continue to be willing to engage and build parternships as part of a sustainable global community, emphasizing the role of nuclear power in combating climate change. We must continue to develop the technological innovations that characterize the nuclear sector, which have made the nuclear lifecycle safer, more robust, more flexible and more resilient. We must continue to push for a level playing field for nuclear energy, in terms of policies and access to financing, which can allow the technology to benefit from similarly favorable conditions that helped to deploy renewable energy technologies at scale over the last decade.

Long term energy policies, innovative electricity market designs and technology-neutral sustainable finance frameworks that recognize nuclear's contribution to energy system reliability, flexibility and decarbonization are needed. On the industry side, robust supply chains and sound project management are needed to enable deployment at scale — all of which will help to reduce the perceived investment risk of nuclear projects. Replication, standardization and localization are relevant factors to the economic competitiveness of nuclear moving forward.

The nuclear industry holds a strong potential for establishing significant professional opportunities across genders and generations. Investments in nuclear power projects can unlock significant social and eonomic benefits such as creating skilled, high-quality and long-term jobs, boosting the economy and driving infrastructure development.

Nuclear power's ability to produce low-carbon heat and hydrogen reprersents an opporutnity to create synergies with industries that need these energy vectors for decarbonization, such as manufacturing, transportation, and buildings. We emphasized the need for comprehensive and inclusive strategies to ensuring a sustainable future, and the need for advocacy regarding the presence of nuclear energy — in its many forms — in climate models and energy frameworks. The inclusion of nuclear energy in the EU Taxonomy in 2022 sparked a global conversation and indeed moved the needle in the right direction.

On Theme Three, Releasing the Full Potential of Nuclear Energy.

We heard forecasts for increased electrification across the energy sector, underscoring the importance of increasing nuclear capacity, along with other low-carbon technologies, to match this growing demand. We found consensus on the crucial role of nuclear energy in meeting climate targets, with emphasis on safe long-term operation of existing nuclear power plants in established nuclear markets, the need to rapidly deploy proven large-scale reactors and the urgency of bringing Small Modular Reactors (SMRs) to market as soon as possible, particularly to replace fossil plants of similar size, including to meet the needs of emerging countries and for non-electric applications.

Extending the operating life of nuclear power plants is agreed to be the most cost-effective source of low-carbon electricity. But for the safe and efficient long-term operation of NPPs, the nuclear community must ensure robust supply chains and maintain critical nuclear knowledge and skills and a competent workforce over the long term, while ensuring that these plants continue to meet safety requirements.

Like large reactors, SMRs can deliver flexible and dispatchable power but with lower upfront costs and with more manageable sizes for deployment on smaller grids and befitting multiple

electrical and thermal applications. These attributes are often highlited in the 80 or so SMR designs currently under development around the world, with varying levels of technology readiness. Today, two demonstration projects are in operation and another two are under construction. Several are undergoing regulatory reviews.

To facilitate the effective development and deployment of safe and secure SMRs in both regulatory and industrial aspects, the IAEA launched the Nuclear Harmonization and Standardization Initiative (NHSI) in 2022. The IAEA also established the Platform on SMRs and their Appplications to provide Member States with a single point of access to all Agency services on SMRs, from development and deployment to oversight.

The full power operation of the 200 MWe High Temperature Gas Reactor in 2022 sent encouraging signals to the nuclear community about the potential to use nuclear heat for process steam or other non-electric applications such as hydrogen production. The international effort in assessing the feasibility of repurposing retiring coal plants with SMRs is making progress. Floating NPPs are demonstrating their potential in decarbonization.

Nuclear power is the only technology that can produce at scale the three low-carbon energy vectors needed to reach net zero: electricity, heat, and hydrogen. Unfortunately, there is a large disconnect between what nuclear technology can deliver and how this potential is portrayed in climate scenarios that inform policymakers.

The IAEA's Atoms4NetZero initiative is designed to bridge that gap by supporting energy scenario modelling to demonstrate how net zero objectives can be achieved when the full potential of nuclear power is leveraged, including for decarbonizing sectors beyond electricity.

Last but not least, Theme Four: Mainstreaming Nuclear Power as a Sustainable, Low-Carbon Energy Source. The key findings under this theme:

Nuclear is not only a valuable low-carbon energy source but also a robust and reliable power technology. Thanks to highs levels of safety, nuclear power's adaptability and stong resilience to extreme weather impacts from by climate change has been demonstrated in many scientific studies including from the IAEA.

Engaging with the global community with clear messages from authoritive data sources is crucial for positively engaging with the public about the value and benefits of nuclear energy in fighting climate change and achieving Sustainable Development Goals.

Building a culture-, gender-, and age-diverse community to ensure equity in facilitating nuclear energy's role in addressing climate change will enable the effective engagement with different stakeholders including decision makers.

Since the first conference on this topic held four years ago, a gradual reshaping of the nuclear landscape has been witnessed. Constantly advocating the value of nuclear energy in addressing climate emergency and sustainble development and dialoguing with the non-nuclear community at various levels and at various international fora have paid dividends. High-level engagement led by the IAEA at COPs has helped to built strong momentum in mainstreaming nuclear energy in the fight against climate change and achieving Net Zero transtions. The Atoms4Climate pavilion at COP27 symbolized the first time nuclear showed up in the center of the top global climate debate.

Strengthening international cooperation and building strong partnerships among international organizations will facilitate the development and deployment of advacnced nuclear power technologies with multiple purposes. The IAEA has played and will continue to play an indispensable role in this regard.

Ladies and gentlemen, let us take a look at what could be the main takeaways from this conference, and what we can bring to the coming COP28.

To keep the 1.5 degrees goal of the Paris Agreement within the reach, the world needs to accelerate a just, equitable and affordable clean energy transition and deepen decarbonization efforts in all sectors. This process needs to go through global solidarity and collaboration and mobilize all stakeholders and available energy resources and tools including nuclear energy.

Thanks to the joint efforts of the nuclear community in the past four years, particularly the IAEA, nuclear power has gained a seat at the global climate platform.

Today, there is less doubt about the low-carbon attributes of nuclear power thanks to the significant role of nuclear power in securing energy supply and avoiding GHG emissions in the past decades. Other attributes of nuclear power in supporting the global decarbonization including district heating, desalination, industry process, hydrogen among others, are being acknowledged.

SMRs have attracted significant interest for their potential to contribute to the clean energy transition. The early deployment of more SMRs could demonstrate the true value and potential of this innovative and versatile nuclear technology. To facilitate the development and deployment of SMRs and move those more than 80 designs from paper to the ground, international efforts are observed including the IAEA's Nuclear Harmonization and Standardization Initiative.

To unleash the potential role of nuclear energy in achieving carbon neutrality commitments, more work needs to be done at national, regional, and international levels to model nuclear energy in net zero pathways. The Atoms4NetZero initiative is contributing to this objective and providing scientific references for policy makers to draw their net zero blueprint. Similarly ambitious net zero actions from other stakeholders including the nuclear industry are also observed.

The nuclear community should not be complacent about what has been achieved. We should be more vocal about the benefits and value of deploying nuclear at the scale needed to mitigate the worst impacts of climate change.

We should be more engaging with other stakeholders to discuss those challenges facing the energy sector including nuclear in a broad and technology neutral context such as balancing expanded electrification while minimizing cost, ensuring security of energy supply and deep decarbonization.

The growing demand for electricity in both developing and emerging economies and advanced economies against different backdrops in the coming decades has created an equal opportunity for both nuclear energy and renewables. The nuclear community should take more ambitious actions to pursue synergies with renewable and other low-carbon technologies to collectively contribute to the clean energy transition.

Scientific data shows nuclear projects can be bankable and profitable. There are different approaches to advance financing options and spurring private investment, including through taxonomies and ESG frameworks. To enable the large-scale deployment of nuclear power, access to financing must be improved, including for embarking countries in the Global South. To achieve these objectives, different stakeholders have a role to play.

Governments should take an active role to de-risk nuclear investments by formulating long term and incentivising policy and building a level playing field to ensure investor confidence and channel the flow of financing.

Multilateral financial institutions are encouraged to be more open and inclusive towards nuclear power to ensure the same favourable financial access that renewables and other low-carbon energy technologies have been enjoying.

The nuclear industry should do its own part to ensure nuclear projects can be delivered on time and on budget. They also need to continue their efforts in making technology breakthrough and establishing mature business models to maintain high techno-economic features of nuclear power in the evolving competitive energy market with a high penetration of renewables.

International organizations including the IAEA should further strengthen international cooperation in supporting technological innovation, capacity building, infrastructure development and legislative frameworks.

The first global stocktake under the Paris Agreement will be concluded at COP28 in Dubai, UAE. This mechanism is calling for more ambitious pledges and actions by all stakeholders at a global scale. The nuclear community should seize this excellent opportunity to flag the indispensable role of nuclear energy in a just and equitable clean energy transition, dispel misinformation on nuclear energy and collectively chant that “Nuclear is and will continuously be part of solution for climate change” in United Arab Emirates, COP 28 host country which has explicitly included nuclear energy in its 2050 net zero strategy.

Ladies and gentlemen,

The past week has been very intense. Different stakeholders, from government to industry, from international organizations to non-gonvermental organizations, from women's groups to the young generation, sat together to elaborate the opportunities and challenges facing the nuclear sector and propose constructive solutions on how to further enlarge the role of nuclear power in mitigating climate change. I would like to take this opportuntiy to express my heartfelt thanks to every and each of you for your professional and insighful contributions, which have led to very fruitful outcomes for the conference.

I would also like to thank the Scientific Programme Committee for organizing the conference and evaluating and reviewing the scientific contributions, all chairs and co-chairs and chairpersons of high-level panels and technial sessions for guiding the interactive discussions, and all those who has contributed papers, presentations and posters.

I also want to thank our scientific secretary, Huang Wei, his team, Henri Paillere, Bianca Carpinelli, Joaquin Fuentes Cardona, Brianna Lazerwitz, Hal Turton, Valerie Gartner, as well as Tom Danaher, and all those in the Agency who have worked hard to make this conference a success.

Ladies and gentlemen, now I declare that the 2nd International Conference on Climate Change and the Role of Nuclear Power is closed.

ANNEX I. CONFERENCE STATISTICAL DATA

Organized by	IAEA Department of Nuclear Energy (NE)
Location	IAEA Headquarters, Vienna, Austria
Total No. of participants and observers	508 (36% female, 64% male)
Total No. of officially designated participants	443 (Member States) and 65 (organizations)
No. of Member States	88
No. of organizations represented	33
No. of statements or presentations and others	Sessions 31 (incl. open/close) Side events 7 Presentations/Speakers 96 E-posters 22
Scientific Secretary (IAEA)	Wei Huang (NEPK)
Scientific Support (IAEA)	Henri Paillere (NEPK) Bianca Carpinelli (NEPK) Joaquin Fuentes Cardona (NEPK)
Administrative support (IAEA)	Valerie Gartner (NEPK)
Conference coordination (IAEA)	Tom Danaher (MTCD)
Technical Cooperation Coordination	Denis Subbotnitskiy (TCAP)
Conference website	https://www.iaea.org/events/atoms4climate-2023

No. of participants by Member State: 443

Albania	1	Guatemala	3	Romania	2
Algeria	1	Honduras	1	Russian Federation	24
Argentina	6	Hungary	2	Saudi Arabia	1
Armenia	1	India	2	Senegal	1
Australia	3	Indonesia	5	Serbia	1
Austria	1	Israel	1	Sierra Leone	6
Bahrain	1	Italy	3	Slovakia	2
Bangladesh	1	Jamaica	1	South Africa	3
Benin	1	Japan	2	Spain	1
Bosnia and Herzegovina	1	Jordan	2	Sri Lanka	2

Brazil	8	Kenya	8	Sweden	6
Bulgaria	1	Lesotho	1	Switzerland	3
Burkina Faso	3	Libya	1	Syrian Arab Republic	1
Burundi	1	Luxembourg	1	Tajikistan	1
Cameroon	2	Malawi	1	Thailand	3
Canada	13	Malaysia	3	Tunisia	2
Chile	1	Mali	1	Türkiye	8
China	71	Mexico	2	Uganda	5
Comoros	1	Mongolia	2	Ukraine	1
Congo	2	Netherlands	3	United Arab Emirates	6
Croatia	1	Nicaragua	2	United Kingdom	27
Czech Republic	2	Niger	1	United Republic of Tanzania	1
Dominica	1	Nigeria	6	United States of America	47
Egypt	11	Norway	2	Uzbekistan	2
Ethiopia	12	Oman	1	Viet Nam	1
Finland	1	Pakistan	19	Yemen	2
France	31	Paraguay	1	Zambia	3
Georgia	1	Poland	5	Zimbabwe	1
Ghana	10	Republic of Korea	6		
Greece	1	Republic of Moldova	1		

No. of participants by Permanent Observer: 1

State of Palestine	1

No. of participants by organization: 64

Clean Air Task Force (CATF)	1	OECD Nuclear Energy Agency (NEA)	1
Electric Power Research Institute (EPRI)	1	Shell International Petroleum Co. Ltd	1
European Atomic Forum	3	Sizewell C	1
European Bank for Reconstruction and Development (EBRD)	1	Sustainable Energy for All	4
European Commission JRC	2	TerraPraxis	1
European Nuclear Society (ENS)	3	The Voices of Nuclear	1
European Union	1	United Nations (UN)	1
International Bank for Nuclear Infrastructure Strategic Advisory Group	2	United Nations Economic Commission for Europe (UNECE)	1
International Energy Agency (OECD/IEA)	2	United Nations Industrial Development Organization (UNIDO)	3
International Nuclear Energy Academy (INEA)	1	URENCO	1
International Youth Nuclear Congress (IYNC)	1	Vienna Center for Disarmament and Non-Proliferation (VCDNP)	4
International Fusion Energy Organization (ITER)	2	Women in Nuclear	4
Latin American Energy Organization (OLADE)	2	World Association of Nuclear Operators (WANO)	3
Natixis Bank	1	World Meteorological Organization (WMO)	3
Nuclear Energy Institute (NEI)	1	World Nuclear Association (WNA)	4
Organization for Security and Cooperation in Europe (OSCE)	1	YOUNGO	6

ANNEX II. LIST OF PAPERS

Track	Paper	Presenter	Country	Paper Title
4	015	C. Omondi	Kenya	Opportunities for nuclear professional association in addressing climate change
2	016	A. Phiri	Zambia	Nuclear techniques in climate change for sustainable water resources management
2	017	H. C. Odoi	Ghana	Human Resource Development for Ghana's Nuclear Power Program: Contribution by the Ghana Research Reactor-1 Facility
1	019	M. F. A. Bin Abdullah	Malaysia	Climate Change Induced Climate Variabilities and Extremes over Malaysia: Impact on the Monsoons.
1	021	A. Ibrahim	Nigeria	The role of nuclear power in the generation of electricity for industrial, economic development and sustainability while mitigating climate change in Africa
1	023	R. J. Soja	Nigeria	Nigeria's Landmark in Realization of Net Zero Carbon Emission Target: Accomplishments and Prospects.
2	026	S. Çam	Türkiye	Mobilizing multi-stakeholders, including teachers, talents and young generation groups, to facilitate the global dialogue about nuclear and climate change: A TENMAK case from Türkiye
3	030	R. Bhattacharyya	India	Techno-Economic Analysis of Thermal Batteries for Surplus Nuclear Heat Storage: Towards Enabling Flexible Reactor Operations
2	031	B. Aregga	Ethiopia	Ethiopia's Energy Policy Implementation Aligned with SDGs to mitigate Climate Change
2	035	R. Tscherning	Canada	Nuclear Power and the NetZero 2050 Opportunity: Expediting Canada's Low-carbon Economy

Track	Paper	Presenter	Country	Paper Title
3	042	M. K. Shaat	Egypt	Use of Clean Energy from Small Modular Reactors (SMRs) for Industrial Applications and Socio-economic Development
1	043	R. Yaccup	Malaysia	Potential impact of climate change including extreme events on small modular reactor site – a review of Sabah, Malaysia.
4	044	S. Korraa	Egypt	Nuclear Technology the Imperative Solution for African Women Health and Socioeconomic Status
1	045	M. Akat	Türkiye	The Role of Nuclear Energy in Türkiye's Climate Change Mitigation Strategies.
1	046	G. Güngör	Türkiye	Probabilistic Flood Hazard Assessment for a Coastal Nuclear Power Plant using Climate Change Projections
1	047	G. Koca	Türkiye	A case study energy analysis and simulation for SMR and solar system
1	051	R. Eljarian	Jordan	The contribution of nuclear energy to accelerating progress toward low-carbon energy.
2	052	T. Gelo	Croatia	Assessing the macroeconomic impact of building small modular reactor on small economy: case of Croatia
4	053	P. Carter-Cortez	Nuclear4Climate	Nuclear4Climate Survey: Mapping the Nuclear Landscape in the Age of the Nuclear Renaissance
3	058	J .Shook	United States of America	Overview of the EPRI Nuclear Energy in the District Energy Applications (NuIDEA) Initiative
4	059	C. J. G. Shouop	Cameroon	Will SMRs Be Accepted as a Clean Nuclear Energy Source for Developing Countries? Cameroon Projection

Track	Paper	Presenter	Country	Paper Title
2	060	B. Heard	Australia	Assessing the prospects of nuclear technologies in the global energy mix – a structured analysis methodology to support decision-making.
2	061	F. Tassi	United States of America	Clean and Prosperous? Modeling Least-Cost Coal Plant Retrofit Decarbonization Meeting Local Economic Impacts of North Carolina's Coal Fleet
1	065	M. A. Nyasapoh	Ghana	Energy Transition and Investment Decisions in Africa: A Cost Analysis of Ghana's Emissions Reduction Trajectories.
2	071	M. Kovachev	International Bank for Nuclear Infrastructure Initiative	International Bank for Nuclear Infrastructure (IBNI) Initiative: The missing link to enable nuclear in achieving climate scale
4	072	A. Mbhele	South Africa	Milestones of the African Young Generation in Nuclear (AYGN) in its advocacy for nuclear energy as a solution to climate change in Africa
1	076	K. Artemiev	Russian Federation	The development of nuclear power in Russia as a key driver for the energy transition and the achievement of the UN SDGs
4	079	S. Aksoy	Türkiye	The correlation between nuclear literacy and net zero goals: Effectively explaining nuclear power in the climate crisis with communication campaigns and digital contents
1	080	A. Zbib	United States of America	The Clean Energy Mix of the Future in the Pacific Northwest and the Role of Nuclear Energy
3	081	W. Dridi	Tunisia	Comparative study of Nuclear Water Desalination Technologies in Tunisia using SMRs
1	082	H. A. Kalambuka	Kenya	A Carbon Footprint Appraisal of the Development of Kenya's Nuclear Power Program

Track	Paper	Presenter	Country	Paper Title
1	083	K. Perche	France	Preservation of biodiversity and nuclear power production: The new challenges linked to climate change
4	084	A. N. Yustus	Russian Federation	Nuclear energy 2.0: The new public image
3	086	B. Hussain	Pakistan	A Nuclear-hybrid Energy System with Co-generation: Economy for Peaker Operation
3	087	H. Zhang	China	Analysis on the Prospect of Coupled Development of Nuclear and Petrochemical Enterprises under the Goal of Carbon Neutrality – The Case of China
3	089	S. Rahman	Bangladesh	Advanced nuclear energy technology to reduce climate mitigation cost
2	090	J. Gu	China	Status and Role of Nuclear Power in China's Clean Energy Transition
3	093	S. Feutry	France	Nuclear flexible operation for a low-carbon electricity mix
3	095	M. Baryshnikov, E. Zhurbenko	Russian Federation	Sustainable nuclear fuel cycle as the most efficient and responsible way of nuclear fuel use
1	096	O. Y. Kutlu	Türkiye	Optimum Sizing of Nuclear Renewable Hybrid Energy System with Hydrogen Plant: A Case Study for Türkiye
1	099	H. Majid	Pakistan	Mainstreaming nuclear power in Pakistan: Prospects and challenges
1	101	N. Jamal	Pakistan	Assessing the Role of Nuclear Power in Decarbonizing Pakistan's Electricity Generation System by 2060.
4	102	E. Gyane	Austria	Women in Nuclear (WiN) Global's Role in Elevating Young Generation Engagement for Global Dialogue

Track	Paper	Presenter	Country	Paper Title
3	104	A. Kashirskii	Russian Federation	Two-component nuclear energy system: Generation IV nuclear reactor technologies
1	105	A. van Heek	Netherlands	The potential of combined emissions reduction and value creation by SMRs in energy-intensive industry – an example from The Netherlands.
4	106	L. Gehrig, K. Doty	United States of America	Expanding Nuclear Energy to Reach Net Zero: Balancing Nonproliferation Opportunities and Risks
4	110	M. Hurlbert	Canada	Building net zero emission power production futures in Saskatchewan, Canada
3	111	M. Wang	China	China's policy formulation and technological innovation empower nuclear energy in promoting global clean energy transitions
3	112	Y. Long	China	China's Nuclear Power Development and Multi-application of Nuclear Energy toward Net Zero Target
4	115	R. Iqbal	Pakistan	The Vital Role of Nuclear Power as a Productive Source of Energy for Pakistan
1	117	F. Kausar	Pakistan	A Technical Optimization Study of Nuclear Renewable Integrated Energy Systems as a Carbon Free Energy Resource for Future
3	120	A. Khan	Pakistan	Evaluating Small Modular Reactors for Mitigating Climate Change
4	121	L. Shasko	Canada	How visual science fiction storytelling using the social media platform Instagram could positively mobilize women and young generations to facilitate global dialogue on nuclear power as a sustainable, low-carbon energy source
2	122	P. Lion	Russian Federation	Integration of Nuclear Energy into Regulatory Framework of Low-Carbon Economy

Track	Paper	Presenter	Country	Paper Title
4	123	R. Asaba	Uganda	Mobilizing multi-stakeholders, including women and young generation groups, to facilitate the global dialogue – a case study for Uganda
2	124	A. Khan	Pakistan	Mitigating Effects of Climate Change through Nuclear Energy: Policies and Options for Sustainable Development of Pakistan
3	126	S. L. Wild	United Kingdom	Using Microreactors to Decarbonise the Defence Industry
3	127	N. Anuar	Malaysia	Strategies for accelerating hydrogen production commercialization with nuclear-renewable hybrid energy system in Malaysia
1	128	M. Hjelmeland	Norway	Nuclear Energy Capacity Expansion Planning for a Nordic Low-Carbon Power Grid.
2	129	M. Hjelmeland	Norway	The role of nuclear energy in achieving a Net-Zero future: Alignments with the UN's Sustainable Development Goals
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1	178	C. Gully	Canada	Nuclear for Net Zero: Canadian opportunities and challenges

All synopses and presentations can be found on the INIS website:
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