International Framework for Nuclear Energy Cooperation
Nuclear Energy's Role in the 21st Century – Finance Conference
11-12 May 2016 – Paris, France

Nuclear Energy's Role in the 21st Century: Addressing the Challenge of Financing

Conference Proceedings
11-12 May 2016
Paris, France

IFNEC
INTERNATIONAL FRAMEWORK FOR NUCLEAR ENERGY COOPERATION

NEA
NUCLEAR ENERGY AGENCY

Nuclear Energy's Role In the 21st Century: Addressing the Challenge of Financing

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1. Executive summary

Objectives and goals

On 11-12 May 2016, the International Framework for Nuclear Energy Cooperation (IFNEC) held a conference in cooperation with the OECD Nuclear Energy Agency (NEA) in Paris, France on "Nuclear Energy's Role in the 21st Century: Addressing the Challenge of Financing". The conference brought together approximately 150 stakeholders from more than 30 countries, including government representatives and members of the nuclear and finance communities as well as experts from the NEA and the OECD.

The main objective of the conference was to discuss ideas on how to secure financing for new nuclear projects. Through multiple expert presentations, moderated sessions and scenario discussions, participants acquired a better understanding of the unique challenges, approaches and techniques involved in financing new nuclear power plants (NPPs).

Current nuclear energy market challenges

Throughout the conference, experts set the stage to understand why financing new NPPs is so difficult and complex. The following are the key challenges identified through discussions:

- unstable electricity prices in a liberalized market;
- electricity market designs that do not provide investment signals for low-carbon technologies;
- insufficient carbon pricing to promote nuclear investments;
- explicit governmental support for renewables;
- uncertain and changing political support;
- poor social and political perception of safety;
- historical new nuclear project budget and schedule overruns;
- long-term nature of capital investments.

Final recommendations for consideration

Conclusions were reached through discussions and debate on how to best address the aforementioned challenges. Although not all of these challenges can be resolved, there are methods to address the risks involved and to build the confidence necessary for investment. The key recommendations from the conference for financing new NPPs include:

- conduct electricity market reform to level the playing field across all energy sources;

- demonstrate an ability to construct nuclear projects to time and budget;
- remove taxes and penalties explicitly placed on nuclear;
- establish strong governmental support for nuclear energy;
- harmonize regulatory requirements internationally;
- employ effective program management mechanisms;
- communicate clearly and early with all stakeholders;
- demonstrate a strong nuclear safety culture;
- choose proven technologies for deployment;
- leverage contracting mechanisms to ensure a long-term revenue stream;
- employ vendors and operators with positive nuclear experience.

Through implementation of these recommendations and others, new nuclear projects may effectively identify appropriate financing mechanisms.

2. Introduction

Background

At the 2015 Paris Climate Conference (COP21), many countries, for the first time, committed to keep the impacts of global warming to below 2°C. As a result, countries must make substantial energy market reforms to provide consumers with cleaner energy sources.

A single energy source will not be the solution to meet the COP21 climate change goals. However, nuclear must play a role in securing a diverse clean energy portfolio. In order to guarantee the future of the nuclear industry and its part in the solution to reduce carbon emissions, financing must be secured to increase the nuclear fleet.

The IFNEC Conference on Nuclear Energy's Role in the 21st Century: Addressing the Challenge of Financing convened in Paris on 11-12 May 2016 and brought together a broad spectrum of approximately 150 stakeholders from the IFNEC countries. Stakeholders included government representatives and members of the nuclear energy and financial communities. The conference was directed at bringing together ideas on how to secure financing on new nuclear projects and bring together all key actors to better understand each stakeholder position. Through multiple expert presentations, moderated sessions, and scenario discussions, attendees acquired a better understanding of the unique challenges, approaches, and techniques to financing NPPs.

Through the discussions of the conference, key challenges and unique approaches to securing financing for new nuclear projects were identified to promote the development of a new nuclear generation in support of COP21 carbon emission goals.

Purpose of report

IFNEC members, stakeholders, and participants may utilize this report as a historical archive of the IFNEC conference proceedings, findings, and recommendations. Recommendations address solutions to the financing of nuclear projects. Each stakeholder may consider implementing or investigating these recommendations further in order to address the key challenges associated with financing new nuclear projects.

Structure of report

The report is organized by grouping together each specific session and scenario discussion. Presentations not grouped into those specific sessions are grouped into logical subject or context sections of the report. Each presentation is summarized, with final recommendations noted in the executive summary.

Conference participants at the OECD Conference Centre in Paris, France.

3. Opening remarks

The IFNEC conference opened with remarks from Mr. Edward McGinnis, Chair of the IFNEC Steering Group and Mr. William D. Magwood, IV, the Director-General of the Nuclear Energy Agency (NEA).

Mr. McGinnis set the stage for the conference by emphasizing nuclear energy's role in a nation's commitment to combat climate change. In order to meet national pledges to no more than 2°C global temperature increase, each committed nation will need to strategically invest in cleaner energy. However, every country cannot invest in a single technology to provide clean energy. Energy diversity is key to guaranteeing long-term energy supply. Most renewables are not as accessible over time as nuclear energy and are unable to provide baseload requirements. As a result, nuclear energy is an important part of the global solution to a clean electricity future.

Mr. Edward McGinnis (left) and Mr. William Magwood (right) delivering opening remarks.

Mr. Magwood highlighted that although nuclear energy is important to meeting climate goals, nuclear energy is at an important crossroads. Currently, nuclear energy faces an environment in which it is difficult to establish new nuclear projects. However, most of the reasons are highly uncertain and difficult to predict.

In addition, gaining public support has become more challenging with misperceived fears in the wake of the accident at the Fukushima Daiichi nuclear power plant. Nuclear energy is a multination business, unlike other forms of generation, which adds to the complexity of new development. Mr. Magwood challenged the audience to ask themselves, "How do we move forward?" Nuclear energy as a multination power business is very challenging.

4. Background presentations

Throughout the conference, background presentations were given by international experts.

The global energy forecast and the path forward facing the economic challenges ahead

To set the stage for the opening sessions of the conference, three speakers provided remarks. The first speaker was Mr. Ángel Gurría, the Secretary-General for the Organisation for Economic Co-operation and Development (OECD). Mr. Gurría echoed Mr. McGinnis's comments regarding the environmental demands placed upon countries from the COP21 commitments to no more than 2°C global temperature increase. Current projections for electricity demand do not indicate that nations will meet the requirements without significant electricity supplier shifts. He emphasized that this transition to a low-carbon economy is made difficult by policy misalignments in areas such as tax and electricity markets.

Mr. Gurría noted that nuclear energy alone will not solve the carbon emission issue; however, it is a large part of the solution. But, the nuclear industry must demonstrate that safety is of the utmost importance. Safety reviews and upgrades performed after the Fukushima Daiichi accident are helping to restore confidence. But public acceptance is not the only issue. Financing nuclear projects is a major challenge.

Mr. Gurría delivering his remarks.

This capital-intensive business means that the cost of finance and the design of electricity markets are crucial in mounting an investment case. Mr Gurría underlined the need to ensure that electricity markets are designed to deliver a competitive platform for low-carbon power sources, and, supported by robust carbon pricing, can provide the right investment signals to achieve a transition to a low-carbon power sector.

He also recognized that the world of nuclear technology supply and demand has changed dramatically in the last decades. New suppliers are entering the export market. More and more countries are planning to build nuclear power plants for the first time. In this context, it is important to improve the transparency of nuclear exports to build confidence in nuclear projects while ensuring that safety remains the main priority. Mr Gurría advocated that IFNEC was the ideal forum to discuss the evolving global supplier-customer relationships in nuclear exports, and ultimately to improve the conditions under which nuclear can develop and compete effectively with other low-carbon technologies.

Vital role of nuclear energy in the global climate agenda

Next, Mr. Keisuke Sadamori, Director of Energy Market and Security at the International Energy Agency (IEA) discussed, "The Vital Role of Nuclear Energy in the Global Climate Agenda." The IEA seeks to open the door to help emerging countries strengthen and broaden energy security, and promote clean energy. Nuclear energy plays a significant role in these goals.

While confirming that nuclear electricity generation remains in the competitive range, even with decreasing costs of renewables, Mr. Sadamori recognized that under current market circumstance and without a carbon price, market-based nuclear investments are unlikely. Long-term support schemes are necessary to secure financing for nuclear projects. He also underlined the importance of being able to extend the operating lifetime of current reactors, provided they can operate safely, to maintain low-carbon generation capacity.

Additionally, research, development and demonstration (RD&D) will require significant investments with strong support from governments in order to develop new technologies to realize the full potential of nuclear in the fight against climate change.

Targeted government financial guarantees for a new build project

Finally, Mr. Dong Kim, Chief Operating Officer of the US Department of Energy Loan Programs Office, provided a presentation on, "Targeted Government Financial Guarantees for a New Build Project." The loan program is authorized under two pieces of legislation: Title XVII Innovative Clean Energy Projects and the Advanced Technology Vehicles Manufacturing (ATVM). The program has USD 40 billion remaining loan authority to invest for acceleration of the deployment of innovative clean energy projects and to advance vehicle manufacturing facilities in the United States. Of that USD 40 billion, about USD 12.5 billion remains to invest in the advancement of nuclear energy.

Currently the program has USD 32 billion in debt financing in nuclear energy that includes backing the new build at Vogtle. Vogtle alone will decrease greenhouse gas emissions by more than 10 million metric ton of carbon dioxide annually. US financing decreases the risk of the project to bridge the gap between RD&D and full deployment and commercial maturity. Programs like this in nations looking to promote renewables will provide a viable mechanism for meeting COP21 emission goals.

Closing remarks

While closing the stage-setting presentations, Mr. Magwood challenged nations to translate climate goals into legislation with a broad view towards diversifying the energy investment portfolio. Nuclear is part of the global solution to achieve a low-carbon future. But the reality is that investors will only promote clean energy technologies if they bring returns on their investments. Governments have a key role to play to ensure that the

COP21 goals can be met, by re-establishing electricity markets that work as they should, and promote investments in low-carbon solutions.

Mr. McGinnis challenged the nuclear industry to do its part by:

- fully analyzing and understanding the challenges facing the nuclear industry;
- fully integrating the supply chain and its diverse regulators;
- finding innovative solutions for ensuring financing for future nuclear plants.

At these crosswords, the nuclear industry must be proactive in addressing its known and unknown challenges. Stakeholders all saw that after Fukushima, Japan shut down all of its nuclear reactors. Slowly, some of those plants are coming back online. However, carbon dioxide emissions increased significantly as Japan relied more on fossil fuels. The nuclear industry needs to regain public confidence and show the world nuclear energy's critical role in meeting carbon emission reductions.

From left to right – Mr. Gadomski (moderator), Mr. McGinnis, Mr. Magwood, Mr. Sadamori, and Mr. Kim during the first question and answer session.

Nuclear Suppliers Group, facilitating nuclear trade and cooperation through confidence

Mr. Rafael Grossi, Ambassador of Argentina to the International Atomic Energy Agency (IAEA) and International Organizations in Vienna, and Chair of the Nuclear Suppliers Group, addressed, "Nuclear Suppliers Group, facilitating nuclear trade and cooperation through confidence." The Nuclear Suppliers Group is organized to ensure that trade within the nuclear industry is executed in the proper manner and in no way threatens non-proliferation.

Mr. Grossi identified three priorities for the nuclear industry:

- nuclear safety;
- nuclear energy being seen as supporting energy security and climate change;
- non-proliferation.

Non-proliferation is of the utmost importance to the Nuclear Suppliers Group. The industry must remain agile with the evolution of technology to address existing and future threats to non-proliferation.

Nuclear New Build: Insights into Financing and Project Management

Another background presentation, based on the recent publication *Nuclear New Build: Insights into Financing and Project Management*, was given by Mr. Jan Horst Keppler, Senior Economist for the NEA. Mr. Keppler opened his presentation by highlighting the dysfunction of the current energy market. Energy prices in Europe were negative this past weekend since there was an oversupply. The energy market requires reform; however reform needs to be implemented by a robust team involving engineers and economists. In order to address the needs to secure financing for nuclear new builds, Mr. Keppler offers the following conclusions:

- electricity market design, technology choices, and carbon emissions are all linked;
- high electricity price risk results in a bias against high capital investments like nuclear;
- nuclear is more competitive with low interest rates and stable electricity prices;
- risks to bondholders are much lower than those risks to shareholders.

OECD arrangement financing rules for nuclear power projects

The final background presentation addressed, "OECD arrangement financing rules for nuclear power projects," by Mr. David Drysdale, Head of Export Credits Division for the OECD. In 1978, the members of the OECD Export Credit Group came together to form the Arrangement on Officially Supported Export Credits, which currently has nine participants (with the European Union counting as one). The arrangement is a gentleman's agreement that aims to:

- level the playing field in export credit and trade-related aid;
- create a framework for monitoring compliance;
- set out efficient resolution in disagreements.

The agreement sets the most favorable repayment official export credit terms participants may offer. In the context of nuclear power plants, the maximum repayment term (not including the construction period) is 18 years. Official support may be delivered in the form of credit insurance, credit guarantee, direct financing, refinancing, and interest rate support. The maximum support that may be afforded is up to 85% of the export contract value, and 30% of the export contract value towards local costs.

Additionally, the OECD leads a Working Party on Export Credits and Credit Guarantees (ECG). This is a formal OECD body and applies to most OECD members. This Party aims to address environmental and social impacts of export credits and to deter and detect bribery and corruption.

5. Moderated sessions

Alternatives for effectively meeting the challenges of financing nuclear projects

Mr. Ron Cameron chaired the first session focused on methods by which to effectively finance nuclear projects. Mr. Cameron specializes in securing investments for new nuclear projects as a Nuclear Specialist Adviser to the UK Department of Trade and Investment. Within this session, there were three speakers addressing the topic.

Which financing alternatives have been most effective and why?

Mr. Cameron introduced the first speaker, Ms. Fiona Reilly, Head of Nuclear Capital Projects and Infrastructure, Price Waterhouse Coopers (PwC). Ms. Reilly addressed the topic, "Which financing alternatives have been most effective and why." Within this topic she highlighted the standard nuclear funding models: government funded, corporate on balance sheet, build-own-operate (BOO), Mankala, vendor financing, and government guarantee. In present fully-funded nuclear projects, each solution is a hybrid of those standard models. In order to secure the funding under any funding model, Ms. Reilly made the following key recommendations:

- clearly establish objectives of the project;
- fully understand all available solutions;
- government must play a key role;
- establish and communicate the project structure, procurement strategy, and framework early with stakeholders;
- align and integrate the procurement and funding activities;
- engage with the all stakeholders early and in a balanced manner;
- create a manageable and realistic roadmap.

Independent, transparent and effective regulator: The role of the International Atomic Energy Agency's Integrated Regulatory Review Service

Next, Mr. Cameron introduced Ms. Adriana Nicic, Head of the Division of Nuclear Safety Technology and Regulation at the NEA to address, "Independent, transparent and effective regulator: The role of the International Atomic Energy Agency's Integrated Regulatory Review Service."

Ms. Nicic noted a key barrier to securing new nuclear investments in developing countries is gaining public and international confidence in the safe and secure construction, operation, and decommissioning of an NPP. Confidence can be established through an independent, transparent, and effective regulator. The NEA has an internationally recognized integrated regulatory review service that is available to emerging countries to evaluate and demonstrate regulatory competence that can serve to support the financing for new nuclear projects. The service provides specific country recommendations and release public reports to communicate its findings.

Multinational Design Evaluation Programme

Mr. Cameron, then, introduced the final speaker of the session: Mr. Ho Nieh, Head of the Division of Nuclear Safety Technology and Regulation, NEA. Mr. Nieh provided a presentation on, "Multinational Design Evaluation Programme (MDEP)." This program develops innovative approaches to leverage the resources and knowledge of the national regulatory authorities that are currently or will be tasked with the review of new nuclear power reactor designs. In order to secure financing, investors must be confident of the design and its certification process. Multinational cooperation through MDEP supports the convergence of codes, standards and safety goals in licensing and regulatory decisions associated with new reactor designs. These efforts serve to promote the confidence necessary for investors to support new nuclear projects.

After the presentations, Mr. Cameron chaired a question and answer session involving the speakers. During the session, Mr. Cameron noted some key issues from the speakers regarding the most effective financial alternatives. Key findings regarding securing investments include:

- pensions funds are not invested because too high risk and investment period is too long;
- projects must be built to time and budget to demonstrate project certainty and reliability;
- safety guides must be written to establish how to meet new safety requirements post-Fukushima;
- despite prior reviews and approvals, issues in the construction of new nuclear power are difficult to predict due to the high level of complexity;
- governments need to provide policy confidence and support nuclear for the long term in order to mitigate perceived political risk by investors;
- nuclear safety is of utmost importance, but requirements need to be crafted in an attainable way for projects to meet requirements;
- working relationships between the regulator must be established early with clear expectations;

From left to right – Mr. Cameron (moderator), Ms. Reilly, Ms. Nicic and Mr. Nieh in a question and answer session.

Key recommendations

All three speakers highlighted requirements in order to gain confidence from project financers. Ms. Reilly provided a broad perspective of the frameworks for investment and how to ensure its success; Ms. Nicic provided information regarding a review process that may be leveraged to establish international confidence in a new nuclear country's regulatory body; and Mr. Nieh highlighted a technical international forum, MDEP, that streamlines international licensing and safety design upgrades.

In summary, investors must have confidence in a project's success and this includes effective regulating, licensing, and technical safety. According to all three speakers, financing can only be guaranteed if:

- the regulator is effective, independent and transparent;
- nuclear safety is demonstrated in the design of the reactor;
- clear objectives of the project are established and shared early with stakeholders;
- government is involved in the financing, licensing, and regulating of the project.

Addressing those aspects of a new nuclear project will provide investors the confidence required for their financial involvement.

Alternatives for successful financial risk management

Ms. Fabienne Pehuet from NucAdvisor and Mr. Ahab Abdel-Aziz from Gowling Lafleur Henderson, LLP co-chaired the second session addressing alternatives for successful financial risk management. Mr. Abdel-Aziz opened the session remarking that the energy market is broken and there is not a lot of time spent addressing financing challenges. The co-chairs introduced four speakers who addressed this issue from multiple angles.

Financing a new nuclear plant and managing the risks; Experience feedback from the Hinkley Point C Project (UK)

First, Mr. Vakisasai Ramany, Senior Vice President of Development for New Nuclear Projects and Engineering with EDF spoke about, "Financing a new nuclear plant and managing the risks; Experience feedback from Hinkley Point C Project (UK)."

Mr. Ramany stated that risks during any new nuclear project can be broken along the timeline of the project as follows: political and regulatory risks, construction risks, operation risks, and decommissioning and waste management risks. Each of these risks must then be allocated across the stakeholders involved so they can be managed or mitigated by those best positioned to do so.

Key risks include: lack of political support in the long run, construction project management risks, and electricity market risk. For Hinkley Point C, the electricity market risks were addressed through the development of a contract for difference (CfD). The CfD is a private law contract between the UK-government-backed CfD counterparty and EDF. There is a guaranteed "strike price" set for the first 35 years of reactor operation resolving the revenue uncertainty and ensuring more than 95% of the project return recovery. From managing/mitigating these risks to secure the funding of the project, EDF learned:

- negotiations with local authorities, governments, equity partners and debt providers on new nuclear are long, tough and multidimensional;
- all stakeholders need to be engaged early in order to ensure they are fully educated at the time of the decision;

- partnerships should be adopted with local and national authorities;
- business case must be sound in order to attract investors and lenders;
- detailed audits will be requested to provide confidence to the lenders.

Options for distributing risks with financing nuclear projects

The next speaker in the session was Mr. George Borovas from Shearman and Sterling, LLP. Mr. Borovas provided a presentation that addressed, "Options for distributing risks with financing nuclear projects." The electricity market has shifted significantly from government or publicly owned to privately owned. As a result, financing new projects has become more uncertain. From the lender's perspective, Mr. Borovas broke risk into two categories: financial and reputational. The financial risks were the known standard set, but Mr. Borovas focused on the reputational risks that had yet to be addressed. These included:

- poor public social perceptions associated with nuclear power;
- political risk associated with changing policies and support;
- public acceptance issues;
- post-Fukushima environment and nuclear safety concerns;
- nuclear non-proliferation concerns;
- radioactive waste management and disposal concerns;
- historical and current experience of project delays and cost overruns.

In order to address these risks and others, Mr. Borovas provided recommendations for de-risking any new nuclear project:

- demonstrate a culture of safety within the project otherwise regulatory delays should be expected;
- select a design that has been recently and successfully constructed with a proven supply chain;
- manage projects through an integrated project delivery team with personnel that have experience building new nuclear projects;
- choose owners that have experience managing large construction projects;
- employ sound project management techniques in which the owner is largely "hands off" permitting the vendor to implement;
- establish an owner-vendor working partnership aimed at implementing the contract together;
- identify clear and established mechanisms for interacting with the regulator and encourage cooperation across regulatory bodies;
- ensure the host country has mechanisms to support the import of a nuclear project;
- execute human development early to ensure the local population supporting the new project has the skills necessary.

Does risk differ with the deployment of small modular reactor technology?

Next, in the session, Mr. John Hopkins, CEO of NuScale addressed, "Does risk differ with the deployment of small modular reactor (SMR) technology?" NuScale is one of the world leaders in SMR development. The business case for SMR projects may be much more attractive to investors because of reduced risk in the following areas:

- construction;
- technology;
- regulatory;
- safety;
- operation;
- societal.

Additionally, the upfront capital investment for nuclear power comes down from around USD 10 billion to USD 3 billion. Finding investors for projects with a much smaller initial capital investment and a much earlier return on investment is significantly easier. Most nuclear plants take 5-7 years to begin operations and providing a return on investment. However, SMRs are expected to be able to be fully installed (12 x 50 MWe modules) within 40 months. Given all of the risk reductions that SMRs provide, they may be a much more appealing nuclear power investment.

How to effectively address the financial risks associated with nuclear projects

Finally, Mr. Carl Cho of Citigroup addressed, "How to effectively address the financial risks associated with nuclear projects." Mr. Cho addressed the key financial risks associated with large-scale infrastructure projects. These key risk include:

- large upfront capital investments requiring multiple lenders with more moving parts;
- long-term investments given that project return breakeven occurs late into the plant's operation;
- power purchase agreement (PPA) may inadequately address market price for power in the long term;
- project completion risk is a challenge nuclear projects for multiple reasons and plants must be completed on time and budget;
- nuclear operating risk presents itself in the safety and reliability of the nuclear power plant;
- regulatory changes may require additional physical changes to the plant during construction or operation that affect costs.

Mr. Cho demonstrated through case studies that there is money available for large upfront capital investments in electrical infrastructure. However, nuclear faces unique challenges that make it less favorable for investment in a privatized market. The US plants (Vogtle and Virgil C. Summer) are funded through a tariff structure that will increase through the completion of the projects. Established utilities fund investments for construction on their balance sheets. Both US new build projects have had cost overruns and scheduled delivery delays. In order to secure investments, the ability of the utility and vendor to demonstrate the delivery of nuclear power plants on schedule and budget is key to instilling confidence.

From left to right – Ms. Pehuet (moderator), Mr. Abdel-Aziz (moderator), Mr. Borovas, Mr. Cho, Mr. Hopkins and Mr. Ramany in a question and answer session.

Key recommendations

Each presentation within this session addressed the risks and challenges the nuclear industry faces that impact securing financial investments. The key risk facing financing for new nuclear projects include:

- operational safety of the power plant;
- long-term revenue uncertainty with changes in the privatized electricity market;
- long-term political support instability;
- large upfront capital investment requiring complex deals;
- long-term investments that cannot begin returns until the plant is constructed and operating, reaching breakeven many years into the operation of the power plant;
- regulatory changes impacting construction and operation;
- project completion risks associated with constructing to schedule and budget.

In order to secure financing, projects will need to implement proper risk mitigation mechanisms to provide confidence in financial returns. Throughout the presentations, the following key mitigation techniques were identified:

- demonstrate a culture of safety and establish early relationships with regulators;
- choose proven and safe technologies with established supply chain;
- employ sound project management;
- leverage contracts and unconventional models for ensuring long-term revenue stream;
- choose project owners with demonstrated experience managing large construction projects to schedule and budget;
- vendor should have an integrated project delivery team with experience in building new nuclear projects;
- SMRs provide a unique opportunity to reduce risk and attract investors.

There is no prescribed approach to ensure the financing for a new nuclear project. The key to every investment is negotiating mechanisms to adequately address and distribute risk to gain the confidence of investors.

Establishing confidence in future pricing and return on investment

The third session was chaired by Mr. Paul Murphy with Gowling WLG. The session addressed the need to establish confidence in future electricity pricing and guaranteeing a return on investment from nuclear power plants. Within this session, there were two speakers: Mr. Jeremy Allen and Ms. Fabienne Pehuet.

The UK perspective: The role of long-term electricity price guarantees

The first speaker was Mr. Jeremy Allen, Head of Procurement and Investor Relations for the Department of Energy and Climate Change in the United Kingdom. Mr. Allen addressed, "The UK perspective: The role of long-term electricity price guarantees." The United Kingdom is pursuing nuclear power to promote three key policies: security of supply, affordable prices, and carbon emissions reductions. As a result, the United Kingdom has identified nuclear power as a part of that solution and industry has put forward plans to increase nuclear power's electricity contribution to 30-35% of the total by 2035.

Mr. Allen delivering his remarks.

Hinkley Point C is the first reactor to employ the CfD approach to secure financing for a new nuclear plant. The CfD is a private law contract between the electricity generator and the government-owned Low Carbon Contracts Company (LCCC). This contract provides a stable platform for investment by ensuring that the generator will be paid the difference between a market reference price and the "strike price" agreed to in the contract for 35 years of plant operation. The strike price can be adjusted at fixed points over the duration of the period to reflect changes in certain costs. There are incentives for the delivery of the project early and if savings are achieved, the savings will be shared. Additionally, if project performance or equity sales provide returns above the base case, those additional returns would be shared for the lifetime of the asset.

In addition to the CfD, the UK government and EDF reached a separate agreement acknowledging the political risk associated with the project. In the event of a political shut down of the plant, the plant stakeholders will receive compensation.

Finally, the last piece of the Hinkley Point deal is the establishment of a funded decommissioning program (FDP) that must be approved. The negotiated "strike price" covers the required funds set aside for waste management and decommissioning. The operator must demonstrate a comprehensive program before operation may begin and is

expected to enter into a waste transfer contract (WTC) with the government to transfer the title and liability of spent fuel for a fee.

Through these primary three mechanisms, the UK anticipates the secured financial investment for the Hinkley Point C new nuclear power plant. The negotiation process was complicated and involved multiple moving parts; however, reaching an agreement was possible.

What approaches can be used in new builds to attract private capital that provide confidence there will be an adequate return on investment?

The second, and final, speaker of the session was Ms. Fabienne Pehuet from NucAdvisor to address, "What approaches can be used in new builds to attract private capital that provide confidence there will be an adequate return on investment?"

Ms. Pehuet delivering her remarks.

One of the specific features of NPPs projects is that 80% of the financial investment occurs prior to plant operation, while future operating costs are very predictable over the plant life time (60+ years). Mitigating construction risk and revenue risk is thus very important to attract investors and provide confidence there will be adequate return on investment. Appropriate risk allocation and risk management among owner(s), lender(s), and vendor are key to mitigating construction risks such as long lead times and size of the projects, technology risks especially for first-of-a-kind (FOAK) projects, and complex regulatory environments. Financial institutions (banks, export credit agencies) and Regional Institutions play a central role in this process by securing financing as well as improving projects' overall governance through their required rules and principles.

Nuclear power programs are being financed and funds are available, but financers/investors require construction and revenue risks to be hedged through sophisticated mechanisms such as the CfD implemented for the Hinkley Point C Project in the United Kingdom.

Liberalized electricity markets do not provide for predictable energy prices to ensure future revenues. As a result, the revenue risk must be mitigated through mechanisms like long-term PPAs, offtake arrangements, and tariff schemes. Nuclear projects do not meet the requirements for pure project financing. Ms. Pehuet illustrated how three nuclear projects are being financed, combining sophisticated risk allocation, bank loans,

equity, direct or indirect government guarantees, and visibility over future revenues: i) TVO for the OL3 project in Finland, ii) EDF for Hinkley Point C in the United Kingdom, and iii) the four investors in the Vogtle project in the United States. Recent projects schemes show a new investor's profile, where the key players directly address the main underlying risks and nuclear vendors can be requested to take an equity or debt interest in the project. The vendor can go as far as taking overall responsibility of a project, with or without government backing. (For the Akkuyu project in Turkey the vendor bears financing risk, construction risk, operational risk and some electricity market risk.)

In order to attract private capital, the industry needs to demonstrate that power plants may be brought on line meeting schedule and budget and negotiate agreements with governments to set the conditions necessary to establish an acceptable level of revenue certainty.

Key recommendations

Securing revenue returns is a key component to soliciting financing for new nuclear power plants. This has become much more challenging in the liberalized electricity market. As a result, industry has needed to employ sophisticated mechanisms to ensure electricity price guarantees. Additionally, the nuclear industry must address construction risk and employ appropriate construction risk sharing to attract investors.

Innovative finance solutions for investment in clean energy

The fourth, and final, session was chaired by Mr. Chris Gadomski from Bloomberg and addressed innovative solutions to secure financing for clean energy. With many countries committing to the goals of COP21, nations are looking for mechanisms to ensure clean energy growth in a liberalized electrical market. These solutions are complex and may have unintended consequences. These presentations addressed such mechanisms and their relation to nuclear energy.

The impact of carbon pricing

The session was comprised of two presentations. The first presentation was by Mr. Edward Kee, CEO of Nuclear Economics Consulting Group and addressed, "The impact of carbon pricing." In order to address carbon emissions, multiple nations have employed carbon pricing schemes to promote clean energy. This is described in a recent World Bank report. These carbon pricing schemes have had minimal impact on reducing carbon emissions largely because carbon prices are too low to force changes in energy production. However, a higher carbon price would likely not be ideal as it would negatively impact economies and not gain popular support from voters and governments. Additionally, revenues from carbon taxes could be refunded to make the program revenue neutral with respect to the overall economy, but it has been found that governments can use carbon tax revenue for other purposes than refunds.

Implementation of any carbon pricing program is not straightforward. Over half of greenhouse gas emissions come from the agriculture sector, not easily managed by carbon pricing programs. A primary focus of carbon pricing is the energy (including electricity) sector. A long-term goal is to "de-carbonize" the electricity sector entirely.

Mr. Kee delivering his remarks.

Decarbonizing the electricity sector requires a massive long-term shift in energy generation technology and assets. Mr. Kee concluded that politically feasible carbon pricing will not cause this shift, and no nuclear power project has been developed because of carbon pricing. Further, the low-level, indirect benefits, and uncertainty associated with carbon pricing do not provide the revenue levels and long-term revenue certainty required for nuclear investments.

The subsidies and favorable treatment of renewable energy technologies have largely been justified by the potential for carbon reduction. Nuclear has not received the same subsidies and favorable treatment as renewable projects despite nuclear having lifetime greenhouse gas emissions similar to (or even lower than) renewable generation. Mr. Kee further concluded that because carbon pricing will not be enough to drive nuclear investment, carbon pricing is not likely to ensure that COP21 goals are reached.

Mobilizing the bond markets for a low-carbon transition

The second speaker of the session was Mr. Christopher Kaminker, economist from the OECD addressing, "Mobilizing institutional investors and bond markets for a low-carbon transition." Presently, less than 1% of all pension funds are invested directly in unlisted infrastructure equity (projects) and less than 3% of that is invested in renewable energy. This is because there are multiple barriers to investment:

- uncertain or counterproductive energy and climate policies;
- regulatory policies with unintended consequences;
- lack of suitable financial vehicles that can attract institutional investors;
- lack of information to assess investments and the underlying risks/returns.

Mr. Kaminker delivering his remarks.

To address approaches to overcome these barriers, the OECD published a report titled, "Managing Channels to Mobilize Institutional Investment in Sustainable Energy." Within the report, there are eight key recommendations:

- establish preconditions for institutional investment;
- ensure a stable "investment grade" policy environment;
- address market failures;
- provide a national infrastructure roadmap and pipeline;
- facilitate development of liquid financing instruments and risk mitigations;
- promote market transparency, disclosure, standardization and improve data availability;
- reduce the transaction costs of green investment;
- establish a "green investment bank" or refocus existing public financial institutions.

The underlying theme regarding the promotion of investments in green energy is a strong commitment and backing from the national government in order to secure the proper confidences in revenue certainty. Investors do not invest in energy solutions just because they are green and may hedge climate change risk. They invest in order to secure proper risk-adjusted returns on investment.

The OECD, in cooperation with the International Energy Agency (IEA), the International Transport Forum (ITF) and the NEA, produced *Aligning Policies for a Low-Carbon Economy,* [1] a report that identifies misalignments between climate change objectives and policy and regulatory frameworks across a range of policy domains (investment, taxation, innovation and skills, trade, and adaptation) and activities at the heart of climate policy (electricity, urban mobility and rural land use). Our societies have been hard-wired around fossil fuels for well over a century; as a result, we are living with many regulations and institutions that were designed to make a fossil economy work. That wiring will fight against even quite ambitious climate policies. In addition to a well-

1. www.oecd-ilibrary.org/environment/aligning-policies-for-a-low-carbon-economy_9789264233294-en.

balanced package of carbon pricing, energy efficiency measures and targeted support to low-carbon technologies, therefore, a cost-effective transition will require governments to address these misalignments. According to the FASTER principles[2] for carbon pricing developed by the OECD and the World Bank Group, we know from experience that **well-designed** carbon pricing schemes can be a powerful and flexible tool that can cut emissions that cause climate change. Properly designed and implemented, they can play a key role in enhancing innovation and smoothing the transition to a prosperous, low-carbon global economy.

Key recommendations

In addressing financing solutions for clean energy, both presenters highlighted the need for a strong political backing for clean energy deployment. The current liberalized electrical market is broken and has led, in many places, to negative energy prices. As a result, the revenue stream is highly uncertain.

Additionally, political support for clean energy in many countries has been weak and ever changing. As a result, unless appropriate mechanisms are in place to guarantee investment returns, industry will not invest in clean energy. Renewable energy has largely been segregated and protected from the general electrical market with government backing and revenue guarantees. In order to meet COP21 climate change goals, the electricity market must diversify with a transition to a clean base for energy. In order to do that, nuclear will need to play a key role in providing baseload requirements. This means that nuclear needs to be treated more like renewable energy and not be subject to the standard market conditions facing traditional energy production operators.

2. www.oecd.org/environment/tools-evaluation/FASTER-carbon-pricing.pdf. The FASTER principles for successful carbon pricing include: i) fairness, ii) alignment of policies and objectives, iii) stability and predictability, iv) transparency, v) efficiency and cost-effectiveness, and vi) reliability and environmental integrity.

6. Special guest speakers

On the second day of the conference, Mr. McGinnis and Mr. Magwood welcomed three special guest speakers. These speakers included:

- Ms. Agneta Rising, Director-General, World Nuclear Association;
- Mr. Jean-Pol Poncelet, Director-General, FORATOM;
- Mr. Gerassimos Thomas, Deputy Director-General for Energy, European Commission.

Global commercial state of play and the current role of financing

Ms. Agneta Rising represented the World Nuclear Association (WNA), an international organization representing the commercial nuclear industry. She noted that nuclear energy is ranked among hydroelectric and wind power for its low-carbon dioxide emissions for the full lifecycle. The World Bank employs an environmental and social framework by which it identifies investments, and nuclear meets all of those requirements. However, the World Bank is still not investing in nuclear energy.

Ms. Rising answering questions.

Ms. Rising emphasized that there is no question nuclear energy needs to be a significant part of the solutions for meeting environmental goals. However, mobilizing private-sector financing has been challenging. Currently, according to McKinsey & Co., there is USD 1.6 trillion a year invested in all forms of energy infrastructure projects. However, to meet future carbon emission requirements, McKinsey estimated the need to invest USD 2.7 trillion a year through 2030 (McKinsey & Co., 2016, *Financing Change: How to mobilize private sector financing for sustainable infrastructure*). Of this amount, the World Nuclear Association estimate that a total of USD 1.2 trillion will be invested in nuclear energy generating plants to 2030 under currently known plans. As a result, the industry

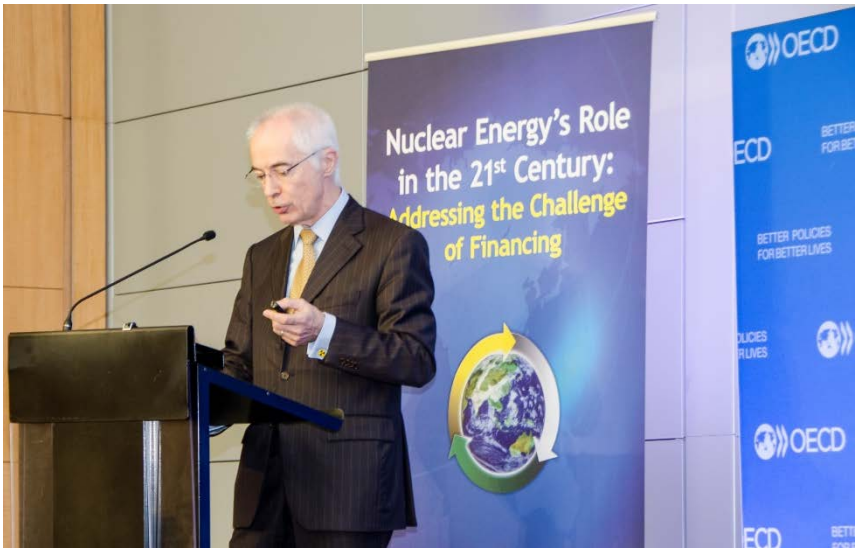
must understand the requirements for investors. Developers and operators need to have a secure long-term revenue stream. Investment banks need to secure returns on loans. Insurance funds investors require liquid equity stake with steady returns. Understanding these needs enables industry to create innovative solutions to attract investments. In order to do this, Ms. Rising stated that industry must work with nations and stakeholders to:

- level the playing field for all low-carbon technologies;
- harmonize regulatory processes internationally;
- implement an effective and socially accepted safety paradigm.

Only through these mechanisms will nuclear energy be able to effectively be a part of the solution to meet climate goals.

Addressing the financing challenge – An industry perspective

Mr. Jean-Pol Poncelet, Director-General of FORATOM, the voice of the European nuclear industry presented on the industry perspective on addressing the financing challenge. Within Europe, in particular, nuclear energy faces numerous hurdles. The first, and primary hurdle is the division across the European Union (EU) regarding policies relating to nuclear energy. Countries right next to each other may have completely divergent policies on nuclear energy. As a result, it is nearly impossible to harmonize international regulation.



Mr. Poncelet delivering his remarks.

Mr. Poncelet noted that in addition to policy, nuclear energy faces unique challenges associated with the liberalized energy market. These include:

- inability to recover investments as indicated by the price signal;
- inadequate taxing schemes to promote renewables;
- specific taxes on nuclear energy;
- no incentives for security of supply.

These challenges must be alleviated in order to allow nuclear investments. To do that, FORATOM recommends that nations:

- ensure transparency of all system costs;
- reorganize market to ensure system costs are internalized by suppliers;
- internalize carbon climate costs into electricity prices;
- level the field between all low-carbon energy sources;
- award security of supply as part of long-term and short-term perspectives;
- instill confidence with regulatory stability;
- harmonize European regulation;
- support long-term contracts.

Addressing the financing challenge – A European Commission perspective

Mr. Gerassimos Thomas, Deputy Director-General for Energy at the European Commission spoke regarding political views on nuclear energy. Although he agreed with the recommendations and conclusions of the presenters, he highlighted the difficulty to convince members to support and execute.

Internationally, the nuclear industry has failed to get explicit acknowledgment that nuclear energy is a key ingredient to a low-carbon future. This lack of recognition is largely due to political and social uncertainty regarding the safety of nuclear energy, resulting in a bias towards certain renewables.

Mr. Thomas delivering his remarks.

The European Commission recognizes that the liberalized electricity market is flawed. The Emission Trading Scheme (ETS) in place has not been successful in driving low-carbon energy investments. However, the initial mechanisms are presently employed to permit the reform and implementation of a successful scheme.

Additionally, Mr. Thomas noted that the commission must ensure that government intervention within the market is reduced, especially with its explicit support of renewables. The commission seeks to address the failures of the entire electricity market

before it can begin to address the specifics of nuclear energy. As a result, proposals are presently solicited through the end of the year for market reform recommendations.

The nuclear industry, however, has a role in ensuring its future. Within Europe, nuclear new builds have demonstrated significant cost and schedule overruns. An increase from seven to ten years to build a plant doubles its financing cost. The nuclear industry must be able to deliver projects as anticipated. Additionally, the supply chain needs to be integrated and competitive with other renewables.

7. Country-specific approaches to financing

On the second day of discussions, the afternoon session opened with multiple presentations highlighting the key approaches to funding new nuclear projects employed by Russia, China and the United States. These discussions were directed at identifying approaches that have been successful in order to offer solutions that may be employed in other nations.

Russia

Mr. Alexander Bychkov from Rosatom presented on behalf of Mr. Vyacheslav Ivanov about Russia's approach to financing new nuclear projects. Presently, Rosatom has 43 new reactors in progress, 25 in the process of negotiations, and an additional 24 potential projects. Mr. Bychkov stated that financing of exported nuclear projects are driven by:

- economic and credit metrics of the host country;
- selected business model for the nuclear project;
- bilateral relationship between host country and Russia.

The present models employed and advocated by Russia are the engineering, procurement and construction (EPC) model and the build-own-operate (BOO) model. The EPC model entails a full handover upon project completion and often requires debt financing. Rosatom can execute these projects in a relatively short time frame and gains no equity in the transaction. Under the BOO model, Rosatom must have an appetite for equity and requires a long-term PPA. Rosatom does have the benefit of leveraging Russian sovereign funds in order to finance new projects. However, through these models, it is able to partner with global and local suppliers and providers to continue to advance the nuclear industry globally.

Mr. Bychkov delivering his remarks.

China

Ms. Zijiao Xu presented on behalf of Mr. Sunjiao Chen regarding China's approach to financing new nuclear power. China leverages its China Development Bank (CDB) that was established in 1984 to finance medium to long-term loans for infrastructure development.

China signed the Paris Agreement committing to decreasing its carbon emissions. In order to meet these goals, China must build six to eight new nuclear reactors per year. By 2020, China will reach 58 GWe power delivered by nuclear power (from the present 25.5 GWe). These projects are funded through project or corporate financing. In support of these new projects, CDB recommends:

- assessing and disclosing safety risk of operating nuclear power plants;
- completing of technical standards for retirement and life extensions;
- emphasizing the low-carbon emissions of nuclear energy;
- developing new nuclear power technologies.

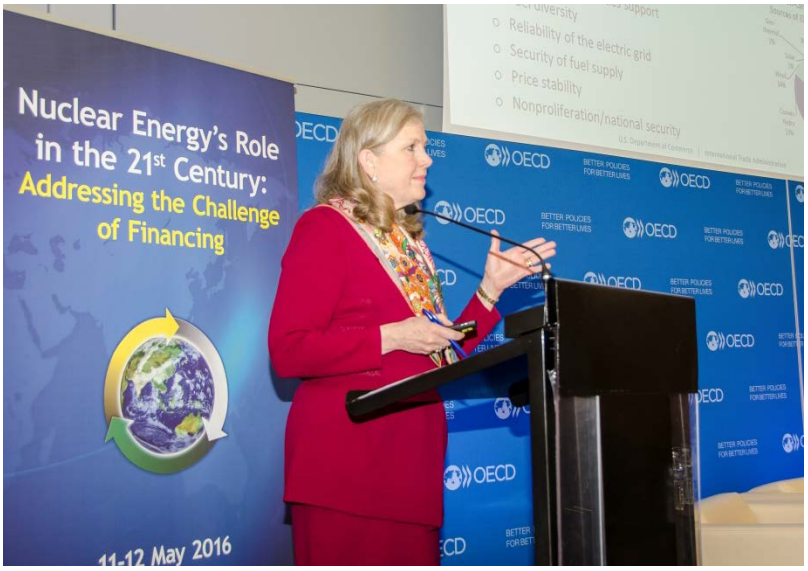
Ms. Zijiao Xu delivering her remarks.

United States

Ms. Diane Farrell, Deputy Assistant Secretary for Asia International Trade Administration from the US Department of Commerce addressed the US approach to financing. In order to finance new nuclear projects, the project must meet the following criteria:

- safe technology;
- stable host country government with a strong commitment;
- independent, transparent and effective regulator;
- trained and knowledgeable human resource base;
- managed environmental risk;
- commitment to international treaties and standards;
- sufficient host grid size and stability;
- sound economic decision.

The United States has multiple governmental organizations working together to promote international nuclear energy. The Export-Import (Exim) Bank of the United States serves as an investor to support projects to fill gaps where private financing is unavailable. The Exim Bank supports a broad range of goods and services, to include nuclear plants. Across the world, the Exim Bank has financed nuclear projects in 12 different countries.



Ms. Farrell delivering her remarks.

8. Hypothetical case study exercises

Scenario roles

The hypothetical case study exercises consisted of various scenarios where multiple participants played unique roles and considered the scenarios through different lenses. The participants viewed the market differently, which allowed for an engaging discussion about how to approach financing solutions for new nuclear projects. In both exercises, participants filled the following roles:

1. Country represented by the Ministry of Energy, comprised of four roles:
    - Energy Planning Authority as NPP proponent representing government energy policy;
    - project consultant supporting the Energy Planning Authority on financial/technical/legal matters;
    - electricity market regulator representing short- and long-term consumer interests;
    - national utility as investor (or vendor "partner" in a BOO arrangement).
2. Financing sources represented by:
    - vendor as investor or lender (ECA), (meant to encompass BOO arrangements and related variations);
    - banker as lender;
    - NPP financing expert supporting investors and lenders (recognizing that in reality each entity would have its own experts).

Newcomer country in a regulated market

The first scenario addressed a small newcomer country looking to pursue nuclear power to address energy needs. Specifically, the newcomer country:

- has a central government that has a lead role on major economic/infrastructure decisions through a national energy policy;
- is seeking to optimize financing alternatives to introduce nuclear power into its energy mix with the primary justification being energy security (in-country energy resource production is projected to have difficulties in the future in keeping up with demand); reducing carbon emissions is recognized as an important goal but is not driving the interest at this time in nuclear;
- has a regulated electricity market structure with a national utility, single buyer model;
- has a current installed electricity capacity of 20 000 MWe.

From left to right – Mr. Gadomski (moderator), Mr. Samson, Mr. Herdem, Mr. Kee, Mr. Araj, Mr. Surina, Mr. Cho and Ms. Reilly participating in the scenario.

Within the session, key considerations for the introduction of nuclear generation are that:

- the government is in no position to finance a 1 000 MWe reactor (it is, however, willing to develop the national physical and human resources infrastructure to support the reactor project);
- the government has limited capability to provide meaningful financial guarantees of direct debt that would attract the interest of investors;
- if the country wanted to pursue a PPA approach to support financing, the government would likely have some ability to commit to price guarantees.

However, on the positive side:

- The economic growth and electricity demand for the country are projected to be strong into the future (adding 1 000 MWe baseload within 15-20 years can be justified based on growth projections); the country needs "in excess of" 1 000 MWe of new build to support demand growth plus it needs to replace existing generation; further, additional baseload generation will be needed to replace existing power sources as their operating lives expire and/or are replaced by cleaner forms of generation to meet climate change targets.
- A regulatory authority is in place that has experience with the country's research reactor.
- The government, employing experienced consultants, understands, and is prepared to financially support establishing the in-country regulatory capabilities needed to assure the safety of both construction and operation, as well as the grid upgrade requirements needed to meet the growing electricity demand whether the NPP effort succeeds or not.

In order to facilitate discussion, the participants were asked to address the following key questions:

- What should the Ministry of Energy consider to secure the necessary financing and make the project happen, and how should those options be most effectively combined or prioritized?
- How can different procurement approaches make a difference? At a first look, the government is going to have to focus on vendor finance (against direct government guarantee or backing of the project, or the government guarantee of long-term rates and revenues, or a build, own, operate procurement), government-to-government deals, overseas development assistance (ODA), and/or international development banks (IDBs). The last two are currently more theoretical than practical. As for the vendor finance efforts, they would be negotiated with the vendor by the government.

- At this point in the country dialogue on introducing nuclear capacity, the potential impact on consumer electricity prices, or the level of government subsidy or financial exposure, have yet to be developed. In considering financing approaches, should, and if so how should, this subject be considered?

Key outcomes

At the conclusion of each session, participants were asked to identify ten key outcomes resulting from the conversation. The key outcomes to address financing of a newcomer country were:

1. **Confidence in future revenues**: A requirement for securing financing is establishing confidence in future revenues from electricity sales:
   - If a government-owned utility is the NPP buyer, the government's ability to recover costs by controlling rates, potentially combined with government guarantees, would support financing.
   - Another option is to have the NPP owned by a separate entity that sells power to the government utility pursuant to a PPA. The new entity should be able to finance the nuclear power plant with cash flow certainty because of the PPA with the government utility. Depending on factors that include: i) the terms of the PPA, ii) the creditworthiness of the government utility, and iii) whether the government utility obligations are considered obligations of the government, the PPA may need to be supported by a guarantee from the government.
   - Another option is a combination of the first two options where a PPA is created and a special purpose entity (SPE) is established as the owner of the NPP that has significant equity or debt participation by the government utility.
2. **Role of vendor, design and operator**: The vendor, NPP design and operator are important credit risk factors:
   - Lower credit risk will be present if the selected vendor has a proven track record of delivering NPPs (using the design selected) on time and on budget. Lower credit risk will also be present if the selected NPP design has been certified by the nuclear safety regulator in the country of origin (if the building country has agreed to accept country-of-origin safety approvals) or in the country where the NPP will be built (this may take longer, depending on the capability and competence of the nuclear safety regulator).
   - It is possible that an NPP vendor may be willing to take significant commercial risk and offer lower prices for their first export project. In some instances, procuring a vendor's first export nuclear project might be attractive, despite the risk of combining a first export project with the buying country's first nuclear power project (e.g. as in the United Arab Emirates [UAE]).
   - The experience of the operator, who under most liability regimes is responsible for the consequences of the operation of the plant, is also an important factor for credit risk of the project. There are several ways to secure an experienced operator that include having the expertise and experience provided through an equity partner, and implementing an operational readiness plan that builds the expertise into local resources that are supplemented by international support.
3. **NPP ownership**: Ownership of the project can be through the government utility, an independent power project (IPP) owned by a third party, or an SPE created by the utility with the assistance and participation of the vendor. The details of the ownership will have an impact on project costs. The PPA terms, government guarantees, and other credit support for approaches using an IPP or an SPE may be significantly more expensive than direct government ownership with government

financing. The necessary return on investment for IPP or SPE equity investors may be high, reflecting the risk associated with a new NPP in the country. Direct government utility ownership will be least expensive from a financing point of view, but may require other costs (e.g. contracting for an operations and maintenance [O&M] operator) and may take longer as the government utility develops a capability to build, own, and operate an NPP. The details of the overall arrangement will be examined closely by lenders and rating agencies.

4. **Pass through of costs**: Whether the NPP will be owned by the government utility, or the government utility will be an off-taker of electricity through a PPA with an IPP or SPE owner, clarity on how NPP costs will be allowed to pass through is very important. If there is any question about how this will work or any doubts that costs will be recovered, credit risk will increase along with financing costs. If the costs are to go to ratepayers, the potential for rate shock or other problems must be addressed. If the costs will be recovered partly from ratepayers and partly through government subsidies, there must be a very clear view of how the government subsidies will work and lenders will likely require a government guarantee of these subsidies.

5. **Role of safety regulator**: Financing entities will need a basis for confidence in the capability and independence of the nuclear safety regulatory body. Most important is a clear view of whether the NPP will be subject to operation interruptions that will cause revenue/profit problems and whether the nuclear safety regulator will impose additional costs (capital or operating) on the NPP over time. A clear view of the decommissioning requirements and funding approach is also important, even though it is 60 years or more in the future, because it is a contingent liability on the equity owner.

6. **Completion risk and stability**: Completion risk is the greatest concern during the construction of the NPP. Lenders and rating agencies will want to understand all relevant factors related to completion risk. In addition, political risk will be important; broad based support, stability, and commitment of the government will be essential.

7. **Distribution of risk**: The NPP vendor will want the buying country to assume significant risk. The buying country will want the vendor to do the same. Agreements on how risk will be distributed will be key. The selection of a project structure (i.e. government utility, IPP, SPE) will also work to assign risks. Within the project structure, the details of each major contract will also serve to assign risks.

8. **Address potential conflicts of interest**: Banks will look for the absence of conflict between equipment supplier/warranty provider and the equity investors. When the vendor is also an equity participant, the conflict between these two important roles needs to be recognized and dealt with contractually. The issue here is that the equity ownership may make decisions that are favorable to the vendor, to the potential detriment of other equity partners and/or lenders.

9. **Neighboring countries**: Consideration can be given to expanding the electricity grid to neighboring countries to support the case for financing. If there are no existing grid connections and electricity export arrangements before the NPP project, it may be difficult to convince lenders or rating agencies that such export arrangements are viable. A better approach would be to use existing grid connections and electricity sale arrangements with neighboring countries to structure PPAs and even equity investments with the neighboring countries to help provide credit support to the project.

10. **Export Credit Agency (ECA) funding**: Maximize opportunities to secure ECA funding. This may help lower the cost of financing, may reduce the amount of financing needed, and, more importantly, will provide comfort to other lenders. These ECA arrangements will mean that one or more exporting country has conducted due diligence and has decided to take financial risk in the project.

Country with existing fleet in liberalized electricity market

The second scenario addressed the addition of an NPP in a country with an existing fleet and a liberalized market. Specifically, the developed country:

- has a liberalized electricity market structure seeking to find an overall market design that balances:
  - the desire have a diverse energy portfolio that promotes price stability;
  - the need for baseload investment to meet future demand; and is
- seeking to make meaningful progress towards carbon reduction goals; the country needs to make a significant transformation in its current and future energy mix to achieve its carbon reduction goals; and
- there currently exist a 60% level of public support for nuclear and the government understands that such support will need to continue in order for the project to go forward.

In addition, the following are key components to the environment:

- The government policy explicitly supports nuclear power expansion, with meeting carbon emission goals with baseload generation as the primary basis for that policy.
- The government has left open the issue of its participation in partial ownership of the plant, and supports the consideration of reasonable modifications to its existing market structure, if necessary, to make investment in a new NPP feasible.
- The possibility for some yet to be identified government commitments necessary to support the development of an NPP have been recognized, and remain on the table for discussion.
- The electricity market regulator provides the focal point for market reform and the country's liberalized market is continuing to evolve.
- There is strong public support for further efforts to more effectively promote a diversified and secure supply of low-carbon energy; competition, either in short-term markets or for long-term contracts would be desirable but is not an end in itself.
- The interest in promoting electricity market competition continues to fall in direct opposition to the critically important national interests in:
  - having an approach for government to express its preference for certain types of generation technologies rather than relying only on market entry;
  - long-term baseload demand/production planning;
  - investing in high capital cost generation sources such as nuclear that are essential to meeting the national carbon emission goals (and other national objectives, including diversity of fuel type, reliability, etc.).

Which approaches can leverage the existing market structure to attract sufficient financing for the nuclear power plant project with minimum necessary role for the government?

In order to facilitate discussion, the participants were asked to address the following key questions:

- What is the optimal design of the market structure and government involvement in the project?
- Possible avenues for financing are carbon taxes (which establish a floor for electricity prices and make low-carbon power more attractive; consider, too, that carbon taxes could be reinvested in clean energy generation) as well as additional revenue streams for capacity provision, diversification and availability organized by the regulator.
- While there is broad public support for nuclear, the specific country dialogue on adding additional nuclear capacity, its potential impact on consumer electricity prices and the extent of government involvement or financial exposure have yet to be develop. How should, this subject be considered in considering approaches to market structure?

From left to right – Mr. Gadomski (moderator), Mr. Samson, Mr. Borovas, Mr. Kee, Mr. Araj, Mr. Surina, Mr. Cho and Mr. Murphy participating in the scenario.

Key outcomes

At the conclusion of each session, participants were asked to identify ten key outcomes resulting from the conversation. The key outcomes to address financing of an NPP in an existing market are:

1. **Role of market structure**: Current merchant/deregulated electricity markets will not provide the necessary certainty to financiers (both debt and equity) that would be necessary to support nuclear and current low-carbon goals; the challenge is to identify needed changes to the electricity market that will create conditions that support the building of an NPP. The simple answer is to re-regulate the market, but that may be politically untenable in most countries. Other approaches might include the government developing market mechanisms such as CfDs with large retail utilities.
2. **Bases for market reforms**: The impetus for the necessary level of market reform needed to support the development and financing of NPPs can be based on the need for baseload nuclear power to support goals such as desirable security of supply, grid stability, and carbon emission goals.

3. **Loan guarantee programs**: As presently construed, government loan guarantee programs, absent other key factors, are not enough to support NPP development. It needs to be recognized that such programs in the United States and the United Kingdom have not addressed risk transfer.
4. **Market certainty and dispatch priority**: Market price certainty and dispatch priority (absent a "take or pay" approach) need to be addressed in a manner to support financing.
5. **Load following**: Load following capability could be one way to address dispatch issues; however, absent certainty on minimum price and minimum dispatch, NPP development and financing will remain challenged by market factors. An alternative would be a "take or pay" PPA. Another approach is to pay the NPP owner for load following services, as Ontario does for Bruce Power.
6. **Role of integrated resource plan**: A country that is considering an NPP needs an integrated resource plan, that recognizes the need for stable and reliable carbon free generation, as well as designing the market (either directly or indirectly) to the support NPP development. The political support for, and acceptance of, this resource plan will be important in the assessment of credit risk. In the most ideal situation, the accepted resource plan would have the force of law.
7. **Government assuming risks**: Given current markets and recent NPP history, there is a strong rationale for the host government to step up and accept a reasonable portion of the risk associated with NPP development and financing. There are high risks (difficult to finance) associated with the development and construction period, and much lower risks (easier to finance) during the operation period. The host government can take financing pressure off of the project during the risky period, perhaps taking an equity stake that it then divests after the initial operating period (through first fuel reload) when new investors would consider taking a partial ownership stake in the operating asset.
8. **Approaches to managing risk**: Ways to manage risk include picking an experienced vendor and proven technology to increase delivery certainty, as well as engaging an experienced operator to reduce operating risk.
9. **Market must support long-term investments**: Given the nature of an NPP (high upfront costs; high risk during the development and construction period; challenging financing; long, 60-80 year operating period for Gen III/III+ reactor designs, market price certainty is required to promote financing. Unfortunately, most financiers have a focus on the short term, and deregulated markets further perpetuate short-term thinking. As a result, market mechanisms to support long-term investment need to be developed. The market has to accommodate long-term objectives with structures such as CfD (United Kingdom) or tariff pass through (United States in its regulated markets). One method to promote long-term offtake certainty is to consider a long-term PPA that is guaranteed by the government and that is insulated from political force majeure. Of course, such a PPA will need to have a credit-worthy counterparty.

9. Acknowledgments

The IFNEC Finance Conference was the result of significant creativity and contributions from many individuals and organizations. A broad spectrum of stakeholders was brought together from various countries and aspects of the industry to reach a joint understanding of each's roles and perspectives regarding financing of new nuclear projects. Each participant contributed his/her expertise, professional insights, and recommendations to the discussion.

The IFNEC Steering Group formed a Planning Committee whose members support all stages of the development for the conference. Everything from establishing the venue, to identifying the agenda and scenarios, to ensuring proper conference participation was addressed by the members. This conference would not have been successful without these individuals.

Members of the Planning Committee included:

- Rakan Ayoub, Jordan Atomic Energy Commission, Jordan
- Nadira Barkatullah, Consultant
- George Borovas, Partner, Project Development and Finance Group, Shearman & Sterling, LLP
- Alex Burkart, Department of State, United States
- Carl Cho, Citibank
- Aleshia Duncan, IFNEC Technical Secretariat, NEA
- Chris Gadomski, Lead Analyst, Bloomberg
- Janet Gorn, Foreign Affairs Specialist, Department of State, United States
- Jaejoo Ha, Head of the Division of Nuclear Development, NEA
- Jan Horst Keppler, Senior Economic Advisor, NEA
- Vladimir Kuchinov, ROSATOM, Russia
- Dan Lipman, Vice President, Nuclear Energy Institute
- John Mathieson, IDWG Co-Chair, Head of International Relations, Nuclear Decommissioning Authority, United Kingdom
- Ed McGinnis, Steering Group Chair, DAS for Nuclear Energy, Department of Energy, United States
- Paul Murphy, Managing Director, Gowling WLG
- Robert Mussler, Secretariat Contract Support, BAH, United States
- Henri Paillere, IFNEC Technical Secretariat Coordinator, NEA
- Fiona Reilly, Head of Nuclear Capital Projects and Infrastructure, PwC
- Xavier Rollat, Consultant
- Motomitsu Sadayasu, Cabinet Office, Japan
- Regine Schapiro, Head of Unit Space, Telecommunications, Energy and Project Financing, COFACE
- David Shropshire, Head of Planning and Economic Studies Section, IAEA

NEA staff that helped make the two-day event a success from an organizational and logistical point of view should also be acknowledged: Aleshia Duncan, Weronika Kmiec, Gisela Grosch, Charlotta Lundell, Andrée Pham Van and Fabienne Vuillaume were pivotal in that respect. The support of the staff of the OECD Conference Centre is also gratefully acknowledged.

Last but not least, the IFNEC Steering Group would also like to express its appreciation to staff from Booz Allen Hamilton for drafting the initial report, subsequently edited and printed in its present form by the OECD Nuclear Energy Agency on behalf of IFNEC.

Appendix A. List of abbreviations and acronyms

ATVM	Advanced Technology Vehicles Manufacturing
BOO	Build-own-operate
CDB	China Development Bank
CEEM	Chair European Electricity Markets (Université Paris-Dauphine)
CEO	Chief Executive Officer
CfD	Contract for difference
CNLO	Canadian Nuclear Law Association
COP21	Twenty-first session of the Conference of the Parties to the 1992 United Nations Framework Convention on Climate Change (2015 Paris Climate Change Conference)
DECC	Department of Energy and Climate Change (United Kingdom)
ECA	Export Credit Agency
ECG	Export credits and credit guarantees
EFSI	European Fund for Strategic Investments
EIF	European Investment Fund
ENS	European Nuclear Society
EPC	Engineering, procurement and construction
ETS	Emission trading scheme
EU	European Union
FDP	Funded decommissioning program
FOAK	First-of-a-kind
IAEA	International Atomic Energy Agency
ICEF	International College of Economics and Finance
IDB	Inter-American Development Bank
IEA	International Energy Agency
IFNEC	International Framework for Nuclear Energy Cooperation
INLA	International Nuclear Law Association
IPP	Independent power project

ITF	International Transport Forum
LCCC	Low Carbon Contracts Company
LLP	Limited Liability Partnership
LPO	Loan Programs Office
MDEP	Multinational Design Evaluation Programme
METI	Ministry of Economy, Trade and Industry (Japan)
NEA	Nuclear Energy Agency
NECG	Nuclear Economics Consulting Group
NPP	Nuclear power plant
NRC	Nuclear Regulatory Commission (United States)
NSG	Nuclear Suppliers Group
O&M	Operations and maintenance
ODA	Overseas development assistance
OECD	Organisation for Economic Co-operation and Development
OPAL	Open pool Australian light water reactor
PPA	Power purchase agreement
PwC	PriceWaterhouse Coopers
RD&D	Research, development and demonstration
SMR	Small modular reactor
SPE	Special purpose entity
SVP	Senior vice president
UNAM	Universidad Nacional Autonoma de México
UNIDO	United Nations Industrial Development Organization
UNODC	United Nations Office on Drugs and Crime
UPD	Université Paris-Dauphine
USIBC	US India Business Council
VP	Vice president
WNA	World Nuclear Association
WTC	Waste transfer contract

Appendix B. IFNEC Nuclear Finance Conference program

Nuclear Energy's Role in the 21st Century: Addressing the Challenge of Financing
11-12 May 2016
OECD Conference Centre
Paris, France

Wednesday 11 May 2016

09:00-09:05 Opening Remarks – Mr. Edward McGinnis, Chair, IFNEC Steering Group

09:05-09:10 Welcome – Mr. William D. Magwood, IV, Director-General, Nuclear Energy Agency (NEA)

09:10-09:25 "The Global Energy Forecast and the Path Forward to Facing the Economic Challenges Ahead" – Mr. Ángel Gurría, Secretary-General, Organisation for Economic Co-operation and Development

09:25-09:45 "Vital Role of Nuclear Energy in the Global Climate Agenda" – Mr. Keisuke Sadamori, Director of Energy Markets and Security, International Energy Agency (IEA)

09:45-10:05 "Targeted Government Financial Guarantees for a New Build Project" – Mr. Dong Kim, Chief Operating Officer, US Department of Energy Loan Programs Office

10:05-10:45 Q and A Session with Speakers: Keisuke Sadamori, Dong Kim, William D. Magwood, IV and Edward McGinnis

Moderated by: Chris Gadomski, Lead Analyst Nuclear, Bloomberg New Energy Finance

10:45-11:30 Session 1: Alternatives for Effectively Meeting the Challenges of Financing Nuclear Projects

1.1 "Which Financing Alternatives have been Most Effective and Why" – Fiona Reilly, Head of Nuclear Capital Projects and Infrastructure, PriceWaterhouse Coopers (PwC)

1.2 "Independent, Transparent and Effective Regulator: The Role of the International Atomic Energy Agency's Integrated Regulatory Review Service" – Adriana Nicic, Section Head of the Regulatory Activity Section, IAEA

1.3 Multinational Design Evaluation Programme – Ho Nieh, Head of the Division of Nuclear Safety Technology and Regulation, NEA

11:30-12:10 Q and A Session with Speakers: "Alternatives for Effectively Meeting the Challenges of Financing Nuclear Projects"

Moderated by: Mr. Ron Cameron, Nuclear Specialist Adviser, UK Department of Trade and Investment

14:00-15:30 Hypothetical Case Study Exercise: Newcomer Country in Regulated Market

Moderated by: Chris Gadomski, Bloomberg, and Edward McGinnis , IFNEC Steering Group Chair

Role Players: Energy Planning Authority: Mr. Kamal Araj; Project Consultant: Ed Kee; Electricity Market Regulator: Safak Herdem; National Utility: Tom Samson; Vendor: Jay Surina; Banker: Carl Cho; NPP Financing Expert: Fiona Reilly

15:50-16:05 "Nuclear Suppliers Group, Facilitating Nuclear Trade and Cooperation Through Confidence" – Rafael M Grossi, Ambassador of Argentina to IAEA and International Organizations in Vienna, Chair Nuclear Suppliers Group

16:05-17:00 Session 2: Alternatives for Successful Financial Risk Management

2.1 "Financing a New Nuclear Plant and Managing the Risks; Experience Feedback from the Hinkley Point C Project (UK)" – Vakisasai Ramany, Senior VP Development, New Nuclear Projects and Engineering, Électricité de France (EDF)

2.2 "Options for Distributing Risks with Financing Nuclear Projects" – George Borovas, Shearman and Sterling, LLP

2.3 "Does Risk Differ with the Deployment of Small Modular Reactor Technology?" – John Hopkins, CEO, NuScale

2.4 "How to Effectively Address the Financial Risks Associated With Nuclear Projects" – Carl Cho, Citi

17:00-17:40 Q and A Session with Speakers: "Alternatives for Successful Financial Risk Management"

Moderated by: Fabienne Pehuet, NucAdvisor and Ahab Abdel-Aziz, Global Director Nuclear Power Generation, Gowling Lafleur Henderson, LLP

Thursday 12 May 2016

09:00-09:20 Special Guest Speaker "Global Commercial State of Play and the Current Role of Financing." – Agneta Rising, Director-General, World Nuclear Association

09:20-09:40 Special Guest Speaker "Addressing the Financing Challenge – An Industry Perspective" – Jean-Pol Poncelet, Director-General, FORATOM

09:40-10:00 Special Guest Speaker "Addressing the Financing Challenge – A European Commission Perspective" – Gerassimos Thomas, Deputy Director-General for Energy, European Commission

10:00-10:20 "Nuclear New Build: Insights into Financing and Project Management" – Jan Horst Keppler, Senior Economist, NEA

10:45-12:15 Hypothetical Case Study Exercise: Country with Existing Fleet in Liberalized Electricity Market

Moderated by: Chris Gadomski, Bloomberg, and Edward McGinnis , IFNEC Steering Group Chair

Role Players: Energy Planning Authority: Mr. Kamal Araj; Project Consultant: Ed Kee; Electricity Market Regulator: George Borovas; Private Utility: Tom Samson; Vendor: Jay Surina; Banker: Carl Cho; NPP Financing Expert: Paul Murphy

13:30-13:50 "OECD Arrangement Financing Rules for Nuclear Power Projects" – David Drysdale, Head of Export Credits Division, OECD

13:50-14:10 "Russia's Approach to Financing" – Vyacheslav Ivanov, Deputy Director-General for Economics and Finance, Rosatom

14:10-14:30 "China's Approach to Financing" – Mr. Sunjiao Chen, Deputy Director-General, China Development Bank

14:30-14:50 "US Approach to Financing" – Diane Farrell, Deputy Assistant Secretary for Asia International Trade Administration, US Department of Commerce

14:50-15:20 Session 3: Establishing Confidence in Future Pricing and Return on Investment

3.1 "What Approaches Can Be Used in New Builds to Attract Private Capital that Provide Confidence There Will Be An Adequate Return on Investment?" – Fabienne Pehuet, NucAdvisor

3.2 "The UK Perspective: The Role of Long-Term Electricity Price Guarantees" – Jeremy Allen, Head of Procurement and Investor Relations, Department of Energy and Climate Change, United Kingdom

15:20-15:40 Q and A Session with Speakers: "Establishing Confidence in Future Pricing and Return on Investment"

Moderated by: Paul Murphy, Gowling WLG

16:00-16:30 Session 4: Innovative Finance Solutions for Investment in Clean Energy

4.1 "The Impact of Carbon Pricing" – Edward Kee, CEO, Nuclear Economics Consulting Group

4.2 "Mobilizing the Bond Markets for a Low-Carbon Transition" – Christopher Kaminker, Economist, OECD

16:30-16:50 Q and A Session with Speakers: "Innovative Finance Solutions"

Moderated by Chris Gadomski, Bloomberg

16:50-17:50 Findings from Hypothetical Moderated Scenarios

17:50-18:15 Conference Wrap Up with Organizers

Appendix C. IFNEC Nuclear Finance Conference contributor biographies

Speakers biographies

Ángel Gurría

Ángel Gurría is the Secretary-General of the OECD since June 2006. As OECD Secretary-General, he has reinforced the OECD's role as a "hub" for global dialogue and debate on economic policy issues while pursuing internal modernization and reform. Mr. Gurría is a Mexican national and came to the OECD following a distinguished career in public service in his country, including positions as Minister of Foreign Affairs and Minister of Finance and Public Credit in the 1990s. Mr. Gurría holds a B.A. degree in Economics from UNAM (Mexico) and a M.A. degree in Economics from Leeds University (United Kingdom). He is married and has three children.

Keisuke Sadamori

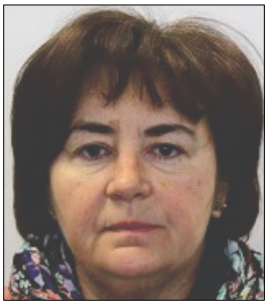
Keisuke Sadamori became the IEA Director for Energy Markets and Security in 2012, leading an administrative structure that includes several core functions of the IEA. Mr. Sadamori, a Japanese national, held many senior positions at the Japanese Ministry of Economy, Trade and Industry (METI), including Deputy Director-General at the Minister's Secretariat. Mr. Sadamori served as the executive assistant to the Prime Minister in 2011, when the Great East Japan Earthquake and Tsunami hit Japan, causing the Fukushima Daiichi nuclear power plant accident. He worked on international energy affairs and was the representative of the government of Japan.

Dong Kwun Kim

Dong Kwun Kim, prior to holding the Chief Operating Officer position with Energy's Loan Programs Office (LPO), served as Chief Engineer and Director of LPO's Technical and Project Management Division. As Federal Project Director to the Office of Civilian Radioactive Waste Management, he successfully achieved Nuclear Regulatory Commission (NRC) certification of a licensing support network for the Yucca Mountain Project before the Atomic Safety Licensing Board, and led systems simulation and design studies resulting in safety improvements and cost reductions. Mr. Kim was a senior policy advisor to numerous Program Secretarial Officers appointed during the Clinton administration.

Fiona Reilly

Fiona Reilly is Head of Nuclear Capital Projects and Infrastructure, PricewaterhouseCoopers (PwC) and an international nuclear expert with over 20 years' experience in the market. She has worked on the development, structuring and financing of nuclear new build projects in the United Kingdom, the Middle East, Russia and Central and Eastern Europe. She has served as a designated expert on the financing, development, structuring of nuclear projects and decom-missioning and waste management at IAEA special meetings.



Adrina Nicic

Adrina Nicic holds a Masters' Degree in Electrical Engineering and she is currently the Head of the Regulatory Activities Section, in the Division of Nuclear Installation Safety at the IAEA. In this role she is involved in the delivery of the IAEA's program in support of enhancement of effectiveness of national regulatory systems and development of nuclear safety infrastructure in IAEA member states, based on the IAEA safety standards, with emphasis on regulatory peer reviews and self-assessment. Ms. Nicic worked for the Canadian Nuclear Safety Commission as the Acting Director-General for the Directorate of Safety Management and Standards and contributed to the delivery of its mandate in various areas.

Ho Nieh

Ho Nieh is Head of the Division of Nuclear Safety Technology and Regulation at the OECD Nuclear Energy Agency (NEA). Mr. Nieh is responsible for the NEA's programs in nuclear safety regulatory policy, research and international cooperation. Mr. Nieh has also held positions at the United States Nuclear Regulatory Commission and at the International Atomic Energy Agency.

Rafael Mariono Grossi

Rafael Mariano Grossi is Ambassador of the Argentine Republic to Austria and Permanent Representative to the International Organizations in Vienna, namely the IAEA, CTBTO, UNOV, UNODC and UNIDO. At present he is the Chairman of the Nuclear Suppliers Group (NSG) for the second consecutive period. He also was elected as President of the Diplomatic Conference of the Convention on Nuclear Safety, which adopted the Vienna Declaration in February 2015. Mr. Grossi has extensive experience in disarmament and non-proliferation affairs and diplomacy.

Vakasai Ramany

Vakisasai Ramany is Senior Vice President-Development at EDF, New Nuclear Projects & Engineering. Mr. Ramany joined the EDF Group in 1999 as an R&D engineer, then joined the French supply division of EDF and contributed to putting in place the required tools and processes to run a customer portfolio management function. In 2008, Mr. Ramany joined the EDF Group Chief Financial Officer's team to support the company's efforts to expand its international business. In 2011, he moved to EDF Energy in the UK as Merger & Acquisitions and Investments Director. He is currently one of the leading contributors to EDF's efforts to secure funding for the 3 200 MW Hinkley Point C nuclear new build project in the UK, including notably the development of cooperation with China in this regard. Since September 2015, Mr. Ramany leads the international new nuclear development activities for the EDF Group.

George Borovas

George Borovas is the Head of Shearman and Sterling's Global Nuclear Group and specializes in the development and financing of nuclear power projects. He advises lenders, governments and sponsors, and has worked on nuclear projects and transactions in the UK, the US, Russia, Europe, the Middle East, Japan, Korea, Southeast Asia, China, Australia and South Africa. Before becoming a lawyer, Mr. Borovas worked as an engineer in the nuclear industry.

John L. Hopkins

John L. Hopkins is Chairman and Chief Executive Officer NuScale Power. Mr. Hopkins has led NuScale Power's rapid development of its small modular reactor (SMR) technology and is currently the Vice Chairman of the Board of Directors of the US Chamber of Commerce, Washington, DC, an organization representing over three million small to large US businesses. Prior to joining NuScale Power, Mr. Hopkins held numerous executive positions in his 24 years of service with Fluor Corporation, a Fortune 150 international engineering and construction company. He also served as the senior executive member of the Board of Directors for both Fluor Netherlands and Fluor United Kingdom.

Carl Cho

Carl Cho is a senior corporate banker in Citi's North American Power and Alternative Energy group, primarily covering wind and solar developers and independent power producers. He also serves as Industry Specialist on debt financing approval committees in North America, Latin America and Asia, where he is asked to opine on the regulatory, merchant and technical aspects of electric generation, transmission and distribution. Mr. Cho has been with Citi for over 20 years. His experience includes Structured Finance and Risk Management prior to joining Power in 2011. He is based in New York.

Agneta Rising

Agneta Rising is the Director-General of the World Nuclear Association. She was Vice President of Environment at Sweden's Vattenfall AB, the fifth largest electricity utility in Europe, where she headed a pan-European department focused on energy, environment and sustainability. Over the past two decades, Agneta Rising has been appointed by the Swedish government, the EU Commission and the IAEA to several significant expert and advisory positions relevant to the safety and future development of nuclear power. Among these, Ms. Rising served for four years on the IAEA's International Nuclear Safety Group. She was awarded the Atoms for Peace Prize in 2013, WiN Spain Special Award in 2015 and Swedish Nuclear Society Honorary Prize in 2016.

Jean-Pol Poncellet

Jean-Pol Poncelet is the Director-General of FORATOM, the trade organization of the European Nuclear industry and the Secretary-General of the European Nuclear Society (ENS). He holds a Master's Degree in Nuclear Engineering. He previously was Areva's SVP Sustainable Development, and Director of Strategy and External Relations of the European Space Agency. He was Deputy Prime Minister, Minister of Defense and Minister of Energy of Belgium from 1995 until 1999.

Gerassimos Thomas

Gerassimos Thomas is Deputy Director-General in the Directorate-General for Energy at the European Commission and member of the Steering Board of the European Fund for Strategic Investments (EFSI). Prior to his current assignment, Mr. Thomas had professional assignments as Director Finance at DG ECFIN; member of the EIB and EIF Board of Directors; Head of cabinet of Joaquin Almunia, Commissioner for Economic and Monetary Affairs; Deputy Spokesman for Commission President Romano Prodi; and Spokesman for economic and monetary affairs under Commissioner Pedro Solbes.

Jan Horst Keppler

Jan Horst Keppler is Senior Economic Advisor in the Nuclear Development Division of the OECD Nuclear Energy Agency (NEA). He is also Professor of Economics at the Université Paris-Dauphine (UPD) where he directs the Masters in Energy, Finance, Carbon. He is also the Scientific Director of the Research Chair on European Electricity Markets (CEEM) at UPD. His research is on investment in low-carbon technologies such as nuclear energy. Recent publications include *Nuclear New Build: Insights into Financing and Project Management* (2015) and *Nuclear Energy and Renewables: System Effects in Decarbonising Energy Systems* (2012).

David Drysdale

David Drysdale is the Head of the Export Credits Division of the Trade and Agriculture Directorate of the OECD. He has worked in the field of export credits since 1994 when he joined the Export-Import Bank of the United States, the official American export credit agency. From 2002until July 2013, he worked at the US Department of the Treasury in the Office of Trade Finance and Investment Negotiations, with his last position as Director. As lead negotiator within the United States government of trade finance and export credit matters, he has a vast and in-depth knowledge of all export credit issues. While Chairman of the OECD Premium Experts Group, he successfully led the negotiations that resulted in the Malzkuhn-Drysdale Package which set forth buyer risk pricing disciplines of the Arrangement on Officially Supported Export Credits. Prior to working for the US government, Mr. Drysdale practiced law in Washington, DC for seven years, focusing on many of the technical issues (environment, bribery) and sectors (aviation, energy) that are key aspects of the OECD export credit work. He also served as an officer in the United States Navy.

Vyacheslav Ivanov

Vyacheslav Ivanov prior to joining Rusatom Energo International held senior positions at Rusatom Overseas, Financial Corporation URALSIB, LUKOIL, Financial Broker Troika Dialog, Gazprom Neft. Mr. Ivanov was awarded the title of "best ICEF teacher" 2011, 2012 being a senior lecturer at the International College of Economics and Finance (National Research University – Higher School of Economics). He graduated from Moscow State Institute of Radio-engineering Electronics and Automation and Accounting and Finance at The Faculty of Arts and Science at the University of Toronto and MBA of William E. Simon Graduate School of Business Administration, University of Rochester, New York, USA.

Sunjiao Chen

Sunjiao Chen is Deputy Director-General of Project Appraisal Department I, China Development Bank, senior engineer of hydroelectric engineering. Mr. Chen has successively worked in the China Ministry of Electric Power National Energy Investment Company and China Development Bank since 1985. He has been engaged in the business of investment and financing of electric power projects for most of his career, specializing in the risk evaluation and credit management of electric power industry. Mr. Chen has taken charge of the loan appraisal of various nuclear power projects.

Diane Farrell

Diane Farrell is the principal advisor to the Assistant Secretary for Global Markets on all matters concerning international economics, trade, investment and commercial policy program and agreements with respect to Asia. She also oversees planning and execution of Commerce commercial diplomacy and export promotion strategies at United States Missions in Asia. Ms. Farrell worked at the US India Business Council (USIBC). Ms. Farrell served on the Board of Directors at the Export-Import Bank of the United States (US Exim Bank). She was named a member of the White House Business Council. Before serving at US Exim Bank, Ms. Farrell was elected as the First Selectwoman in Westport, Connecticut.

Fabienne Pehuet

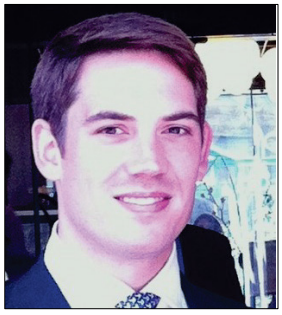
Fabienne Pehuet, after a few years in the French Diplomatic Service, began her career in Finance in the pharmaceutical industry with Eli Lilly in the United States. She then worked as a trader on the Financial Markets in Paris. In the Nuclear Energy business dates from the 1990s she joined Cogema where she held management positions in Finance and Strategy. After Areva was formed she joined FCI and served as SVP Audit. In 2003, she was appointed SVP Marketing of the Areva Group. Since 2012, Fabienne Pehuet is helping companies developing or refocusing their activities in the Energy, Industry and Infrastructure fields as NucAdvisor.

Jeremy Allen

Jeremy Allen is the Head of Investor Relations in the UK's Department of Energy and Climate Change and Deputy Director of the Department's Commercial Directorate. The team provides an investor relations service to companies in the energy sector and to the financial markets in order to increase understanding of and engagement with DECC's policies and programs for key stakeholders. Jeremy has been working mostly on energy markets policy prior to the creation of the Commercial Team. He worked in the Department for Business, on sector support for industries such as automotive and electronics and on workforce development and skills policy.

Edward Kee

Edward Kee is an expert on nuclear power economics. He is the CEO of Nuclear Economics Consulting Group (NECG) and an Affiliated Expert at Nera Economic Consulting. Mr. Kee provides strategic and economic advice to companies and governments on nuclear power and electricity industry issues. He has testified as an expert witness in US and international legal and arbitration cases. A detailed CV is available at www.nuclear-economics.com/biography/.



Christopher Kaminker, FRGS

Christopher Kaminker, FRGS, is an economist in the Environment Directorate of the OECD in Paris. He manages an empirical policy and research project focused on the role of institutional investors in financing low-carbon and climate-resilient infrastructure investment. An economic geographer, his research interests focus on institutional investors and long-term investment in policy-driven markets, sustainable finance, mobilizing the capital markets for infrastructure investment, and energy and climate finance policy. His latest analytical reports "Mapping Channels to Mobilise Institutional Investment in Sustainable Energy" and "Institutional Investors and Green Infrastructure Investments" were written for the G20 Finance Ministers and Central Bank Governors Meetings. His research has been featured in *The Economist*, *Environmental Finance*, *Institutional Investor*, *Euromoney*, *Investment and Pensions Europe*, *Institutional Real Estate* and other media.

Moderator biographies

Chris Gadomski

Chris Gadomski is Lead Analyst, Nuclear, at Bloomberg New Energy Finance, the leading provider of research to investors in clean and carbon free energy and carbon markets worldwide. Mr. Gadomski directs the firm's nuclear energy research team in developing a robust methodology for forecasting global nuclear investment in new build, innovative technologies, operations and management, fuel cycle and decommissioning. Chris spent 25 years working with regional and multinational firms as well as global institutions including the United Nations Development Program, World Bank, US Department of Energy, and UNDP/Global Environment Facility on energy and environment projects.

Ron Cameron

Ron Cameron is Nuclear Specialist Adviser, UK Department of Trade and Investment. He is a Director of his own company that provides consultancy to the UK government on increasing investment in nuclear new build. In this role, he works closely with the three major developers and China. Previously, Mr. Cameron was Head of the Nuclear Development Division at the OECD Nuclear Energy Agency (NEA) and has held senior executive roles in Australia, including as Project Director for building the OPAL Research Reactor.

Ahab Abdel-Aziz

Ahab Abdel-Aziz is a partner and Global Director of Nuclear Power Generation at Gowling Lafleur Henderson LLP. A leader in the global nuclear sector for over 25 years, he advises on policy and legislative development, project development and finance, as well as dispute resolution. Mr. Abdel-Aziz is the President of CNLO and a member of the Board of INLA. He is recognized as a top energy lawyer by multiple publications, including *Who's Who Legal: The International Who's Who of Energy Lawyers*.

Paul Murphy

Paul M. Murphy, Managing Director for Gowling WLG, has over 20 years of experience as a transactional attorney. He is a three-time selection to the *Who's Who Legal/Energy*, 2013-2015, and a member of the International Nuclear Law Association. Mr. Murphy is recognized as an expert in the development and financing of nuclear power programs by the International Atomic Energy Agency (IAEA), the OECD Nuclear Energy Agency (NEA), the International Framework for Nuclear Energy Cooperation (IFNEC) and the US government.

Appendix D. List of participants

Name/title	Country/organization
Facundo Deluchi Manager of Institutional Affairs Argentine Atomic Energy Commission	Argentina
Rafael Mariano Grossi Ambassador Permanent Mission of Argentina, Vienna	Argentina
Gabriel Taboada Minister Embassy of Argentina in France	Argentina
Guillermo Spika Secretary Embassy of Argentina in France	Argentina
Javier Santander Secretary Embassy of Argentina in France	Argentina
Federico Polo Devoto Secretary Embassy of Argentina in France	Argentina
Areg Galstyan Deputy Minister Ministry of Energy and Natural Resources of the Republic of Armenia	Armenia
Aram Gevorgyan Deputy Director Atomic Energy Department Ministry of Energy	Armenia
John Kalish Assistant Secretary Australian Safeguards and Non-Proliferation Office	Australia
Bogdan Dimitrov Financial and Business Director Kozloduy NPP	Bulgaria

Name/title	Country/organization
Venera Bankova Senior Business Trips Officer Protocol Department of Kozloduy NPP Plc	Bulgaria
Siyka Raicheva Penkova Head of Financial Resources Division Business and Finance Directorate	Bulgaria
Colin Hoult Special Advisor Natural Resources Canada	Canada
Nabil Mansour Production Head of FMPP Egyptian Atomic Energy Authority	Egypt
Bart Castermans Assistant to the Deputy Director-General European Commission	European Commission
Thomas Gerassimos Deputy Director-General for Energy European Commission	European Commission
Zuzana Petrovicova Deputy Head of Unit European Commission	European Commission
Maurizio Boella Advisor to the Deputy Director-General, Euratom Issues European Commission	European Commission
Michel Berthélemy Economist The French Alternative Energies and Atomic Energy Commission	France
Jean-Guy Devezeaux Director The French Alternative Energies and Atomic Energy Commission/SACLAY	France
Thomas Mieusset Project Manager, International Affairs Division The French Alternative Energies and Atomic Energy Commission	France
Alban Virlet Deputy Head of Credit-Export Office and Guarantees International Unit Ministry of Economy, Industry and Digital	France

Name/title	Country/organization
Thomas Nunnemann Deputy Head of Division, Nuclear Safety Research and Nuclear Energy Policy Federal Ministry of Economic Affairs and Energy	Germany
Christophe Xerri Director, Division of Nuclear Fuel Cycle and Waste Technology, Department of Nuclear Energy International Atomic Energy Agency	IAEA
Adriana Nicic Head of the Regulatory Activity Section International Atomic Energy Agency	IAEA
Keisuke Sadamori Director of Energy Markets and Security International Energy Agency	IEA
Yoko Nobuoka Energy Analyst International Energy Agency	IEA
Franca Padoani Head of Laboratory for Design and Technical Support for Nuclear Safety, Security and Sustainability, Division of Nuclear Safety, ENEA	Italy
Nobuhiro Muroya Director for Atomic Energy Bureau of Science, Technology and Innovation Cabinet Office	Japan
Motomitsu Sadayasu Advisor Cabinet Office	Japan
Tomoko Murakami Manager The Institute of Energy Economics	Japan
Atsuhiko Suzuki Researcher The Institute of Energy Economics	Japan
Masahiro Oda Deputy Director Ministry of Economy, Trade and Industry	Japan
Kamal Araj Vice Chairman Jordan Atomic Energy Commission	Jordan

Name/title	Country/organization
Rakan Ayoub Financial Analyst Jordan Atomic Energy Commission	Jordan
Emmanuel Wandera Senior Corporate Affairs & Communication Officer Government of Kenya	Kenya
Dong Hoon Lee Senior Researcher Korea Atomic Energy Research Institute	Korea
Kibog Lee Director Policy Research Division, KAERI	Korea
Oum Keltoum Bouhelal École Nationale Supérieure de Mines de Rabat	Morocco
Ángel Gurría Secretary-General Organisation for Economic Co-operation and Development	OECD
Christopher Kaminker Economist Organisation for Economic Co-operation and Development	OECD
David Drysdale Head of Export Credits Division Organisation for Economic Co-operation and Development	OECD
Daniel Iracane Deputy Director-General Nuclear Energy Agency	NEA
William D. Magwood, IV Director-General Nuclear Energy Agency	NEA
Ho Nieh Head of the Nuclear Safety Technology and Regulation Division Nuclear Energy Agency	NEA
Jan Horst Keppler Senior Economic Advisor Nuclear Energy Agency	NEA
Geoffrey Rothwell Principal Economist Nuclear Energy Agency	NEA

Name/title	Country/organization
Jaejoo Ha Head of the Division of Nuclear Development Nuclear Energy Agency	NEA
Marco Cometto Nuclear Energy Analyst Nuclear Energy Agency	NEA
Henri Paillere IFNEC Coordinator Nuclear Energy Agency	NEA
Jozef Sobolewski Director of Nuclear Energy Department Ministry of Energy	Poland
Daniel Dumitru Ene Counsellor Nuclear and Radioactive Waste Agency	Romania
Florin Tatar President Nuclear Agency and for Radioactive Waste	Romania
Mikhail Kim Vice President for Economics, Finance and Investments ROSATOM	Russia
Sergey Elizarov Director of Investments Analysis and Finance Group, JSC Rusatom Overseas Inc.	Russia
Alexander Bychkov Representative of State Atomic Corporation “Rosatom” in Vienna Senior Counsellor Permanent Mission of the Russian Federation to the International Organizations in Vienna	Russia
Alexey Lokhov Marketing Manager Rosatom France	Russia
Andrey Rozhdestvin Vice-President of Rusatom International Network Rosatom France	Russia
Urska Dolinsek Undersecretary Ministry of Infrastructure	Slovenia

Name/title	Country/organization
Alfonso De Las Heras Industrial Counsellor Permanent Delegation to the OECD	Spain
Maksym Nezhura Head of Section on Monitoring of Global Nuclear Energy Development Trends Energoatom	Ukraine
Mykola Kukharchuk Director of International Cooperation Energoatom	Ukraine
Hamad Alkaabi Ambassador Permanent Representative to the IAEA	United Arab Emirates
John Mathieson Head of International Relations Nuclear Decommissioning Authority	United Kingdom
Jeremy Allen Head of Procurement and Investor Relations Department of Energy and Climate Change	United Kingdom
Ron Cameron Nuclear Specialist Adviser UK Department of Trade and Investment	United Kingdom
Alex Campbell Head of EU, International and Inward Investment Office for Nuclear Development Department of Energy and Climate Change	United Kingdom
Ed McGinnis Steering Group Chair, DAS for Nuclear Energy Department of Energy	United States
Robert Mussler Secretariat Contract Support, BAH	United States
Dong Kim Chief Operating Officer, Loan Program Office Department of Energy	United States
Diane Farrell Deputy Assistant Secretary for Asia International Trade Administration Department of Commerce	United States
Malcolm Burke Regional Manager, Advocacy Center International Trade Administration	United States

Name/title	Country/organization
Alex Burkart IDWG Co-Chair Department of State	United States
Michael Apicelli Energy Attaché Permanent Delegation to the OECD Mission	United States
Kyler Turner Department of State	United States
Paul Dickman Senior Policy Fellow, ANL	United States
Kirsten Cutler International Security and Nonproliferation Specialist Department of State	United States
Gareth Price Partner, Global Head of Projects	Allen & Overy LLP
Biplab Rakshi Managing Director	Atomic Acquisitions
Olivier Cortal Project Manager	Areva
Charles Esselin Project Manager	Areva
Julien Jansen Project Manager	Areva
Marcos Rueda Managing Director Head of Structured Trade, Export and Commodity Finance France and Benelux	Banco Santander
Gaëlle Millet Vice President, Structured Trade, Export & Supply Chain Finance France & Benelux	Banco Santander
Ecaterina Mucuta Associate, Trade, Export & Commodity Finance, France & Benelux	Banco Santander
Chris Gadomski Lead Analyst	Bloomberg
Emmanuel Galland Project Manager, Nuclear Industry	Business France

Name/title	Country/organization
Kisang Kim Representative Officer	The Export-Import Bank of Korea
Sunghoon Hong Chief Representative Officer	The Export-Import Bank of Korea
Mark Hibbs Senior Associate, Nuclear Policy Programme	Carnegie Endowment for International Peace
Wenzhi Gao Project Appraisal Department I	China Development Bank
Sunjiao Chen Deputy Director-General	China Development Bank
Jundang Yu Director, Senior Engineer Project Appraisal Department I Division II	China Development Bank
Zijiao Xu	China Development Bank
Yaya Liang	China Development Bank
Carl Cho Senior Corporate Banker Citi's North American Power and Alternative Energy Group	Citi
Frederique Gournail Head of Unit, Space/Telecom/Energy/Project Finance	COFACE
Sandrine Bedat Manager Space/Telecom/Energy/Project Finance	COFACE
Edward Kee CEO	Nuclear Economics Consulting Group
Daniel Grosvenor Head of Nuclear	Deloitte LLP
Patricia Marcetteau Nuclear Economics Expert	EDF
Frederique Agnes Project Manager	EDF
Judicaël Chevalier Nuclear New Build Finance Controller	EDF
Stephane Peyrin CEO, New Nuclear Projects and Engineering	EDF

Name/title	Country/organization
Vakisasai Ramany Senior VP Development New Nuclear Projects and Engineering	EDF
David Tersigni Engineering and New Nuclear Project Direction Resource Manager	EDF
Karen Daifuku Senior Nuclear Project Manager	EDF
Joseph Rippon Strategy Manager	EDF
Dominique Lim Acquisitions, Investments & Financial Advisory	ENGIE
El Mehdi Ben Maalla Financial Advisor	ENGIE
Berta Picamal Executive Advisor to the Director-General	FORATOM
Jean-Pol Poncelet Director-General	FORATOM
Fabien Roques Senior Vice President	FTI France
Paul Murphy Managing Director	Gowling WLG
Ahab Abdel-Aziz Global Director, Nuclear Power Generation	Gowling WLG (Canada)
Safek Herdem Attorney	Herdem Attorneys at Law
Vedove Mattia Dalle Manager, EU Energy Policy	Hitachi, Ltd
Barcu Zobu Energy Lawyer	Independent
Siyka Penkova Head Of Financial Resources Division	KOZLODUY NPP, Plc.
Daisuke Hashimoto Deputy Director	Japan Bank for International Cooperation
Tomoyuki Miyaguchi Deputy Director	Japan Bank for International Cooperation

Name/title	Country/organization
Fumio Suzuki Chief Representative Representative Office in Paris	Japan Bank for International Cooperation
Erika Nakahara Representative Office in Paris	Japan Bank for International Cooperation
Satoshi Sasaki Director	Japan Bank for International Cooperation
Nadezda Kutepova President	NGO The Planet of Hopes
Fabienne Pehuet Consultant	NucAdvisor
Ian Jamieson CEO	NucAdvisor
Tom Samson CEO	NuGeneration
Robert Amour Deputy Chairman	NuGeneration
Mark Vickers Deputy Director, Project Finance	NuGeneration
John Hopkins CEO	NuScale
Surina Jay Chief Financial Officer	NuScale Power
Edward De la Billiere Director	Prospect Law Ltd
Rupert Cowen Solicitor	Prospect Law Ltd
Fiona Reilly Head of Nuclear Capital Projects and Infrastructure	PwC
George Borovas Partner, Project Development and Finance Group	Shearman & Sterling, LLP
Anne Crepin Deputy Head of Export Credit	SFIL
Debra Decker Senior Advisor	Stimson Center
Kathryn Rauhut Attorney	Stimson Center

Name/title	Country/organization
David Blee Executive Director	US Nuclear Infrastructure Council
Walter Howes Senior Advisor	US Nuclear Infrastructure Council
Kenneth Peddicord Professor of Nuclear Engineering	Texas A&M University
Mark Partington Chairman	Turner Harris
Agneta Rising Director-General	World Nuclear Association
Greg Kaser Senior Project Manager	World Nuclear Association

Nuclear Energy's Role in the 21st Century:
Addressing the Challenge of Financing

In May 2016, the International Framework for Nuclear Energy Cooperation (IFNEC) held a conference in cooperation with the Nuclear Energy Agency (NEA) on "Nuclear Energy's Role in the 21st Century: Addressing the Challenge of Financing". This conference brought together over 150 stakeholders from more than 30 countries, including government representatives and members of the nuclear and finance communities, as well as experts from the NEA and the OECD. Conference participants discussed the primary challenges faced by the markets, including how to secure financing for new nuclear projects, as well as approaches and solutions to such challenges. Through multiple expert presentations, moderated sessions and scenario discussions, participants acquired a better understanding of the unique challenges, approaches and techniques involved in financing new nuclear power plants. A CD containing the conference proceedings and presentations is included in the report.

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