IBNI

Expanding Nuclear Energy for a Sustainable Net Zero World

Initial Report and Action Plan

International Bank for Nuclear Infrastructure - Implementation Organization Strategic Advisory Group

1 November 2021

Foreword

This Initial Report and Action Plan (IRAP) has been prepared and is being released just as the nations of the world are preparing to convene in Glasgow, United Kingdom (UK) for the 26th Conference of the Parties (COP26) of the United Nations Framework Convention on Climate Change (UNFCCC) in the first week of November 2021 to discuss how to make further progress on the multinational effort to deal with the climate crisis. The number of countries that have pledged to reach net-zero greenhouse gas (GHG) emissions by 2050 or sooner continues to grow, but so do GHG emissions.

While many countries have made pledges to achieve net-zero GHG emissions by mid-century, the vast majority nations of the world have not actually worked out *how* they are going to achieve net zero in an economically sustainable manner. Until these questions are worked out for most of the nations of the world that are responsible for most of the world's GHG emissions, it is doubtful (unfortunately) that much progress can be made in terms of those nations' ability to enter into binding commitments to achieve net zero in a 2050 timeframe.

This IRAP is designed to be a 'blueprint' and a 'practical handbook' for the leaders and policymakers of the world's nations who are now undertaking the very critical near-term policy decisions that will determine whether we can achieve a net zero and sustainable future for the world. In addition to policymakers, this IRAP is also designed to be used as a resource for climate change-, clean energy-, and sustainability-focused non-governmental organizations (NGOs) and philanthropic foundations, the nuclear industry, global financial market participants, intergovernmental organizations and other interested parties all focused on the main questions of *how* to achieve global 2050 net zero in a sustainable manner. While in some cases, the arguments such as "why net zero?", "why nuclear?", "why now"?, etc. are already obvious already to the reader. In those cases, the sections of this IRAP and the arguments therein, can be glossed over. However, we have written this IRAP so that there are practical solutions in it for all readers. So, feel free to "jump" straight into those sections that provide refreshing new practical ideas and arguments that can be used to take immediate and impactful actions.

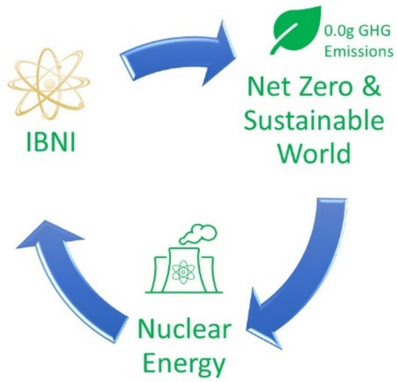
In order to achieve net zero by 2050, it is clear that nuclear energy will need to play a significant role. The task of decarbonization the world's infrastructure and economic foundations is a unquestionably daunting undertaking within the short 30-year window available, requiring massive investments and unprecedented levels global cooperation over the next three decades. The near-term decisions regarding the types of low carbon investments that world leaders decide to make will have a tremendous impact on the feasibility and sustainability of achieving global net zero by 2050 as well as the cost that tomorrow's generations will need to bear for the decarbonization investment decisions made today. Ultimately, decisions made in the near term will impact the sustainability of continuous world economic growth and advancement of global prosperity and improved standards of living for all.

The International Bank for Nuclear Infrastructure (IBNI) is a conceptual new multilateral international financing institution (IFI) which would have the express mission to assist its member nations achieve their net zero commitments by 2050 in the least cost, most sustainable manner. IBNI would provide financing and other support for those nations who decide to develop, expand or scale-up their nuclear energy generation programs over the next three decades, as significant part of their national decarbonization initiatives, and do so in the most affordable, safest and fastest manner possible.

Executive Summary

Key Points

- The International Bank for Nuclear Infrastructure (IBNI) is a conceptual new international financing institution (IFI) that will focus on financing and providing other forms of support to qualified nuclear energy projects and programs within its member states that are developing or expanding their nuclear programs as an integral part of their multi-sectoral decarbonization strategies necessary to achieve their 2050 Net Zero commitments.
- IBNI will be a technology neutral IFI, financing and supporting all nuclear technologies (including large reactor, small modular reactor (SMR), advance reactors, micro reactor, and potentially nuclear fusion).
- IBNI will finance and support a range of qualifying nuclear project types, including new build; lifetime extension and restart; refinancing and restructuring; fuel cycle and decommissioning projects.
- IBNI financing and support programs will be uniformly available on an open and inclusive basis to each of its member countries, which will range from developing countries to highly developed counties.
- While 32 countries have operational nuclear reactors, there are some 20 additional countries currently pursuing new nuclear programs and it is predictable that many more nations may determine that nuclear energy should be a significant component of their 2050 net zero strategies and policies.
- Currently, there are insufficient available and affordable capital resources from the global financial markets to support many existing planned nuclear projects, let alone any significant global expansion of nuclear energy, which will be required in order for nuclear to provide a meaningful contribution toward sustainable 2050 Net Zero.
- The existing nuclear financing structures (predominantly utility and state-sponsored models) are inadequate for the purpose of attracting new sources of global capital.
- IBNI is the 'missing link' and the 'game changer' in nuclear finance and it offers a single comprehensive solution to overcome the numerous and multi-dimensional challenges and impediments which currently inhibit the nuclear sector's access to affordable capital resources (and the ability for many nuclear projects and programs to progress).
- Using proven IFI models, IBNI will serve as the global *leader* and *catalyst* which unlocking vast new capital resources to finance a new wave of nuclear programs and project, which will allow the world to achieve 2050 net zero in the most sustainable manner.
- It is targeted that IBNI will be established early-2023 by a coalition of governments.



Net Zero needs Nuclear – Nuclear needs IBNI

The required collective actions and commitments which need to be undertaken to achieve global net zero GHG emissions by 2050, so as to limit the rise in global temperatures to not more than 1.5°C, are an extraordinary challenge of humanity. Accomplishing 2050 net zero will require systemic transformations of our fundamental global economic establishments and will also entail unprecedented levels of global cooperation.

Full decarbonization of the global energy generation sector over the next three decades is of paramount importance if the world is to achieve the broader objective of 2050 global net zero. The electricity generation sector is responsible for approximately 26% of all global greenhouse gas (GHG) emissions (13.6 gigatons CO_2 /annum)[1]. In all pathways toward achieving 2050 net zero, a very significant share of our global energy systems will need to become electrified (either directly or indirectly through hydrogen and other electrofuels). In addition to replacing fossil fuel consumption in the power generation sector, the transportation, industrial and built environment sectors will each need to become intensively electrified (or otherwise converted to hydrogen and electrofuels produced from low carbon sources). Any residual GHG emissions from the industrial sector will need to be offset by carbon sinks or sequestered through carbon capture utilization and storage (CCUS). Accordingly, not only will there be the monumental challenge of transforming today's fossil fuels dominated economic systems over the course of the next three decades, but there will also be very significant increases in global electricity demand arising from the increasing electrification of other sectors. Global population growth and the desire for sustainable economic development will necessarily drive this increased demand for electricity – which will be massive, even with the adoption of improved energy demand management techniques. In particular access to affordable, reliable, secure and modern electricity, hydrogen and electrofuels (and also heat, cooling and desalinated water) supply will be required in order to address both global population growth and sustainable economic development. All of this incremental energy demands from the power generation sector will need to be met by affordable and reliable low-carbon generation sources.

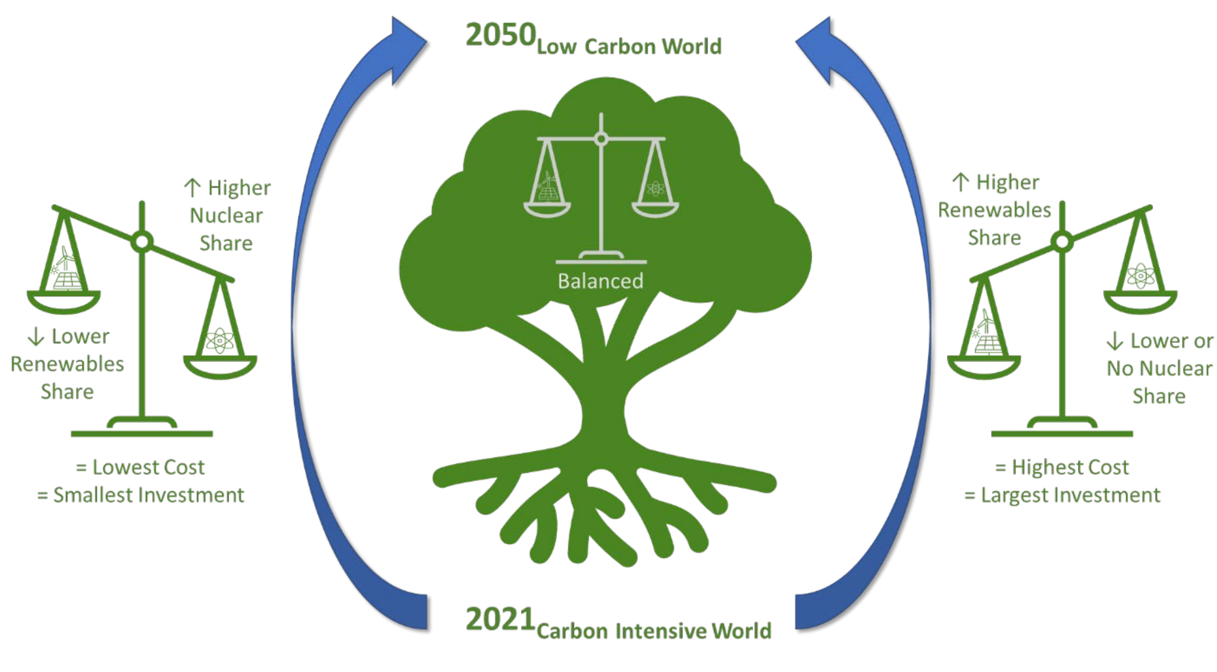
2050 projections for global electricity generation range widely from 27 to 95 petawatt hours (PWh) per year[2], and which are largely correlated with both the pace and intensity of global economic development and electrification. The world is currently able to meet only 39% of global electricity demand with low-carbon generation sources[3]. The remaining 61% of the world's existing electricity demand is currently sourced from carbon-intensive fossil fuel generation plants. Herein lies the enormity of the challenge ahead of us. How

[1] Source: [1] and [2] – Summary.
[2] Source: [3]- p. 16
[3] Source: [4].

will the world generate up to 95 PWh of electricity per year by 2050 relying on only clean and affordable generation sources?

IBNI is a conceptual new multilateral international financing institution (IFI) that will be solely focused on financing and supporting nuclear projects within IBNI member countries ranging from developing countries to the world's most advanced economies - in each case, in nations that will have chosen nuclear as part of their low-carbon energy generation mix and their strategy to decarbonize their energy sectors to achieve net zero by 2050. The core mission of IBNI will be to significantly expand global nuclear generation capacities in order to facilitate the *twin* goals of: a) achieving 2050 global net zero; and, b) promote sustainable global development. The Bank will be capitalized and governed using a model very similar to those of the major multilateral International Financing Institutions (IFI's) which have been in existence and have been successfully fulfilling their missions for many decades (such as the World Bank Group, the European Bank for Reconstruction and Development, the Asian Development Bank, etc.)

As the nations of the world are now seeking to develop and implement their own national strategies and policies to address *how* to achieve Net Zero by 2050 in a sustainable manner, three low carbon alternative strategies emerge: a) whether to pursue high renewables share (in most cases, high variable renewables); b) whether to pursue a high nuclear share with less dependency on renewables (and particularly high levels of variable generation); or, c) whether to pursue a balance of nuclear and renewables.



Source: IBNI-IO SAG.

Today's existing nuclear generation technologies offer proven, affordable, versatile, dispatchable and safe low-carbon generation solutions which are compatible with both existing electricity grids and are also compatible with and complimentary to reasonably high levels of variable renewable energy (VRE) technologies in the future. In comparison to fossil fuels technologies, nuclear also offers security of supply. Under appropriate frame works, existing and proven nuclear technologies can be rapidly deployed on a global scale in order to meet *any* foreseeable 2050 electricity demand scenario.

The IBNI initiative is fully supportive of the maximum possible development of renewables along with utility-scale energy storage, intelligent and distributed grid systems, and interim CCUS solutions, to the extent and subject to the limitations to which each of these technologies may be scaled-up and deployed in a timely, economically viable and environmentally sustainable manner. However, the challenge of achieving 2050 net zero in the energy generation sector is both immediate and real. In order for there to be even a 50% chance of achieving maximum global temperature increase of 1.5°C, the remaining "carbon budget" between now and 2050 must be limited to approximately 500 gigatonnes (Gt) of CO_2-equivalent (GHG) emissions[4]. In order to achieve this target, with no overshoot, the world simply cannot wait years or decades for idealized technological breakthroughs in generation, energy storage (grid-scale, long-term), grid and CCUS technologies to materialize and to be proven to be commercially viable. The time to act is now.

At this point in time, nuclear generation technology, along with hydroelectric, biomass and geothermal are the only proven low-carbon technologies, which can provide safe and affordable 24-hour *non-intermittent* dispatchable electricity. Furthermore, nuclear, biomass and geothermal technologies are the only low carbon technologies that are capable of efficiently and economically generating heat energy for residential, commercial and industrial applications. However, it should be noted that currently available and emerging nuclear technologies (such as Very High Temperature Reactors (VHTRs), Gas Cooled Fast Reactors (GCFRs) sand Sodium Cooled Fast Reactors (SCFRs)) offer significantly more versatility and efficiencies with respect to heat energy available and meeting the requirements of certain industrial processes, which require high temperature heat inputs that are currently being provided by fossil fuel based processes.

Nuclear generation is highly versatile and in addition to electricity production, can efficiently serve as the primary energy source to supply vast amounts of hydrogen, electrofuels, heat, cooling and desalinated water in most markets on an affordable and sustainable basis. Unlike hydroelectric, biomass and geothermal technologies, all of which all have limited capabilities to be further economically developed and scaled-up on a global basis (in most countries), nuclear is proven to be a technology that is scalable in almost any geography proximate to major energy demand centers. Nuclear power is also amongst the world's most *energy intensive* technologies, which translates into the least consumption of land and materials per unit of energy output.

Nuclear energy also provides the advantage of security of energy supply in many countries that are currently dependent upon imported fossil fuels, until such point in time when those countries can make a full transition away from fossil fuels.

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[4] Source: [5] – Chapter 2, Pg. 96. Note: 2018 reference of 580 Gt CO_2-equivalent budget for a "medium chance" (probability) of achieving 1.5°C warming has been reduced to account for approximately 80 Gt CO_2-equivalent emissions in 2019 and 2020.

In addition to today's existing and proven nuclear technologies (Generation III and III+ reactors), there are currently many other new emerging Generation IV nuclear reactor technologies, including advanced reactors and small modular reactor (SMR) designs, which may offer further improvements and enhancements relative to today's already proven nuclear generation technologies in terms of enhanced applicability, scalability, modularity, safety, versatility, affordability and potential reduction of radioactive waste. To the extent that these emerging nuclear technologies become commercially viable over the next years or decades, they may very well further improve the already strong case for nuclear power as a preferred technology in many markets, but we must not wait for these new technologies to become commercially proven and scaled-up.

While IBNI will initially focus on immediately supporting its members in deploying existing and proven nuclear technologies today, it is envisaged that IBNI will also play a role in supporting, both directly and indirectly, an acceleration in the deployment of new generation advanced reactor and SMR technologies. The Bank will directly promote the advancement of new generation nuclear reactor technologies directly by supporting 'first of a kind' demonstration projects and programs as well as providing necessary support for qualified development stage innovative nuclear companies, programs and projects from 'pre-conception through adulthood'. Perhaps more importantly, the Bank will also indirectly support new generation nuclear technology by developing global nuclear financial markets with a strong nexus to Environmental, Social and Governance (ESG) reporting requirements, promoting global demand for new low carbon nuclear technologies, as well as the investment in innovation and the advancement of global nuclear production and supply chains.

Under any 2050 net zero pathway scenario, *"2050 net zero needs nuclear - and nuclear needs IBNI"*. Why does nuclear need IBNI? Amongst the primary factors that have impeded the nuclear power generation industry's ability to scale up and compete globally over the previous three decades have been the related issues of lack of access to cost-effective nuclear-accommodative financing sources, together with the lack of affordability and competitiveness of nuclear (resulting from numerous factors, including cost-overruns and delays, liberalized and unbundled energy markets, lack of nuclear supportive regulatory regimes and other factors), in many markets, relative to other generation alternatives. IBNI will aim to facilitate and promote comprehensive solutions which address multifaceted financing, market, regulatory and the affordability/cost competitiveness issues that have recently plagued the nuclear industries in many countries. IBNI is the 'missing link', and it serves as the 'game changer' in nuclear finance, by offering a comprehensive solution to all challenges and impediments currently facing the nuclear sector.

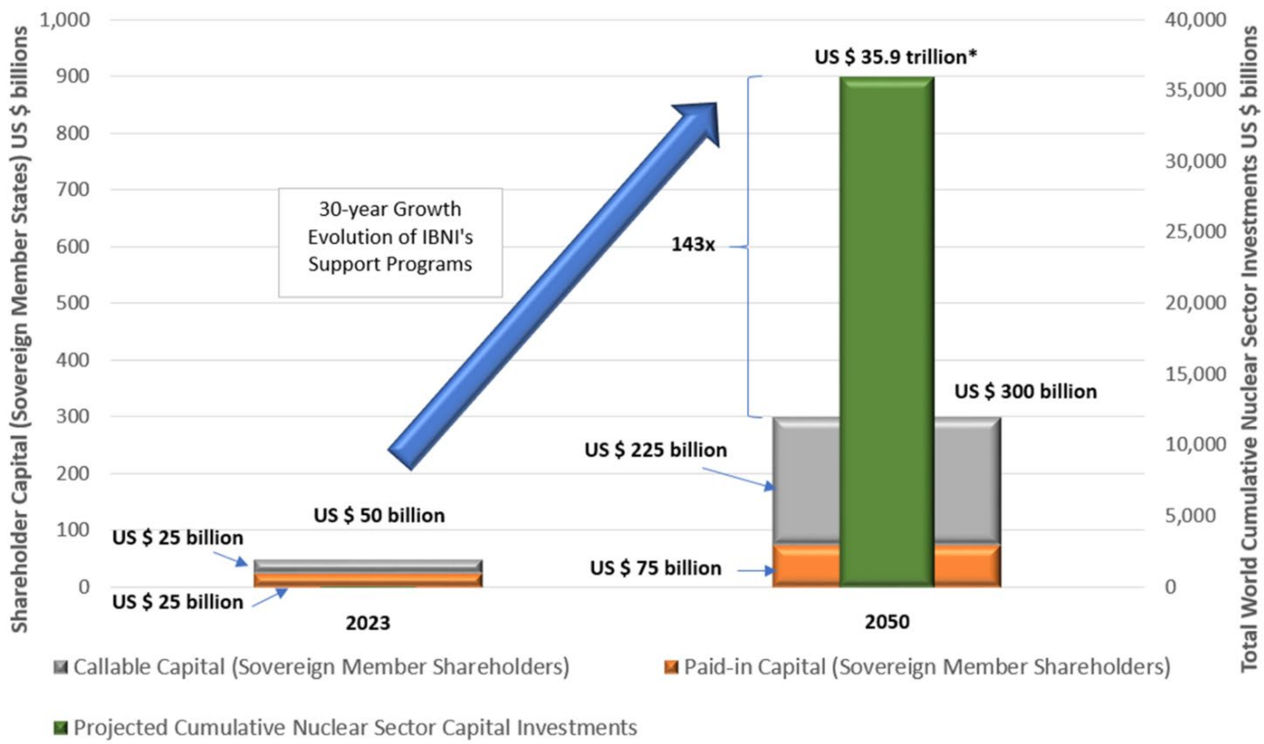
Photo Credit: Matthew Lancaster (Unsplash.com)

IBNI will support all types of qualifying nuclear new-build, reactor life extension and re-start, fuel cycle and decommissioning projects, on an open and transparent technology-neutral basis. As a condition for providing financing and other support for nuclear projects, the Bank will impose and enforce a rigorous set of standards and criteria upon project participants within terms of financing or support. In addition to ensuring that the highest possible thresholds and standards are met by participants in terms of nuclear safety, security and safeguards; commercial viability; regulatory frame works; and competitive procurement. IBNI's standards and criteria will also enable each IBNI-supported project to report well against the emerging ESG metrics.

Amongst the Bank's primary aims will be to catalyze broad and diverse participation from the global financial markets both in the form of private sector investments in the Bank and in the form of investments alongside the Bank for supported nuclear projects which report well against ESG metrics. IBNI's leadership and participation as the 'anchor investor' or 'anchor lender' in the global nuclear finance space is expected to drive significant new sources of capital into an accelerating pipeline of nuclear projects over the next three decades. Similar to the proven models of the existing multilateral IFI's, IBNI will seek to achieve a "multiplier effect" whereby for each government dollar invested by IBNI member states, IBNI will catalyze a multiple quantum of private sector investments in qualified and supported nuclear projects globally.

It is envisaged that IBNI will be established in early 2023, with Member States (a coalition of no fewer than 50 sovereign governments) initially contributing shareholder capital of US $ 50 billion (50% or US $ 25 billion of which will be paid-in and 50% or US $25 billion will represent callable capital). The capital requirement may be periodically increased as IBNI's programs grow over time. Applying similar models that have been utilized by other multilateral IFIs, it is projected that under high demand scenarios (in terms of demand for nuclear energy generation and for IBNI's support programs) that over a 30-year period, IBNI may catalyze up to approximately US $ 26 trillion[5] in total cumulative global nuclear sector investments. This "high-case" level of program activity would require Member States' collective shareholder contributions to increase to approximately US $ 300 billion (representing 25% or US $ 75 billion paid-in capital and 75% or US $ 225 billion callable capital) over a 15-year period. This would allow IBNI to directly provide support to qualified nuclear sector projects in the amount of over US $ 1.1 trillion[5] over 30-years. The total 'multiplier impact' of sovereign governments' capital investments in IBNI is therefore projected to approach 143x.

Projected IBNI Multiplier Impact on Cumulative Global Nuclear Sector Investments over 30 Years



Source: IBNI-IO SAG.

IBNI's membership (and shareholding) is foreseen to include a coalition of the International Atomic Energy Agency ("IAEA") Member States who subscribe in supporting IBNI's mission to significantly expand global nuclear power generation capacities as a key element of attaining 2050 global net zero. The Bank will empower each of its member countries, ranging from developing to advanced economies, to access cost-effective, non-discriminatory, and inclusive financing and support programs for the development or

[5] Inclusive of assumed average rate of inflation of 3.5% per annum.

expansion of their civilian nuclear power programs and industries, as an integral part of that country's commitments to 2050 net zero and sustainable development targets.

The financing instruments and support offered by IBNI will be uniquely tailored to address the specific requirements and known challenges and risks inherent with the financing of nuclear projects, the specific needs of the public or private project sponsor and shall also accommodate the specific economic circumstances and development objectives within the relevant IBNI member country hosting the nuclear project. IBNI's programs are envisaged to also complement existing nuclear development programs such as the IAEA's Integrated Nuclear Infrastructure Review (INIR) milestone framework. The Bank's uniform standards and criteria will align and comply with all IAEA nuclear safety, security and safeguards guidelines and relevant international nuclear treaties and conventions.

Another key focus of the Bank will be with respect to decreasing the cost (increasing the affordability) of nuclear energy options for all of its member countries. It will be essential to the mission of IBNI for the "clean premiums" of nuclear energy (and all low carbon generation) to be eliminated relative to the cost of fossil fuel generation. The steady decrease in and minimization of the cost of nuclear generation will be critical for the success of IBNI's mission and its *twin goals* of achieving 2050 global net zero and promoting robust and sustainable global economic development, prosperity and poverty eradication.

Not only will the energy generation sector need to fully decarbonize by 2050, but it will need to decarbonize in the *least cost manner* possible so as to avoid inhibiting sustained global economic growth. IBNI will play a catalytic role in driving down the costs of nuclear generation technologies, and this - coupled with continued decreasing costs of complementary renewables, storage and innovative grid technologies will achieve an elimination of all "clean premiums" relative to fossil fuel generation well in advance of 2050, inclusive of grid costs related to high levels of intermittent renewables. IBNI will drive nuclear generation cost reductions primarily through building significant global demand for nuclear technologies; reduction of capital and financing costs; promotion of international best practices with respect to projects risk allocations, contractual structures, regulatory frameworks and open and transparent procurement and competition; as well as the fostering of global private sector investments in nuclear innovation, production and supply chains.

This Initial Report and Action Plan (IRAP) is a report that builds the specific rationale describing why IBNI is urgently needed without delay, how it will be established, governed and capitalized and how it will operate. The IRAP also sets forth an actionable and concrete plan which identifies the specific steps and recommended time frames for achieving each step. Furthermore, the IRAP provides near-term (2030), mid-term (2040) and long-term (2050) targets and goals that IBNI as a results-based organization should be evaluated against. These targets are not intended to represent a "moonshot" – instead, they are realistic and achievable sets of milestones.

The IBNI initiative is being led by the International Bank for Nuclear Infrastructure – Implementation Organization (IBNI-IO) Strategic Advisory Group (IBNI-IO SAG). The IBNI-IO SAG has produced this IRAP. The IBNI-IO SAG is comprised of a group of multi-disciplinary experts from banking, economics, regulatory, legal, intergovernmental organization and nuclear industry backgrounds, who have come together to lead the IBNI initiative in its early stages. The composition of the IBNI-IO SAG is set forth herein.

It is currently envisaged that the IBNI-IO will be established by early 2022 as a not-for-profit entity with its main mission to assemble and advise a strong multi-dimensional coalition of governments, philanthropies, non-governmental organizations (NGOs), climate and clean energy policy and research institutions, and industry and financial markets organizations with respect to the optimal and timely establishment and formation of IBNI. Accordingly, it is envisaged that that IBNI will be established, by way of an international treaty by early 2023.

Members of the IBNI-IO SAG are extremely grateful for your organization's strong interest, support for and contributions to the IBNI initiative and the collaborative efforts toward achieving 2050 global net zero. We are happy to offer presentations on the IBNI initiative to your organizations and we are appreciative of all additional feedback.

The International Bank for Nuclear Infrastructure – Implementation Organization
Strategic Advisor Group

IBNI-IO SAG Membership

Member	Affiliation	Country
John Beardsworth	Retired Senior Partner, Hunton Andrews Kurth LLP	USA
Jacques Besnainou	Independent Consultant	USA
George Borovas	Managing Partner, Hunton Andrews Kurth LLP	Japan
Helen Cook	Principal, Global Nuclear Energy Advisory Pty. Ltd.	Australia
Daniel Dean*	Managing Director, Dean Capital Strategies GmbH	Austria
Ian Grant	Independent Consultant	Canada
Daniel Lipman	Independent Consultant	USA
Mark Moseley	Principal and Owner, Moseley Infrastructure Advisory Services (UK) Ltd.	UK
Paul Murphy	Managing Director, Murphy Energy & Infrastructure Consulting Services LLC	USA
Carlos Pabón-Agudelo	Managing Director, Infrastructure Economics Consulting, LLC	USA
Greg Pearce	Managing Director, Rigaud Capital Ltd.	UK
Fabienne Pehuet Lucet	Independent Consultant	France
Daniel Poneman	CEO, Centrus Energy Corporation	USA
Fiona Reilly	Managing Director, FiRE Energy Ltd.	UK
David Stearns	Independent Consultant	UK
Philip Strawbridge	Senior Vice President, Centrus Energy Corporation	USA
Matthew Stuart	Senior Attorney, Hunton Andrews Kurth LLP	USA
Dr. Timothy Stone	Chair, Nuclear Industry Association (UK)	UK
Paul Warren	Independent Consultant	Canada

* *Chair of the SAG.*

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1. Introduction

Key Points

- The Paris Agreement compels countries to pledge certain commitments toward Net Zero GHG emissions (in the form of National Determined Contributions or "NDCSs").
- Nations of the world will be required to transition their economic systems and energy infrastructure away from fossil fuels and towards clean energy generation sources such as nuclear and renewables.
- Nuclear is a low carbon, affordable, reliable and safe source of generation that can be widely deployed throughout the world as part of nations' strategies and policies to achieve 2050 Net Zero.
- IBNI support is essential for those nations pursuing nuclear projects and programs (including all IBNI Member States, ranging from developing countries to highly developed countries).

Since the 2015 Paris Agreement (the "Paris Agreement"), the vast majority of the nations of the world have already made significant commitments toward reducing their greenhouse gas (GHG) emissions in efforts to limit the maximum average global temperature increase to no more than 1.5°C by 2050. The Paris Agreement requires the United Nations Framework Convention on Climate Change (UNFCCC) signatories to submit National Determined Contributions (NDCs) which establish individual nations' commitments and policy frameworks oriented toward ambitious limitations on increased GHG atmospheric concentrations. Approximately 97% (191 out of 197)[6] UNFCC signatory members have submitted initial NDCs. Furthermore, the Paris Agreement[7] requests that each country's NDCs be updated every five years and should reflect a "ratcheting effect" providing successively more ambitious policy targets in terms of national GHG reductions.

Based on the 2018 United Nations Intergovernmental Panel on Climate Change (IPCC) report *Special Report on the impacts of global warming of 1.5°C (IPCC Special Report – 15 or IPCC SR 15)*, it has been recommended that UNFCCC members enact policies to achieve net zero GHG emissions by 2050[8]. As of 23 April 2021, some 80 countries have already submitted new NDCs or updated their initial NDC's to reflect more ambitious targets. Additionally, 44 countries and the European Union have pledged to meet net zero GHG emissions targets (with 10 of these having already made their net zero pledges a form of legal obligation)[9]. Unfortunately, the NDCs and net zero pledges submitted, and the underlying national decarbonization plans

[6] Source: https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs/nationally-determined-contributions-ndcs#eq-4

[7] Article 4 of the Paris Agreement (https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf) sets forth procedures for NDCs.

[8] Source: [5] - Summary for Policymakers, Section C

[9] Source: [6] - Section 1.2

and policies in place to date are insufficient to achieve even < 2°C warming. This suggests that there is still a great deal of hard work ahead of the nations of the world. Many difficult policy decisions are still ahead of many governments. Most nations still need to work out the question of *how* they will each achieve 2050 net zero in an economically and politically sustainable manner. It is widely anticipated that a significantly higher number of UNFCCC members will soon emerge with their own successively ambitious net zero pledges. The upcoming annual 2021 United Nations Climate Change Conference (COP26) in Glasgow, Scotland held in November 2021 will be a major forum for the UNPCCC signatory countries to discuss and agree on a global consensus toward the next level of ambitious NDC and net zero commitments amongst the individual member countries.

As progressively more countries evaluate their own NDC's and the degree to which they able and are willing to commit to aggressive and obligatory net zero pledges, it is critical to understand the economic and geopolitical realities and constraints facing each country. It is clear that any country who commits to achieving 2050 net zero will be required to enact politically difficult policies that are sociologically and economically transformative and are aimed at achieving the following by 2050:

- Complete transition away from fossil fuels (coal, oil and natural gas) and fossil fuel-based infrastructure and economic systems;
- Complete decarbonization of energy generation, industrial and transportation sectors and the built environments;
- Intensive electrification (also including hydrogen and electrofuels production and distribution systems) of industrial and transportation sectors and the built environment;
- Progressive re-balancing of agricultural, forestry and land-use (AFLU) systems to promote carbon sink offsets of residual GHG emissions from AFLU activities and GHG emissions from other non-energy sectors that may prove difficult or impossible to fully decarbonize in a practical and economically viable manner;
- Energy efficiency and a significant degree of "de-coupling" of economic development and energy consumption and carbon intensity per unit of economic output; and,
- Systemic and individual behavioral changes, with respect to governmental, commercial/corporate and individual/consumer energy consumption, carbon and other GHG intensive activities and behaviors.

Clearly, not every nation will implement the same, or even similar, sets of solutions and means toward achieving 2050 net zero and the rapid and progressive achievements of the above objectives. Each and every nation will face their own unique circumstances, limitations and realities which will impact which sets of solutions and pathways will be determined to be feasible and preferable with respect to the specific decisions and policies undertaken in their quests to commit to and achieve 2050 net zero. The international community should remain agnostic as to specifically *how* any particular nation chooses to achieve 2050 net zero. What is important is that each nation develops its own unique solutions and policies that will enable that country to achieve 2050 net zero on-time, and without any material adverse economic consequence or other adverse political, socioeconomic and environmental repercussions.

In this IRAP, our main focus is with respect to *how* nations will achieve full decarbonization of their energy sectors by 2050 (and with due consideration to the interrelated and incremental electricity demands that will be placed upon the energy generation, transmission and distribution sectors, through transition away from fossil fuels and intensive electrification of the industrial and transport sectors and the built environment). Under any analysis, it will be a monumental task for the nations of the world to collectively transform the world's current fossil fuel dominated, carbon-intensive economic foundations and infrastructures in order to supply up to 95 PWh's/year of global electricity demand from clean, low-carbon sources of energy by 2050, and without undermining global economic development. Each nation has a unique set of "tools in their toolkits" which they will take upon themselves to determine which solutions are economically, politically, socially, environmentally and technically feasible, acceptable and accessible for the achievement of 2050 net zero pledges. Some nations – particularly those that are particularly well-endowed with significant developable renewable energy resources (and coupled with energy storage and electricity grid investments and solutions) relative to their energy demands – may determine that it is technically feasible and practical for them to achieve 2050 net zero, including a complete transition away from fossil fuels, with full or an almost entire reliance upon renewable energy solutions. However, a near-100% renewables solution will not be feasible for every country and in many other cases may be neither practical, acceptable nor affordable even in situations where near-100% renewables may be technically feasible. The most likely scenario is that many nations will determine that a range of low-carbon energy technologies and strategies (including applications of various combinations of low-carbon generations technologies, including renewables and nuclear generation, storage, intelligent grid and demand-side management) will be necessary to achieve 2050 net zero in a long-run sustainable manner.

As a complement to renewable energy sources, nuclear may be considered as one of several viable low carbon generation technology options available for many nations to achieve their 2050 net zero pledges. Clearly, nuclear energy may be considered controversial by certain nations and their citizens, and therefore nuclear may not be considered a viable and acceptable low-carbon generation solution for those specific countries. However, for many countries, nuclear generation is and will remain an existing and proven, low carbon, dispatchable, affordable, safe and scalable energy generation technology option that is accepted by their governments and citizenry. As additional countries examine their specific options available and weigh the risks of climate change versus the benefits of nuclear as a low carbon dispatchable generation technology applicable to the decarbonization of their energy sectors, it is predictable that many more nations will consider nuclear as one of their low-carbon generation options.

Currently there are 30 countries that have already included nuclear power in their generation mix and have operating commercial nuclear reactors. According to the IAEA, the world currently operates a fleet of 443 commercial reactors, with a total installed capacity of 393.2 gigawatts, electrical output (GW_e). This existing global fleet of nuclear reactors provides reliable and low-carbon power generation equal to approximately 10% of total annual worldwide electricity generation. In addition, there are 51 additional nuclear reactors currently under construction in 19 countries, which will provide an additional 53.9 GW_e of installed capacity[10]. Furthermore, there are currently 21 counties in the IAEA's Integrated Nuclear Infrastructure Review (INIR) program, which includes countries that are at various stages of planning and developing either new nuclear power programs or expanding existing nuclear programs. Moreover, there are currently approximately 50 countries that have existing or planned civilian nuclear power programs.

It is envisaged that IBNI will offer financing and other forms of support for qualified nuclear projects within its member countries that are either currently operating existing nuclear reactors or have plans to add nuclear generation in the future, plus a potentially large influx of additional newcomer nuclear energy states over the next 30 years. IBNI's programs will be expressly aimed at expanding, renewing and extending each member country's (and therefore the world's) nuclear generation capacities, in the safest, most efficient and affordable manner possible. IBNI's core mission will be to empower each of its member/shareholder states to access affordable nuclear energy as a key component of their initiatives to achieve the *twin goals* of: a) 2050 net zero; and, b) sustainable economic development and prosperity for their people. IBNI's membership (shareholding) is envisaged to include a voluntary and diverse coalition of member nations, ranging from developing and industrializing countries to advanced, highly developed economies. IBNI will provide much needed non-discriminatory financing and other support available to nuclear project sponsors in all IBNI member states, tailored to the specific economic and developmental conditions within each specific country and regional markets.

On a non-discriminatory and on a technology-neutral basis, IBNI will provide financing and other forms of support for civilian nuclear projects in the following five categories:

- New build projects (including large reactors, advanced / small modular reactors, micro reactors and potentially nuclear fusion technologies in the future);
- Reactor life-extensions and re-start projects;
- Refinancing and financial restructuring projects;
- Fuel cycle projects; and,
- Decommissioning projects.

IBNI's capitalization and governance structure is envisaged to be based on a model, which is similar to the major multilateral IFIs that have been in existence and have successfully fulfilled their missions for many decades (such as the World Bank Group/International Bank for Reconstruction and Development, the European Bank for Reconstruction and Development, Asian Development Bank, Inter-American Development Bank, African Development Bank, etc.). Similar to the existing multilateral IFI models, IBNI's controlling (common) shareholders are envisaged to be comprised of a coalition of sovereign nations. In addition to the government coalition's role as governing shareholders in IBNI, the Bank will also be positioned to attract direct investment from the global capital markets, in the form of debt capital (bonds and other debt

[10] Source: [15].

securities issued by IBNI)[11]. One of the key objectives of IBNI will be to increasingly drive the global capital markets into the nuclear sectors. This will be achieved by attracting capital markets investors directly into the Bank, as well as catalyzing participation from the global markets in qualified nuclear projects alongside IBNI. Consistent with the existing multilateral IFI models, IBNI will strive to create a "multiplier impact", whereas for every dollar of government equity investment in the Bank, IBNI's support will affect many multiples of investment volumes in qualified nuclear energy projects, globally. Equally important to availing significant quantums of global capital investment to nuclear projects, IBNI also will effectively drive-down the cost of capital for Bank supported nuclear projects, through both direct support from IBNI's financing programs and indirectly by creating acceptable project investment risk profiles whereby sources of lower-cost long-term capital (such as pension funds, infrastructure funds, insurance companies, sovereign wealth funds, etc.) will participate directly in projects alongside of IBNI.

IBNI will adopt, evaluate and enforce a rigorous set of universal, nuclear specific standards and criteria applicable to the nuclear projects and programs that it supports. Currently, amongst other challenges in the nuclear finance space, there is no universally accepted set of "nuclear specific Equator Principles" or "nuclear specific World Bank / International Finance Corporation Environmental & Social Performance Standards" which, in nearly all other infrastructure sectors, serve as standard benchmarks for international investors and lenders. IBNI will serve as the benchmarking institution and a data aggregator in global nuclear finance.

IBNI's programs will be competitively administered. While the IBNI "standards" will be binary (pass or fail), the "criteria" will be competitively evaluated and scored, which creates a market-based mechanism for nuclear project sponsors to compete for scarce IBNI financing and support. In effort to achieve most favorable consideration for IBNI support, the competing project sponsors and their national governments (IBNI member states) will therefore be compelled to adopt and enact policies and appropriate market and regulatory frameworks that are supportive of sustainable long-term nuclear generation programs, which complement renewables and other low-carbon generation supporting of overall net zero commitments. Given that IBNI's financing and support programs will be finite and competitively sourced, in situations where project applicants are unable or unwilling to enact policies and undertake the tough political decisions and regulatory reforms measures which will allow for nuclear power to be fairly and sustainably supported within their energy markets, such countries will find themselves at a competitive disadvantage for receiving IBNI support to advance their nuclear programs. Therefore, IBNI will provide a very effective competitive and market-based incentive structure for governments and project sponsors to enact policies and frameworks that create a "level playing field" and enable nuclear generation to be competitive with respect to other low-carbon technologies, and ultimately result in projects sustainable from a financing and investment perspective.

Evolving Environmental, Social and Governance (ESG) metrics are rapidly transforming the global financial markets. IBNI itself as well IBNI standards and criteria applied to nuclear projects that the Bank supports will

[11] In the future, after the Bank's operations have been established, a portion of the shareholder's capital (equity) may be funded through the global capital markets in the form of preferred equity shares (non-voting). This option and the details of IBNI's capitalization structure is set forth in Section 6.

be tailored to promote the most favorable reporting against these evolving ESG metrics. Consideration of ESG metrics are seen as critical “enabling criteria” for allowing a targeted rapid expansion in the participation of the global capital markets in IBNI and alongside IBNI in the nuclear projects that it supports. While ESG reporting is an enabler for capital markets participation, it will be IBNI’s lead role in prudently and effectively setting and enforcing rigorous standards and conditions, project structuring and managing the unique risks and challenges inherent in financing nuclear projects, that will give third party investors and lenders necessary confidence required to invest or lend. IBNI will serve in the role of a “lead anchor investor or lender” and lead project structuring and due diligence in qualified nuclear projects (and in countries that have enacted policies and regulatory frameworks that provide the appropriate underlying conditions supporting the long-term competitiveness and sustainability of nuclear power). Serving in this capacity with the aim to stimulate capital market participation is a typical role that the existing multilateral IFIs assume in a project and which has been effectively demonstrated.

Over the past 3 decades, the development and financing of nuclear projects has been increasingly challenging in western (North American and European) markets due to the following key well-understood factors: (a) lack of constant stream of repetitive “n^{th}-of a kind” nuclear projects, which has greatly weakened the global nuclear value chains, and has diminished economies of scale, skilled human capital resources and knowledge-by-doing, and has also curtailed investment, innovation and competition – all of which has contributed toward driving up costs of nuclear power; (b) significant project cost overruns and delays; (c) unsustainable and subsidized fossil fuel policies which have unfairly depressed wholesale electricity prices; (d) deregulated energy markets and regulatory frameworks that do not support nuclear and other capital-intensive energy technologies; (e) lack of fair compensation mechanisms for reliable dispatchable capacity and valuing nuclear as a low-carbon energy source; (f) incentives, subsidies and support mechanisms offered to competing fossil fuels and renewables to the detriment of nuclear; (g) changes in nuclear regulations during project construction; (h) reliance upon utilities financing nuclear projects (increasingly operating in deregulated and unbundled markets); (i) lack of sufficient carbon pricing mechanisms and carbon price levels; (j) public opposition related to the perceived safety risks related to nuclear power generation; and, (k) lack of clear long-term government policies supporting nuclear generation. All of these factors combined, have resulted in the reduction of nuclear investment and a dramatic scaling-back of both nuclear power plant construction starts and life-extensions and re-starts of existing nuclear reactors. While nuclear capacity is still rapidly growing in markets such as China, Russia and India and other emerging markets (largely through state-sponsored nuclear financing mechanisms), the continued lack of investment in new nuclear reactors, globally coupled with the fact that world’s existing nuclear fleet (which is now over 30 years old, on average) may be prematurely decommissioned, world nuclear capacities are projected to precipitously decrease, if the current trends are left unabated. Failure to address the structural problems in energy markets (such as the USA and EU) will lead to significant premature closures of many safe and reliable nuclear reactors over the next decades, resulting in very significant losses in low-carbon generation, exacerbating problem of achieving 2050 net zero in those countries.

IBNI’s programs will be specifically designed to create the necessary global foundations and appropriate incentive mechanisms offered to individual members states to enable market and regulatory reforms, which will favor large-scale nuclear deployment. These mechanisms will also enable nuclear to fairly compete with other low-carbon technologies, and therefore mitigate the above issues. The intended result is that IBNI will enable expansion of nuclear generation across both existing nuclear countries and many more 'newcomer' nuclear countries alike. Both existing and 'newcomer' nuclear states will see the development and expansion of their nuclear programs as a feasible, accessible, affordable and financeable option available as a key component of their 2050 net zero strategies. IBNI's active engagement and promotion of solutions to the current issues plaguing the current nuclear industry is intended to reverse the current global trends demonstrated in the nuclear industry, which will allow the nuclear industry to significantly expand and thrive, once again.

2. Global Net Zero by 2050

Key Points

- 2050 Net Zero requires all GHG-emitting sectors to achieve Net Zero by 2050.
- A full transition away from today's fossil fuels based economic systems and infrastructure is required by 2050.
- Full decarbonization of the global power generation sector and a full transition away from fossil fuels are both critical for achieving 2050 Net Zero across all sectors.
- Nuclear energy is a critical component within any global 2050 Net Zero pathway scenario.

As already established in Section 1 - *Introduction* of this IRAP, achieving net zero by 2050 is quickly becoming the guiding policy target for the nations of the world in effort to collectively limit anthropogenic global average temperature increases to no more than 1.5°C relative to pre-industrial levels. It is also well-understood that the actual achievement of global net zero by 2050 will require unprecedented levels of societal and economic transformation and international co-operation in the span of only 30 years. It is clear that the risks of inaction (or insufficient action) are extremely high and any "business as usual" approach by the nations of the world will certainly not resolve the climate crisis, resulting in predictable dire consequences for humanity and the environment.

Each nation of the world is now faced with the enormous task of developing 30-year actionable and achievable plans, strategies and policies that will provide the economically sustainable means to achieve maximum possible decarbonization of their respective energy, industry and transport sectors, and built environments. Nations will need to otherwise mitigate or provide carbon sinks to offset all other residual GHG emissions across their AFLU and industrial sectors that may otherwise prove difficult or impossible to fully decarbonize through application of affordable, proven and emerging technological solutions. It should be borne in mind that the current 171 NDCs (80 of which have been updated and also considering the 44 plus EU net zero pledges) currently in place under the Paris Agreement and UNFCCC frameworks do not provide for the collective achievement of even +2°C average global temperature increase, let alone <1.5°C. The vast majority of the NDC's of most nations are currently "toothless" and have no associated binding commitments even with respect to the insufficiently ambitious GHG emissions targets initially offered. As of August 23, 2020 only 10 UNFCCC signatory nations have put in place any legally binding net zero obligations.

What is abundantly clear is that the key issue facing most countries, and the vast majority of those nations responsible for the vast majority of GHG emissions and fossil fuels consumption, will be *how* they go about adopting and enacting acceptable and sustainable policies, plans and strategies aimed to achieve their 2050 net zero commitments. Achieving the necessary enactment of such policies required achieve 2050 net zero will be undoubtedly transformational and overcoming the political and economic resistance and pressures for inaction, delay and "business as usual" from well-established market forces (such as those from the entrenched and well-funded fossil fuels interests) will be tremendous. Such required transformational changes to the economic foundations in any nation are fraught with economic and political risks. Such transformations may result in economic winners (industries that are able and willing to adapt to new realities) and losers (those industries that are unable and unwilling to adapt to new realities). Policymakers will need to be extraordinarily adept in navigating these political and economic waters, both in term of overcoming market inaction forces as well as avoiding any unintended detrimental market consequences, such as capital markets shocks and investor panic which could result from abrupt policy changes impacting some of the world's largest industries (such as fossil fuels).

Irrespective of the very significant challenges as they are, achieving 2050 net zero will require a complete decarbonization of each nation's energy sector (as discussed below) as well as a complete transition away from fossil fuels. As stated above, there will be no "one size fits all" solution to achieve 2050 net zero. Each nation will need to develop its own solution and policies which will enable it to achieve 2050 net zero considering the specific economic and political limitations and circumstances relevant to that country. It is predictable, however; that many countries will develop plans and policies that involve some combination of the following common technological, efficiency/conservation and behavioral elements:

- Rapid replacement of carbon-intensive energy sources (fossil fuels) with clean and sustainable low-carbon sources such as renewable technologies (various combinations of hydro, wind, solar, geothermal, biomass, wave and tidal) and nuclear generation;
- Complete decarbonization of the energy generation, industrial and transportation sectors as well as the built environment (applying CCUS to industries – for example cement and steel production – in cases where certain industries prove to be otherwise difficult to economically decarbonize);
- Intensive electrification (including hydrogen and electrofuels) of industrial and transport sectors and the built environment;
- Evolution of flexible, dynamic and decentralized intelligent electricity grids which have the capabilities to accommodate increased sources of geographically dispersed intermittent renewable generation, storage, interconnections, and evolving dynamic demand profiles resulting from increased electrification and energy storage;
- Energy efficiency and conservation measures; and,
- Policies and incentives to affect systemic and individual consumer behaviors with respect to energy consumption (including carbon pricing/carbon emissions trading, dynamic time-of-day pricing and incentives).

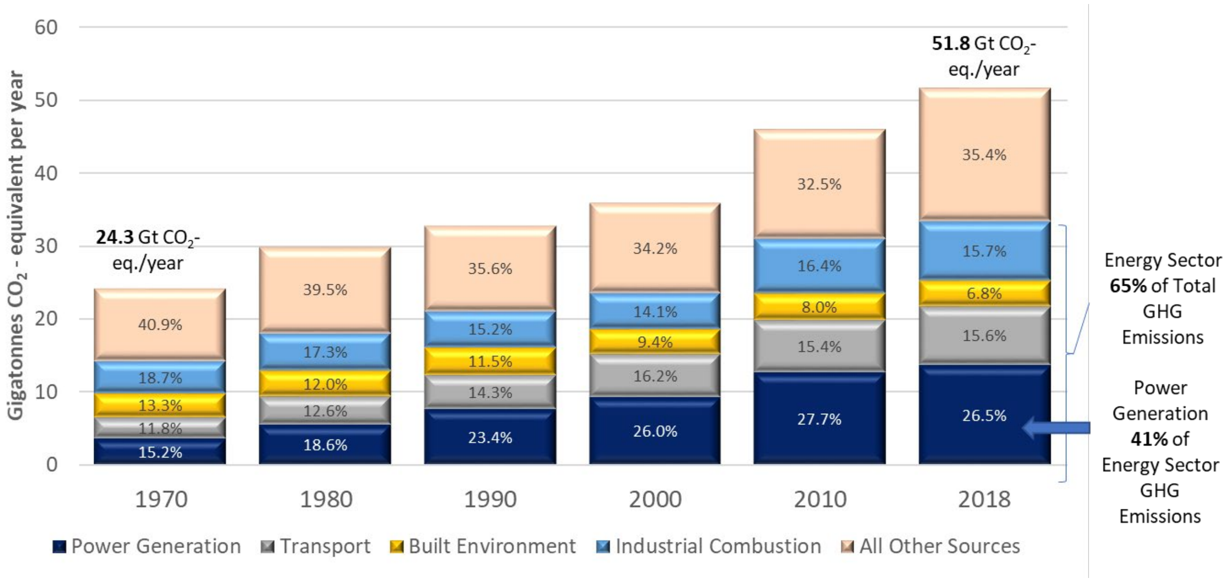
2.1 Full Decarbonization of the Global Power Generation Sector is Necessary

The achievement of net zero in the power generation sector no later than 2050 is amongst the most important and readily achievable components of climate change mitigation plans designed to limit the rise in global average temperature to no more than 1.5°C above pre-industrial levels. The worldwide effort to rapidly decarbonize the electricity generation sector, in a rapid and economically viable manner, is also inextricably linked to the decarbonization of all other energy-intensive sectors, such as industry and transportation as well as the built environment. Therefore, decarbonization of the power generation sectors should be the quintessential aim and priority of all nations in their pursuit of 2050 net zero policies. For example, under the IEA's NZE scenario, emissions from power generation are projected to fall to net-zero in aggregate in advanced economies by 2035 and globally by 2040[12]. The Intergovernmental Panel on Climate Change (IPCC) states that "[T]he electricity sector is completely decarbonized by mid-century in 1.5°C pathways…"[13].

Why is decarbonization of the power generation sector such a critical target in the pursuit of net zero GHG emissions by 2050? The energy sector (including energy utilization in the power generation, industry, and transportation sectors and the built environment) is currently responsible for almost two thirds (65%) of the total GHG emissions globally[14] Power generation remains the single largest source of energy-related CO_2 emissions today, accounting for approximately 41% of total energy-related emissions and 27% of all GHG emissions (compared to 15.2% in 1970). CO_2 emissions from electricity generation totaled 13.6Gt in 2019, of which 9.8Gt was from coal-fired generation and 3.1Gt was from gas-fired plants[15]. It is also worthy to note that while global GHG emissions for the electricity generation sector have more than tripled since 1970, even despite the recent rapid growth in renewables, the percentage of low carbon generation has steadily decreased since 1970. This has been due in large part to the retirements of and failure to extend, renew or and replace as well as expand world nuclear generation capacities over the previous decades[16], while at the same time there has been further reliance on coal and gas to meet the world's generation needs.

[12] Source: [5] - p. 99.
[13] Source: [5] – p. 137.
[14] Source: [3] - p. 13
[15] Note: Related to gas fired generation, does not include methane emissions related to gas extraction, which is an additional and significant source of total world GHG emissions. Source: [1]
[16] Source: [3] - pgs. 13 and 26.

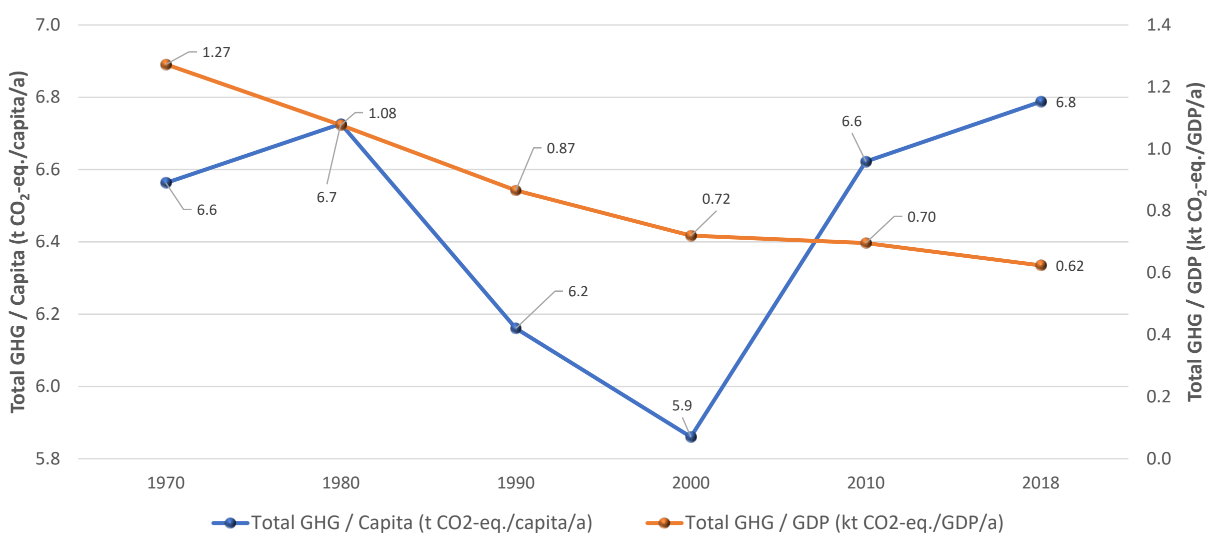
FIGURE 1 - WORLD GREENHOUSE GAS EMISSIONS BY SECTOR (1970 - 2018)



Data Sources: [7] and [8].

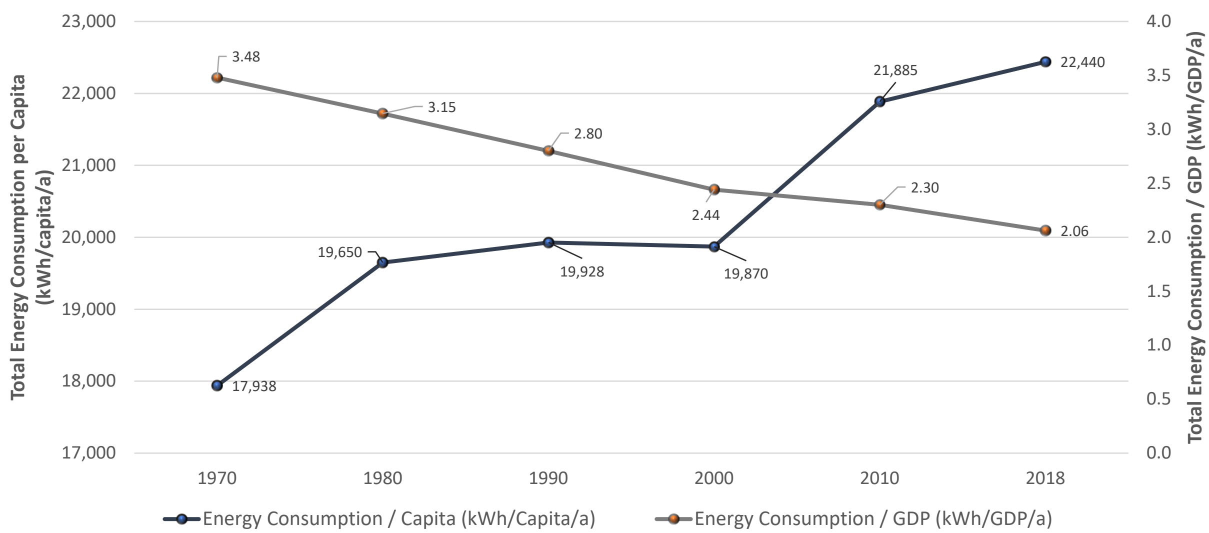
Over the past five (5) decades, the world has been increasingly successful in de-coupling economic growth with both energy consumption and GHG emissions (as shown in Figures 2 and 3, below). Both energy consumption and GHG emissions have decreased per unit of GDP. However, these gains have not been sufficient to offset overall increases in total worldwide energy demand and GHG emissions. Total energy consumption and energy consumption per capital, as well as total GHG emissions and GHG emissions per capita have each increased since 1970. The trends of increasing total world energy consumption, energy consumption per capita (and particular, total electricity consumption and electricity consumption per capita) are likely to continue and significantly accelerate, to the extent that population growth, robust economic development, improvements in living standards and electrification rapidly accelerate. Given these trends, significantly increased volumes of energy (and in particular, electrical energy) will need to be provided on both an affordable and low carbon basis. This is inherently the global challenge over the next three decades.

FIGURE 2 – WORLD GHG EMISSIONS PER CAPITA AND PER UNIT OF GDP (1970 - 2018)



Data Sources: [7], [8], [9] & [10].

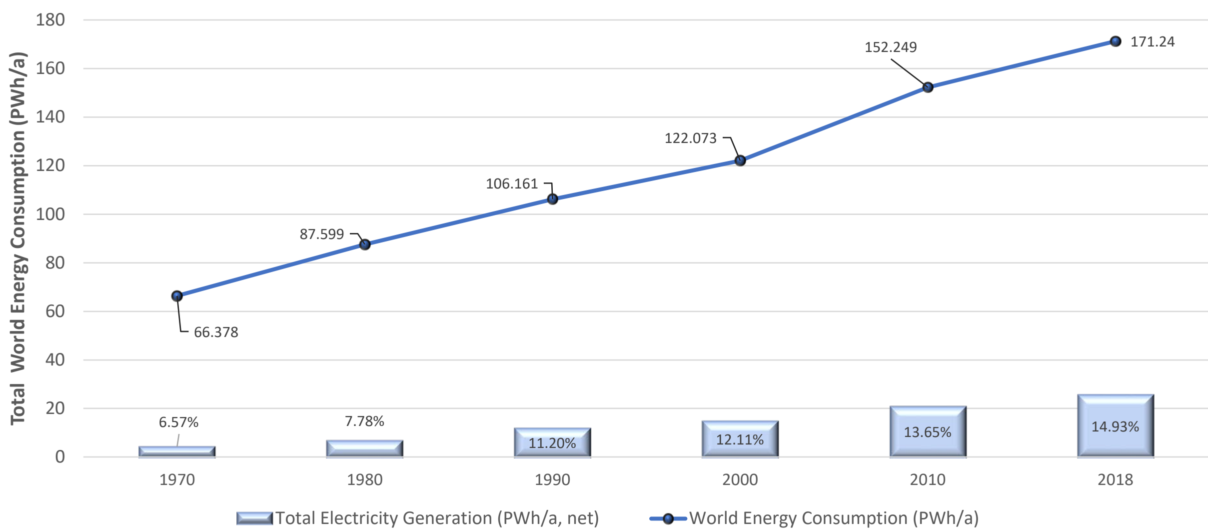
FIGURE 3 - WORLD ENERGY CONSUMPTION PER CAPITA AND PER UNIT OF GDP (1970 - 2018)



Data Sources: [9], [10], [11] & [12].

As total world energy consumption continues to escalate, and energy consumption continues to increase both on a per capita and per unit of GDP basis, also the share of electricity in final energy consumption continues to increase.

FIGURE 4 - TOTAL WORLD ENERGY CONSUMPTION AND ELECTRICITY'S SHARE OF CONSUMPTION (1970 - 2018)

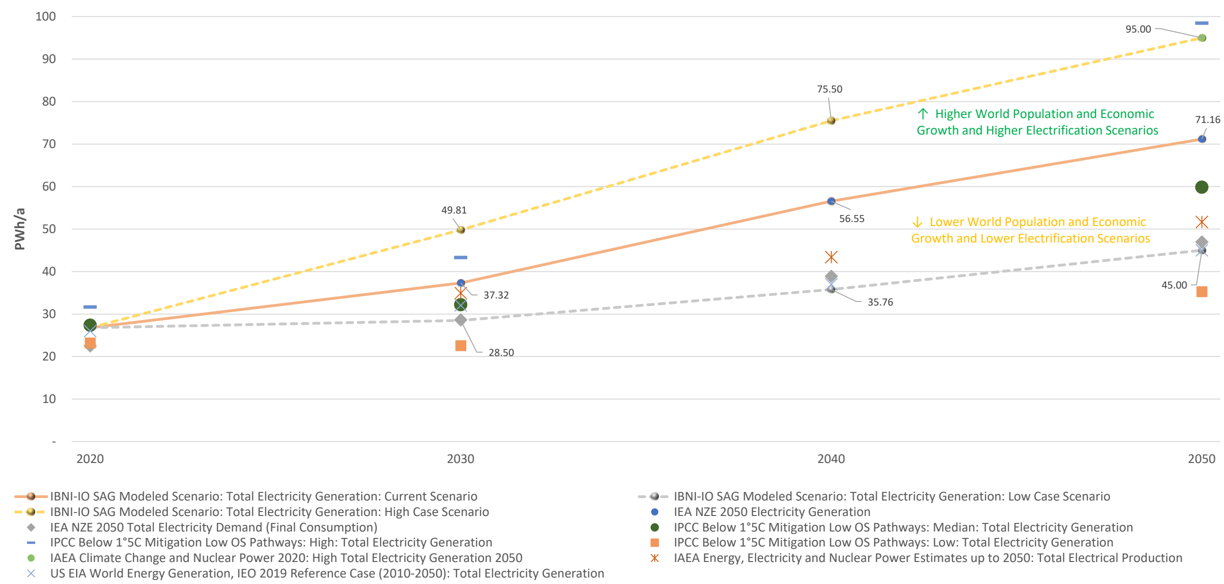


Data Sources: [11], [12] & [13].

Different 1.5°C pathways contemplate different trajectories for electricity demand. Despite significant gains in energy efficiencies and behavioral changes, global demand for electricity (and other related electricity-based carriers of energy such as hydrogen and electrofuels) is projected to increase significantly over the next three decades. This additional electricity demand is expected to result from a combination of global population growth, economic development, intensive electrification and transition away from fossil fuels in the industrial and transport sectors as well as in the built environment. Under the four pathway scenarios in the IPCC SR15 report, 2050 electricity consumption is projected to reach between 27 PWh/a and 95 PWh/a (which corresponds to a range of 6% to 272% increase over 2018 levels of approximately 25.6 PWh/a)[17]. The assumptions embodied for the high-range demand include both robust and sustained global population and economic growth, coupled with intensive electrification as well as build-out of hydrogen and electrofuels infrastructure. In-line with IBNI's core focus on promoting sustainable economic development, we have assumed the higher-end of the demand range will most likely materialize between now and 2050.

[17] Source: [3] - p. 16

Figure 5 - World Electricity Demand Forecasts and IBNI-IO SAG Modeled Cases



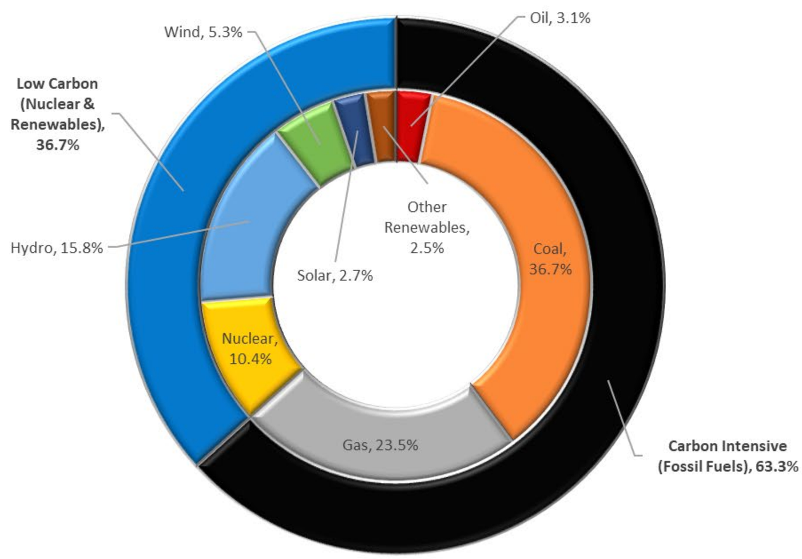
Data Sources: [3], [5] & [6].

If the doubling, tripling or quadrupling of global power generation by 2050 is not to be accompanied by a corresponding doubling, tripling or quadrupling of GHG emissions from the sector then it is clearly essential that the power generation sector must be rapidly decarbonized to the fullest extent possible. As discussed above the IEA's NZE envisages emissions from power generation fall to net-zero in aggregate in advanced economies by 2035 and globally by 2040. The IPCC envisages the carbon intensity of electricity falling rapidly to -92 to 11 gCO_2/MJ by 2050[18] Under any scenario, the power generation sector will need to rapidly transform it current generation mix, which currently includes about 63% carbon intensive fossil fuels (dominated by coal and gas fired generation) to an energy mix comprised entirely of low carbon generation sources comprised of only nuclear and renewables. Carbon intensive fossil fuels currently provide about 84% of total energy mix (primary sources)[19]. The world's power generation industry will have less than three (3) decades to make this monumental transition away for fossil fuels and bring the low carbon generation mix (nuclear and renewables) up to 100% on global scale. Clearly, there is no time to waste.

[18] Any residual carbon emissions from low-carbon generation sources, are typically related to the life-cycle emissions related to the extraction of raw materials, transportation, manufacturing, assembly, construction, installation, operations, maintenance and decommissioning and the disposal/recycling of materials. To the extent that scaled-up generation from biomass energy with carbon capture (BECC) becomes technically and commercially viable, net GHG emissions from the power generation sector could actually become negative.

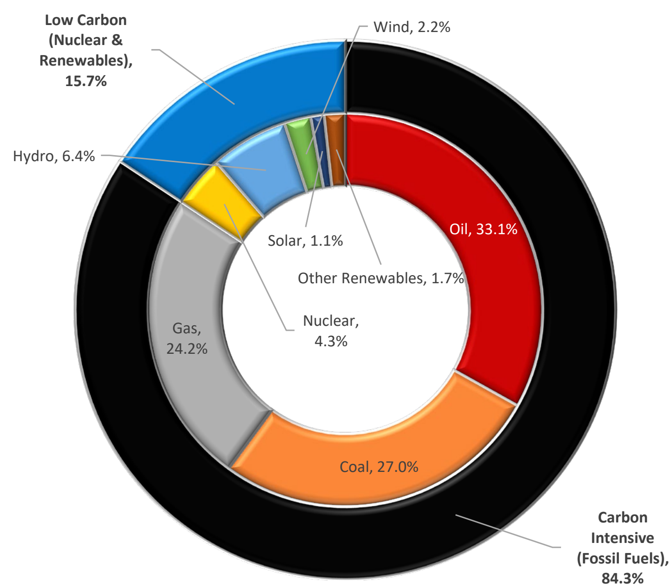
[19] Source: [12].

FIGURE 6 - 2019 WORLD ELECTRICITY GENERATION MIX



Data Source: [12].

FIGURE 7 - 2019 WORLD TOTAL ENERGY MIX (PRIMARY SOURCES)



Data Source: [12].

2.2 Why Nuclear Energy is Needed Under Any 2050 Net Zero Pathway

"*Nuclear is integral to the clean energy transition*"

- Dr. Fatih Birol, IEA DG, March 2021

Decarbonization as drastic as that discussed above in section 2.1 will require first a dramatic reduction and then a rapid complete transitioning away from existing fossil fueled generation. As the IEA notes: "Net zero means a huge decline in the use of fossil fuels. They fall from almost four-fifths of total energy supply today to slightly over one-fifth by 2050. Fossil fuels that remain in 2050 are used in goods where the carbon is embodied in the product such as plastics, in facilities fitted with [Carbon Capture Utilization and Storage], and in sectors where low-[carbon]emissions technology options are scarce."[20]

Nuclear power has amongst the lowest carbon emissions of all generating technologies (see section 3.3) and many experts regard a significant acceleration of investment in increased nuclear capacity as a key component of pathways to achieve net zero by 2050. Nuclear power in combination with renewables offers the only proven, scalable and affordable strategy to replace carbon-intensive fossil fuels generation over the next three (3) decades.

Recent analysis of four hundred (400) GHG mitigation climate mitigation scenarios showed a clear relation between the deployment of nuclear energy generation and the chances of limiting the average global temperature to less than 1.5°C above its pre-Industrial Revolution level[21]

Annual nuclear investment is projected to more than double by 2050 compared with current levels under the IEA's NZE[22]. At its peak in the early 2030s, global nuclear capacity additions are 30 GW per year – which is five times the rate of the past decade[23]. Even at these levels, the NZE pathway scenario reaches 70% VRE penetration, which SAG contends, while this may be technically feasible, it will most likely be unaffordable in most energy markets due to very high "system costs" related to high VRE penetration (see section 3.1) Therefore, SAG maintains that a much higher nuclear penetration will be required in order to achieve full decarbonization of the nuclear sector in an *affordable* manner.

SAG advises that targeted global 2050 VRE penetration should ideally be kept to 30% or less in order to avoid excessive VRE-related "system costs" and consequential heavy burdens on electricity consumers and the stifling of global economic development[24]. Given that the global resources for dispatchable forms of renewable generation (such as hydrological, geothermal and biomass) have limitations on their further exploitation, limiting VRE to less than 30% penetration will necessarily require a much more significant

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[20] Source: [6] – pg. 18.

[21] Sources: [4], Fig. 10, and [5].

[22] Source: [6] – pg. 81.

[23] Source: [6] – pg. 115. *The World Nuclear Association (WNA) regards the NZE scenario as unduly conservative regarding the expansion of nuclear generation required to achieve power sector decarbonization, arguing that it relies too heavily on the deployment of technologies that are "uncertain, untested, or unreliable…"* Source: [17]. In this context it is important to note that fission-based nuclear generation is a proven technology.

[24] In the IEA report "*The Costs of Decarbonization – System Costs with High Shares of Nuclear and Renewables (2019)*", it is estimated that VRE with 75% penetration can add more than US $ 50/MWh in additional "system costs" to electricity generation costs (plant costs). Source: [14] – pg. 20.

growth in global nuclear generation capacities by 2050. In contrast to the IEA's 2050 NZE scenario, SAG advises that global nuclear penetration should reach at least 50% of the world generation mix by 2050. IEA's 2050 NZE scenario shows nuclear falling to approximately 8% of the total global electricity generation mix in 2050[25]. Achieving this rate of growth in global nuclear capacities is significant, but not unprecedented on a historical basis. For example, under our SAG analysis, achieving a 60% nuclear share of the power generation mix in 2050 would require an estimated annual growth rate in worldwide nuclear capacity expansion 21.8% CAGR per year between 2030 and 2040 and a 4.6% CAGR per year between 2040 and 2050. This compares with IEA's nuclear growth rate of under the 2050 NZE of only 2.4% CAGR between 2020 and 2050. There is already strong evidence that the world's global nuclear industry can meet the challenge of scaling up nuclear generation to these levels. Why? Because this industry has already delivered higher capacity growth rates in the past. For example, between 1970 and 1980, global nuclear installed capacities demonstrated an average annual increase of 22.4% CAGR per year[26].

Viewed from the perspective of system requirements it is important to recognize that nuclear is a non-intermittent and dispatchable generation technology. Intermittent or variable renewables (VRE) technologies alone cannot fully replace dispatchable technologies; as back-up (low carbon) generation or grid-scale storage of various kinds (e.g. pumped-hydro storage, utility-scale battery arrays, thermal compressed gas energy storage; conversion to hydrogen and hydrogen-based fuels and other storage technologies and their related incremental infrastructure requirements) are needed. Various types of emerging and unproven utility-scale storage technologies are promising, but batteries also can pose both technical and economic challenges. The successful integration high shares of VRE into power systems – and the cost of compensating for the associated difficulties – remains an area of challenging research. Perhaps the IEA summarizes it best as it analyses the transition to a low emission global energy system: "Wind and solar energy need to play a much greater role in order for countries to meet sustainability goals, but it is extremely difficult to envisage them doing so without help from nuclear power."[27]

[25] Source: [6] – pg. 198, Table A.3 Electricity.
[26] Source [15] – pgs. 16 – 18, Table 7.
[27] Source: [6]

3. Nuclear is Affordable, Reliable, Low Carbon and Safe

Key Points

- Nuclear energy can be considered as the *least cost* solution to achieve Net Zero.
- Nuclear energy requires the *least total capital investment* to achieve Net Zero.
- Nuclear energy is the *least intensive* form of low carbon generation in terms of land and materials consumption.
- Nuclear energy offers the *greatest* low carbon reliability (24/7 dispatchability) & security of supply.
- Nuclear energy offers a *safe* form of generation, which has been proven over almost 7 decades.
- Nuclear energy offers the most *sustainable* pathway toward 2050 Net Zero.

Nuclear energy may be considered controversial in some countries for a number of well-understood and respected reasons, which includes reasonable concerns ranging from safety, proliferation of nuclear technologies and security, nuclear waste storage and disposal issues as well as affordability and accessibility issues. Despite all reasonable concerns and criticisms concerning nuclear energy, nuclear indisputably offers one of the lowest life-cycle carbon emissions generation technologies, and which is also proven to be highly affordable, reliable, scalable and safe. In current market contexts, nuclear also offers nations with security of supply. All nations considering whether to utilize nuclear energy as part of their 2050 net zero strategies, must carefully weigh both the real and perceived risks versus the tangible and proven benefits of nuclear generation relative to all other means of achieving full decarbonization of their power generation sectors and broader net zero and economic sustainability policy initiatives.

In the SAG's view, there are currently only two sustainable low-carbon generation technologies that can currently be considered to be proven, technologically and commercial feasible, affordable, scalable and safe. These two competing low carbon generation technologies are renewables and nuclear. The two categories of renewables are *variable/intermittent* VRE technologies (mainly solar and wind) and *dispatchable* technologies (mainly hydroelectric, biomass and geothermal). All forms of nuclear generation are, of course, *dispatchable*. Given existing technologies, the foreseen incremental worldwide *dispatchable* renewable energy resources (mainly economically viable hydrological and geothermal resources) are limited, and therefore their scalability is also limited. On the other hand, VRE technologies are proven, scalable, technologically and commercially feasible and safe. However, as the percentage of VRE generation (VRE penetration) increases in any electricity market, the system-related costs also increase exponentially. Under low-carbon generation strategies in most countries, balancing the ratio of VRE relative to nuclear will have profound long-term cost implications. Strategies to increase the nuclear share of generation relative to VRE will provide countries with dramatically lower energy costs, which will catalyze rather than inhibit sustainable economic growth.

Analysis of the question as to whether nuclear energy should be considered as "safe and sustainable" from an environmental and social sustainability standpoint is most prominent in the ongoing debate within the European Commission (EC) as to whether nuclear power generation should be included in the European Union's "taxonomy for sustainable activities". Here the critical element of the debate is whether it can be determined that nuclear energy "does no significant harm" to humans and the environment. While the EC's Joint Research Center (JRC) issued their *'JRC Science for Policy Report - Technical assessment of nuclear energy with respect to the 'do no significant harm' criteria of Regulation (EU) 2020/852 ('Taxonomy Regulation')'*[28], which concluded that nuclear energy "does no more significant harm" relative to other generation technologies, the conclusions of the JRC remain under review and the EC has heretodate not approved nuclear as part of the EU sustainable activities taxonomy.

While the decisions taken within the EU with respect to nuclear safety are closely followed internationally, and whatever final decision is undertaken with respect to EU taxonomy will have impacts on global financial markets, each nation and their own capital markets institutions will need to evaluate the questions related to whether the unique risks related nuclear safety, security and safeguards can be managed to the extent that the benefits of nuclear (clean, secure and dispatchable energy) are well worth the risks. Below in Section 3.4 we discuss nuclear safety issues in greater detail.

Another argument often presented by nuclear opponents is that nuclear energy is *not affordable* relative to other lower carbon generation options and therefore should not be considered, irrespective of whether nuclear risks can be managed. There are numerous flaws with this argument that we will address in detail in Section 3.1 below. While it is certainly always recommendable that each nation evaluate the least cost options (LCO's) available for their low carbon energy generation mix, it is essential that such evaluations include the 'whole picture' including factors such as: (a) the additional systemic grid and storage "system costs" related to intermittency and lower capacity factors (associated with a high penetration of VREs); (b) whole life-cycle costs and the cost of life-cycle carbon emissions[29]; (c) opportunity costs of land consumption and materials intensities, energy feedstocks (such as changing hydrological systems due to climate change and silting and cost and sustainability of production and diversion of biomass feedstocks away from food and other sustainable materials production and regenerative agricultural practices) required for many renewable generation technologies; and, (d) costs related to the uncertainty of future technological developments (such

[28] Source: [18]. JRC's conclusions have subsequently been independently reviewed and commented on by two independent groups: The Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) and the Group of Experts referred to in Article 31 of the Euratom Treaty on June 29th and June 20th, 2021 respectively. A coalition of EU states (AT, DE, DK, LU, ES) also subsequently submitted a letter to the EC urging the Commissioners not to approve nuclear in the taxonomy, based mainly on nuclear safety concerns.

[29] Including the relevant construction, production, operation and decommissioning value chains relating to each generation technology.

as energy densities and costs of long-duration grid-scale battery storage, emerging grid and CCUS technologies).

Finally, an argument also used by many nuclear critics is that nuclear is not yet a *proven* technology. This is obviously entirely false, as the nuclear fission-based power generation technologies are proven, mature and have been in continuous existing large-scale commercial operations for almost seven (7) decades. This argument has emerged, and has been propagated by certain interested parties, based on the thinking that current nuclear generation technology and business models (e.g. conventional large reactor technologies) are no longer viable and should not be considered. Proponents of this line of reasoning often convey that next generation (generation IV) advanced reactors and small modular reactor designs are "just around the corner" and once commercially proven that these new technologies will solve most of the perceived "problems" (ranging from nuclear safety, anti-proliferation, high-level radioactive waste, etc.) inherent with existing nuclear reactor designs. Many of these emerging nuclear technologies are indeed very promising and in due course, may provide numerous enhancements, increased flexibility, applicability and adaptability relative to current proven generation III/III+ reactor technologies. However, these new technologies may realistically take years or even decades to emerge as proven, technically and commercially viable and affordable technologies that can be deployed globally, at scale.

While IBNI will strongly support (both directly and indirectly) the development and demonstration of these new and innovative nuclear technologies, the Bank's immediate focus must be with respect to supporting its member states who are pursuing the rapid implementation, deployment and scaling of existing and proven nuclear technologies (such as generation III and III+ reactor designs). The climate crisis requires nothing short of immediate action and the nations of the world cannot wait decades or even years for new and promising technologies to emerge. However, when they do, IBNI will be there to support their widespread global deployment. The immediate focus must be on implementing existing and proven low-carbon generation technologies which are ready to be deployed today.

3.1 Nuclear as a Least Cost Low Carbon Generation Technology

Full and rapid decarbonization of the power generation sector is the primary underlying element of any 2050 net zero pathway scenario. However, achieving this objective will most likely not be possible, at the required global scale, in the case that significant increased energy costs are required to achieve such decarbonization. Access to affordable energy is fundamental to all modern societies. United Nations Sustainable Development Goal 7[30] asserts that all nations should have "access to affordable, reliable, sustainable and modern energy for all". Worldwide expenditures on energy already accounts for approximately 8% of aggregate gross national product[31]. Therefore, any material increased costs of energy (and increasingly significant component will be the cost of electrical energy *and electricity-derived energies such as hydrogen and electrofuels*, as the world's energy systems are projected to become significantly more electricity intensive)

[30] https://sustainabledevelopment.un.org/content/documents/195532018_background_notes_SDG_7Final1.pdf
[31] Source [20] - pg. 24.

will have a profound and predictably negative impact on global economic development and quality of life. If the world is to continue on its current trajectory towards global population growth, robust global economic development, poverty eradication and sustained improvements in quality of lives of all human beings, then *low carbon* energy (and particularly, electricity) must be made available at the *least possible cost*. The "clean premiums" or "clean spreads" of low carbon forms of generation must be minimized and preferably negated relative to the cost of carbon intensive forms of fossil fuels generation technologies (*before* any carbon pricing is considered). Therefore, in the drive to achieve global 2050 net zero, it is abundantly clear that the world must <u>not</u> consider *affordability and cost minimization* of decarbonization as an afterthought, but rather as a central aim of any net zero pathway option.

While each nation of the world will need to make its own long-term policy decisions as to what level of decarbonization costs its future generations should be willing to bear, the SAG is very concerned that extremely high levels of VRE penetration (such as the 2050 worldwide VRE penetration of ca. 70% set forth in IEA's 2050 NZE pathway scenario) may lead to unsustainably high-cost burdens upon society in increasingly electricity-intensive world market environments. Such high-cost burdens related to decarbonization of the power sector will not only directly impede global economic development and industrialization objectives, but it will also promote significant resistance to increased electrification of other sectors, such as industry, transportation and the built environment and transition to hydrogen and electrofuels adaptations. Significant global-scale electrification targets will only be possible if the cost of electricity (and derived hydrogen and electrofuels) are cost-competitive with current carbon-intensive energy resources.

Although it may be technically possible for a very limited number of the world's wealthiest nations' future generations to bear the "luxury" cost of very high VRE penetration rates (presumably with their populations and industries subscribing to the argument that these significant additional costs are worthwhile in order to achieve decarbonization objectives while also avoiding the perceived risks of nuclear power), it is predictable that the vast majority of both advanced/industrialized countries and in particular the lower income and developing countries will reject such cost-intensive high-VRE penetration scenarios, which would significantly inhibit their economic development, increased quality of life and global competitiveness objectives.

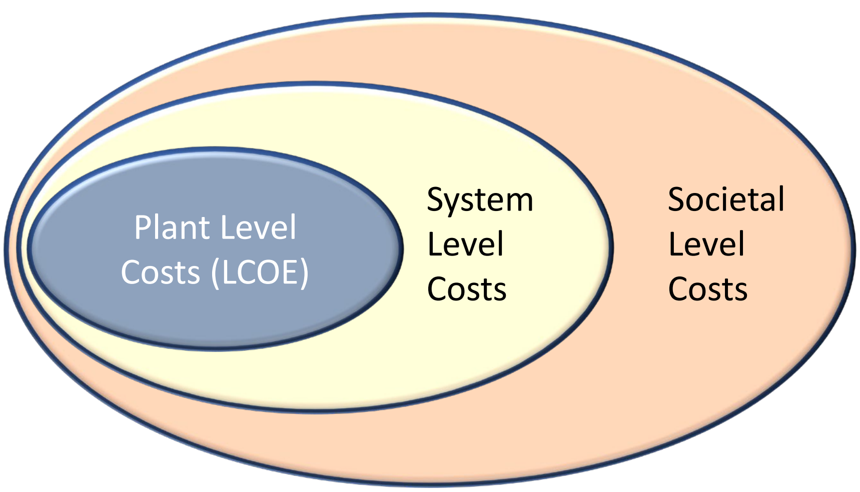
Evaluating Nuclear and Renewables Using Value-Adjusted Levelized Cost of Electricity (VALCOE)

As discussed above, amongst the other common criticisms facing nuclear energy is that it is *too expensive*, and therefore results in less affordable power generation costs relative to other competing low-carbon generation technologies. Unfortunately, this affordability argument is often used by nuclear critics to dismiss nuclear generation's role as the potential principal net zero pathway option, even before the technology's merits and risks can be properly considered and debated. The underlying affordability arguments are often based on the erroneously comparison of only the "plant level costs" of different generation technologies such as nuclear to VRE, using the *levelized unit cost of electricity (LCOE)* methodologies (which is an appropriate cost metric only for comparing one baseload generation technology to another).

It is certainly true that the "plant level" costs of some competing low carbon generation technologies such as VRE technologies (in particular PV solar and wind generation) have drastically decreased in recent years and decades and may very well continue to decrease further. This has resulted in median plant level whole life VRE generation costs (as measured by LCOE) that can now be shown to be as low or in some cases even lower than median nuclear and unabated fossil fuels plant level costs. However, this is far from the 'whole picture' with respect to true cost of VRE generation technologies. Recent studies, including those by the IEA and Massachusetts Institute of Technology (MIT)[32] have clearly demonstrated that the costs of increasingly high VRE penetration in power markets results in the directly correlated exponential increase in energy grid-related "systems costs". These "system costs" are real and tangible increased costs borne by the public (e.g. utility rate payers and/or to taxpayers, via subsidies).

For the proper evaluation the true comparative costs of VRE vs. dispatchable generation technologies, energy economists have devised a methodology called Value Adjusted Levelized Cost of Energy (VALCOE). VALCOE considers the "plant level", "system level" and "societal level" cost categories of different forms of generation. Therefore, when policymakers consider their least cost generation options available to achieve decarbonization objectives, VALCOE should be applied in order to more effectively compare the disproportionately higher "system costs" associated with VRE. The figure below illustrates the three levels of costs included in the VALCOE metric.

Figure 8 - Components of VALCOE Generation Cost Methodology



Source: [19].

The three primary categories of costs relating to the provision of electricity are defined by IEA to be the following:

- **Plant Level Costs (LCOE).** "The LCOE indicates the discounted lifetime costs for different baseload technologies, averaged over the electricity generated. It has its purpose for informing the investment

[32] Sources: [14], [19], [20] & [21].

choices of electric utilities in regulated electricity systems, but it is less pertinent in deregulated electricity systems where revenues vary from period to period over an electricity generator's lifetime. LCOE is also unable to capture the system costs of certain technologies [such as intermittent VRE]"[33].

- **System Level Costs.** The system level costs are incremental grid-related costs attributable to a particular type of generation technology. In particular, high percentages of VRE penetration within the electrical grid can result in escalating grid related system levels costs. These grid-related costs can be further allocated across the following categories:
    - **Profile (Utilization) Costs.** Profile or utilization costs relate to the variability or intermittency of a generation technology such as VRE (such as solar and wind generation), whereby the higher the VRE penetration, the greater the cost for providing the residual load during periods of time when VRE sources are not sufficiently producing.
    - **Balancing Costs.** Balancing costs are related to the uncertainty of power production due to unforeseen outages or to forecasting errors that require a more significant level of spinning reserves. Uncertainties in VRE power production often leads to an increase in ramping and cycling of other dispatchable power plants on the grid, and to inefficiencies in plant scheduling and, overall, to higher costs for the system.
    - **Transmission and Distribution (T&D) Costs.** T&D costs include the incremental costs related to the transmission and distribution grid infrastructure due to the locational constraint of generation plants. While all generation plants have some siting restrictions (including nuclear plants), the impacts are more significant for VRE. Because of their geographic location constraint, it is often necessary to build new transmission lines or to increase the capacity of existing infrastructure (grid reinforcement) in order to transport the electricity from centers of production to load demand centers. High shares of VRE may also necessitate greater interconnectivity with adjacent grid systems. Also, high shares of distributed PV resources may require significant investment into the distribution network, in particular to allow the inflow of electricity from the producer to the grid when the electricity generated exceeds demand.
    - **Connection Costs.** Connection costs are the costs of connecting the power plant to the nearest connecting point of the transmission grid. These costs can also be significant, especially if distant and dispersed generating resources have to be connected, as is sometimes the case for offshore wind farms. Also, in the case of very high VRE penetration, wind and solar plants may need to be located in more remote locations and at increasingly greater distances from established grid infrastructure and energy demand centers, which further increases connection costs.
- **Societal Costs.** Societal costs (also known as externalities) include all other indirect societal costs related to the provision of electricity by a certain type of generation technology. These other cost elements may include costs related to the following:

[33] Source: [19] – pg. 16.

- **Climate Change Costs.** As discussed earlier, fossil fuels-based power generation has been a major source of CO_2 emissions, which is a primary GHG (accounting for approximately27% of annual total GHG emissions). Low carbon generation technologies such as renewables and nuclear generation technologies are also responsible for small quantities of CO_2-eq. emissions, typically through their whole "life cycle" including materials, production, construction, operations, fuel cycle, decommissioning and dismantling phases. Many economists debate what is the optimal societal carbon price that should be charged to carbon-intensive industries such as fossil fuels generation plants. In the IEA's *Projected Cost of Generating Electricity (2020)*, a flat carbon price of US $ 30/tCO_2 is included in the LCOE calculations[34]. We have maintained this as our baseline assumption in our own analysis in this report.
- **Pollution Costs.** Quantifiable pollution costs are costs related to the probability of human mortality, human morbidity, environmental and ecological issues associated with atmospheric air, water and soil pollution (in additional to GHG emissions). Fossil fuels used in the power generation sector have been a major source of air pollution including sulphur oxides (SO_x), nitrogen oxides (NO_x), ozone (O_3), volatile organic compounds (VOCs), heavy metals and other particulate matter ($PM_{2.5}$ and PM_{10}) air emissions. In addition to emissions of CO_2 from fuel combustion in gas-fired power plants, the process of extracting natural gas also releases significant quantities of "fugitive gas" emissions, mainly comprised of methane (CH_4) which is another GHG with 25 times the greenhouse effect in comparison to CO_2. The process of extraction, processing and transport of fuels (including coal, gas, oil and uranium[35]) as well as raw materials used in manufacturing and construction of various generation technologies, including concrete, steel, glass, silicon, copper, nickel, lithium, cobalt, lead, silver, neodymium, terbium, indium, dysprosium, and praseodymium and other 'rare earth' metals are each energy-, land- and GHG-intensive in their extraction and processing phases and pose numerous pollution risks. The respective value chains related to each of these fuels and materials can also lead to significant prospects for additional air, water and soil pollution (including the potential discharge of toxins such as mercury, barium, chromium, and cadmium into soil and water resources), resource depletion, increased cost and cost volatility and social issues (such as those related to "conflict minerals"). In addition to producing virtually no emissions during operations, nuclear generation provides amongst the lowest ratios of fuel, materials and land inputs relative to energy outputs. In comparison to nuclear, VRE technologies require significantly higher inputs of raw materials in their production processes relative to life-cycle energy outputs. VRE technologies such as

[34] Source: [21] – pg. 39.

[35] The entire nuclear fuel cycle (including mining, milling, conversion, enrichment, fabrication, recycling, storage, transport and disposal) represents one of the world's most highly regulated industries. In comparison with the fuel and materials value chains related to other forms of generation, the comparatively high level of concentration, multilateral oversight and regulation of the entire nuclear fuel cycle tends to limit the risk of detrimental environmental, human and social issues.

depleted PV solar panels also contain significant amounts of toxic materials, such as cadmium, lead and mercury and other toxins, which can be a source of further pollution within their life cycles (if not dismantled and recycled properly, which must be considered as a part of their decommissioning costs). All thermal power plants (including nuclear and fossil fuels) can also produce unacceptably high amounts of waste heat pollution from their cooling water discharge. Waste heat must be economically utilized and managed for all categories of thermal power plants (including solar). Each type of pollution can be quantified based on probabilistic mortality and morbity costs to humans, animals and other impacts on the environment.

- **Major Accident Costs.** All generation technologies pose some level of risk for major accidents impacting humans and the environment. Risks of major accidents emanate from the entire value chains for each generation technology. Operating nuclear[36] and hydroelectric plant specific accidents can be extremely severe within a localized area or region, but such major accidents are extremely rare and infrequent and are therefore responsible for far fewer deaths, injuries and environmental contamination issues than other forms of generation on a per kWh basis. The comparatively higher frequency and human and environmental cost of major accidents related to coal and gas production and processing activities, as well as with raw materials extraction throughout the more resource-intensive value chains of both fossil fuels and renewables generation technologies renders these technologies also susceptible to major accident costs, which in most cases, has not been fully accounted for in their generation tariffs. Based on the probability and consequential losses, the expected value costs of each type of major accident can be quantified.
- **Costs of Land Use Change and Natural Resource Depletion.** Different forms of generation technologies have profoundly different impacts on land use requirements, ecosystem and biodiversity impacts and depletion of non-renewable resources and competition for renewable resources (such as biomass and hydrological resources). Because of their significantly lower capacity factors and intermittency, in comparison to most dispatchable technologies VRE generation technologies (predominantly PV solar and wind generation) consume vastly more quantities of land and resources for generation facilities[37] in order to

[36] It should be further noted that in accordance with existing international accords, nuclear power plant operators must maintain requisite amounts of nuclear accident liability insurance from multinational insurance pools. Therefore, unlike other forms of generation, the quantifiable social costs of potential nuclear accidents are already largely included in the generating cost of nuclear power.

[37] While wind farms consume significant amounts of land and aquatic resources, they can allow for certain simultaneous land and aquatic uses (mainly agriculture in the case of land and fishery and shipping in the case of aquatic resources) to continue throughout their operations. Wind farms and their related T&D infrastructure may be incompatible with and may pose severe limitations on other forms of non-agricultural land-uses, such as residential and commercial development and recreation (which may also impact land values, tax revenue, quality of life, social and public policy issues). PV solar can be installed within the built environment, on rooftops, over transportation infrastructure, etc. However, both CSP and increasingly PV solar compete with other land uses,

generate each unit of electrical output. These technologies also consume additional amounts of land and resources required for incremental grid infrastructure and energy storage, which should also be fully accounted for. Both PV solar and wind are also very material-intensive, as they each require significant quantities of land for raw materials mining and processing necessary in their production and supply chains. Nuclear generation is amongst the least land and materials-intensive form of generation[38], which results in the minimal use of land and non-renewable resource inputs per kWh of energy production output. Fossil fuels generation plants require significantly more quantities of land for fuel (coal, oil and gas) extraction, processing and transporting than nuclear plants require for the entire nuclear fuel cycle. Hydroelectric resources can compete for both land and watershed resources, and may have related negative biodiversity, environmental and ecological consequences. Biomass generation can compete against agricultural land used for food production (for humans and animals) as well as alternative uses of the biomass energy feedstocks (such as for building materials, soil regeneration and other uses). Each of these items has a cost, which is challenging to quantity as there is a wide range of variability with respect to local land costs, resource costs and value for alternative uses of land and resources.

While the four categories above describe the relative "societal level costs" related to the various forms of electricity generation, no analysis would be complete without also considering the "societal level *benefits*" of each technology. Societal level benefits may include elements such as: security of supply of energy generation; direct, indirect and induced employment; local and regional industrial and economic development; taxation revenue; reduction of health care costs; innovation; research & development; and other societal level benefits. Existing research on the comparative societal level benefits of generation technologies has largely focused on comparative labor and economic-related benefits. With respect to labor-related aspects, nuclear compares quite well to other technologies in that it creates significant numbers of well-paying jobs during both the construction and operations phases of NPPs.

Based on current available research and electricity grid system models, the estimated system level costs related to any specific generation technologies varies significantly between non-dispatchable technologies, such as VRE relative to dispatchable technologies such as nuclear, hydro, biomass and fossil fuels. The major distinction between technologies is that as the total penetration (percentage of total generation mix) increases for intermittent VRE technologies, the estimated system costs tend to increase disproportionately. Conversely, as dispatchable generation sources increase in total penetration (percentage of total generation mix), the system costs remain relatively constant or slightly decrease. Figure 9 below illustrates a

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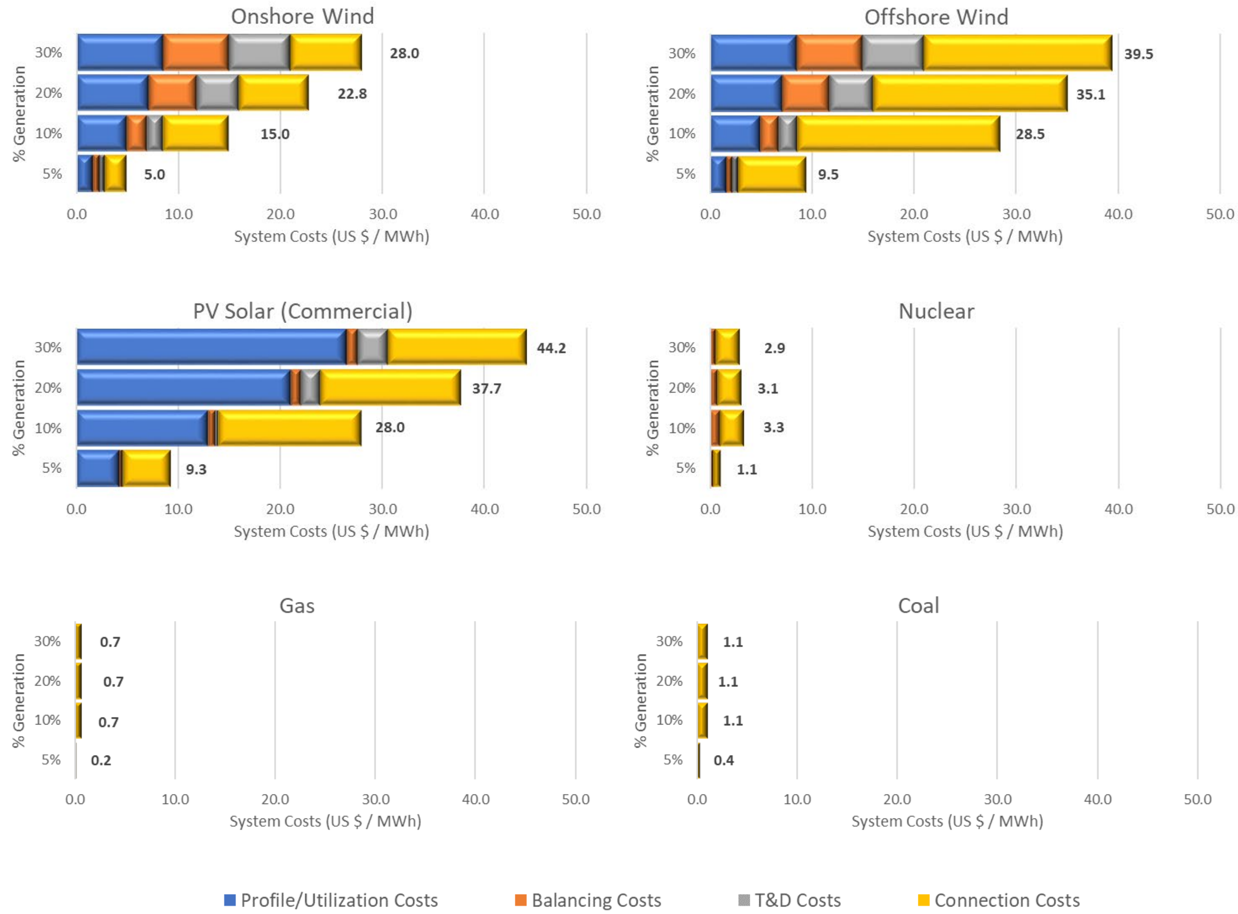
when installed outside of the built environment, which is often a motivation in order to benefit from lower land access costs and alleviate public resistance such as the "not in my backyard" phenomenon. As renewable energy penetration is ramped-up to higher percentages, the potential pressures for competitive land, agriculture, water and resource-related conflicts and costs will also become increasingly more intensified.

[38] Source: [31] – Slide 18, Figure 22.

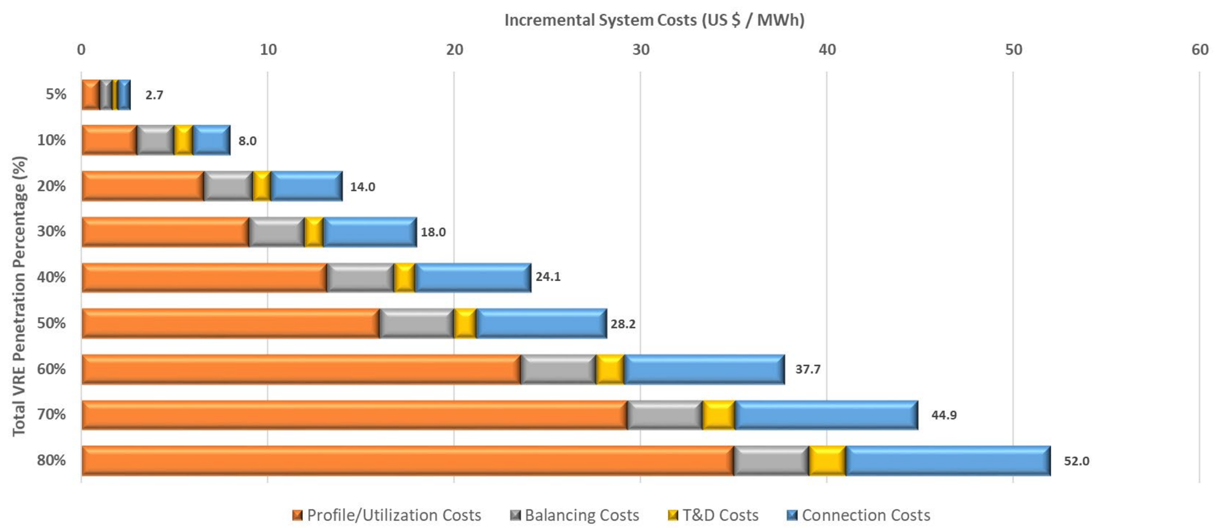
comparative analysis of the various VRE related estimated incremental system costs relative to those estimated for dispatchable generation technologies.



Data Source: [14] (data adapted). System costs related to 5% and 20% penetration levels have been interpolated based on referenced data sets available.

It is noted and acknowledged that potential technological and commercial advances in energy storage technologies (including grid-scale long-term battery storage; hydrogen and electrofuels production, transport and storage; thermal heat and compressed gases production and storage; and similar related technologies), together with emerging grid technologies and energy demand management may serve to reduce the current estimated system level cost gaps between VRE and dispatchable generation technologies. However, the SAG maintains the view that it is highly unlikely that the very significant "system level" cost gaps will be fully closed for high levels of VRE penetration. The world should not depend on unproven and speculative technological breakthroughs. Policymakers are well advised to rely on current proven technologies and associated costs and adapt their strategies, if and when new low carbon technologies emerge as commercially feasible options.

Figure 10 below illustrates the estimated total system costs (additional electricity cost burden on the public) related to increasingly higher VRE penetration rates (percentage of the total generation mix).



Data Source: [19] (data adapted). System costs related to 5%, 20%, 60%, 70% and 80% VRE penetration levels have been interpolated based on referenced data sets available.

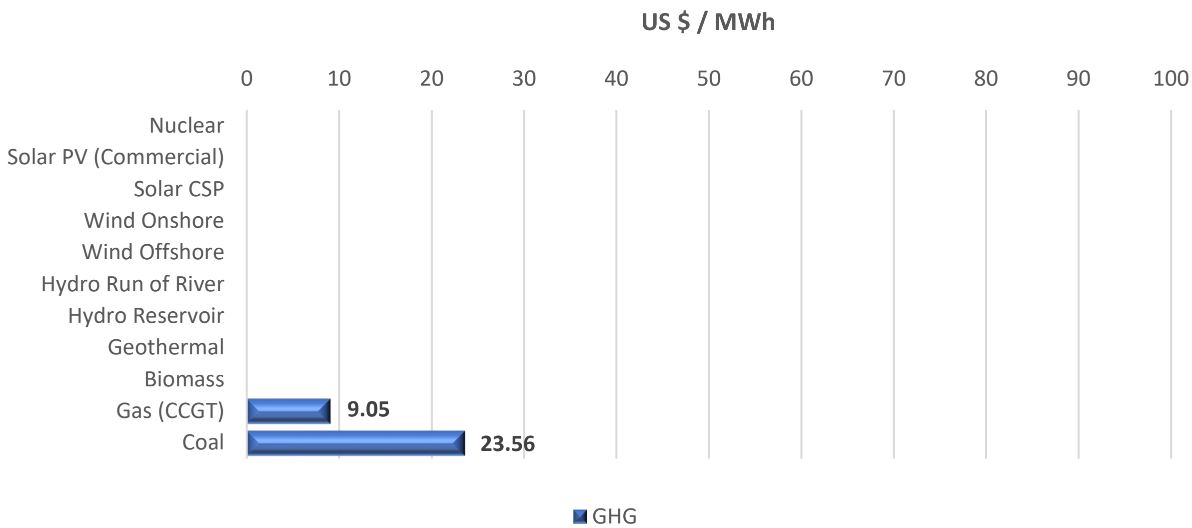
Clearly as VRE generation shares (dominated by wind and solar) reach significantly higher percentages of the overall generation mix in a market, the total system level costs and the overall energy cost burden to the public tend to escalate significantly. As it relates to the overall strategy of decarbonization of the energy sector in an affordable and economically sustainable manner, policymakers are well advised to consider optimizing the balance of VRE with all other available *dispatchable* low carbon generation technologies, such as nuclear, hydro, geothermal and biomass.

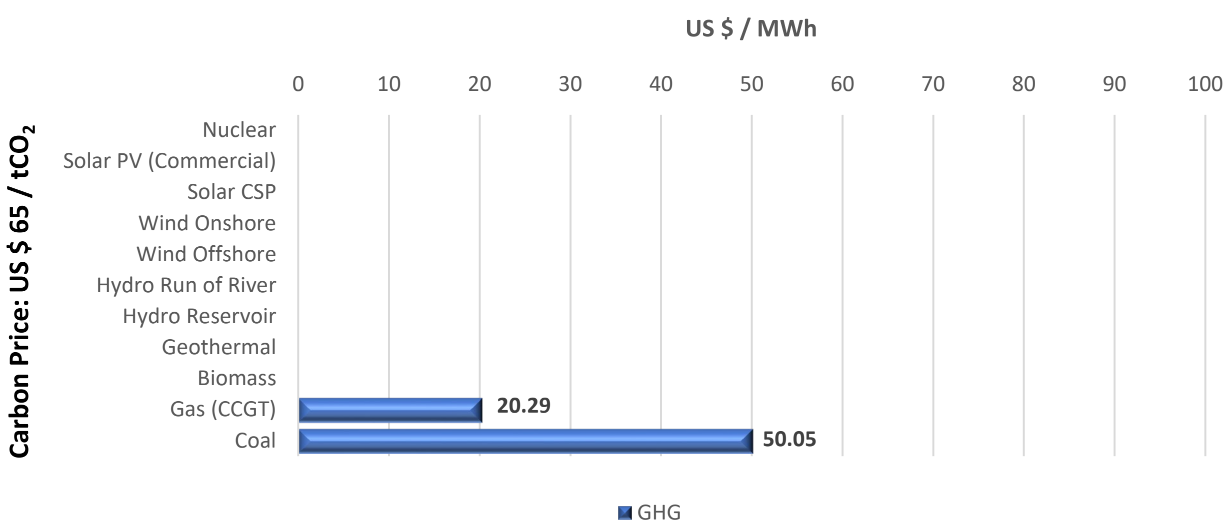
SAG's review of existing economic studies related to "societal level costs" for various forms of electricity generation technologies has determined that this is still an area of research in its very early stages. However, across all studies that we have reviewed[39], the most prominent component of "societal level costs" is the climate change impact (e.g. GHG emissions) component. We therefore regard whole life-cycle carbon cost of each generation option as the main "societal level cost" that should be analyzed. As discussed above, there is significant debate amongst economists as to what is the most appropriate price for carbon emissions, which would fully compensate society for future damages relating to climate change. While we accept the IEA's carbon price assumption of US $ 30 / tCO_2, we have also analyzed higher carbon pricing including US $ 65 / tCO_2 and US $ 100 / tCO_2 carbon pricing levels. Based our conclusion that existing research on non-

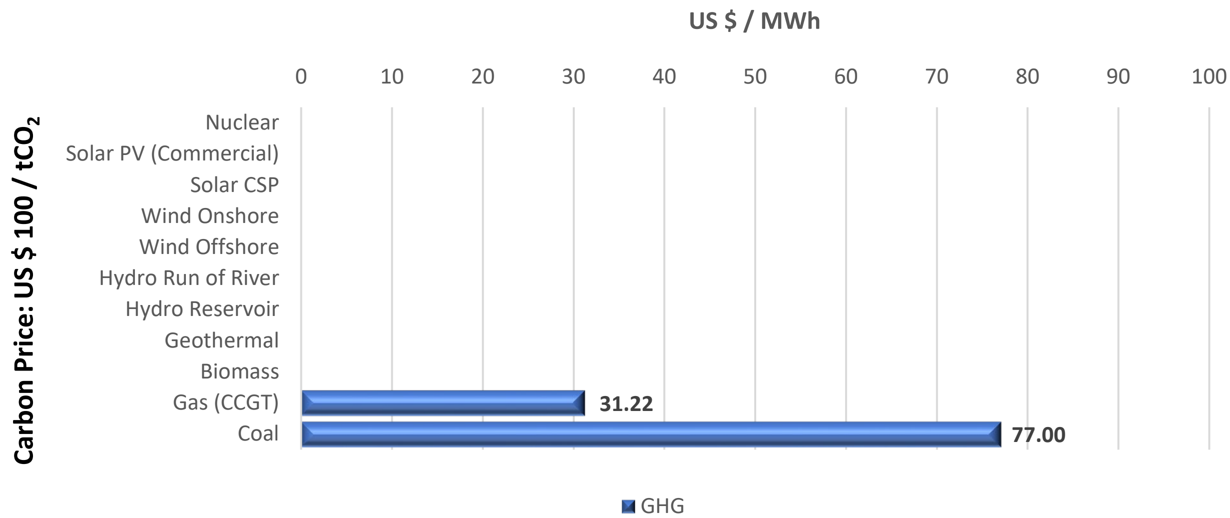
[39] Source: [19] & [22]

climate change components of "societal level costs" are inconclusive, we represent the data extracted from existing studies as a wide range in the component "non-GHG societal costs".

The following charts in Figure 11 illustrate our analysis of the "societal level costs" related the climate change impact (CO_2 pricing) at various carbon pricing levels.







Data Source: [23] – Table A.III.2 - pg. 1335 (data adapted). Note that all low-carbon technologies each produce low median levels of GHG emissions on a life-cycle basis (typically associated with their production and supply chains, construction, O&M and decommissioning activities). See Section 3.4 below. However, over the whole life energy outputs, the GHG emissions of each of these technologies result in a de minimis unit cost, which is indiscernible.

Given the current status of the research related to non-GHG related "societal level costs" do not reflect any widely accepted consensus views on the global median levels of these costs, the chart below in Figure 12 illustrates the potential indicative ranges of these "societal level costs" based on the best available current research and data available.

FIGURE 12 - INDICATIVE RANGES OF ADDITIONAL NON-GHG SOCIETAL LEVEL GENERATION COSTS FOR VARIOUS TECHNOLOGIES

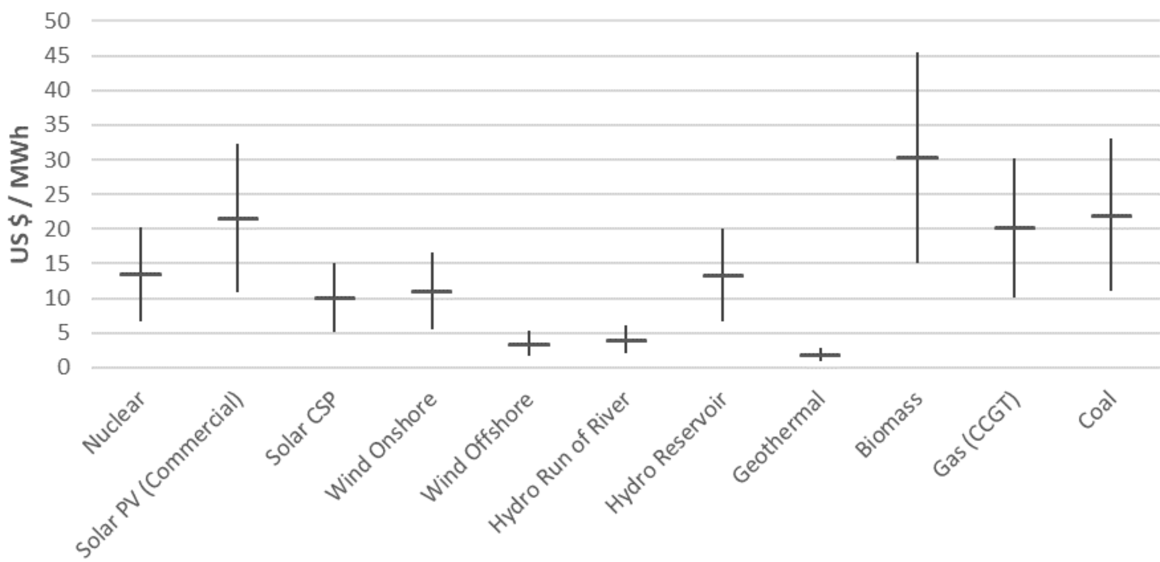
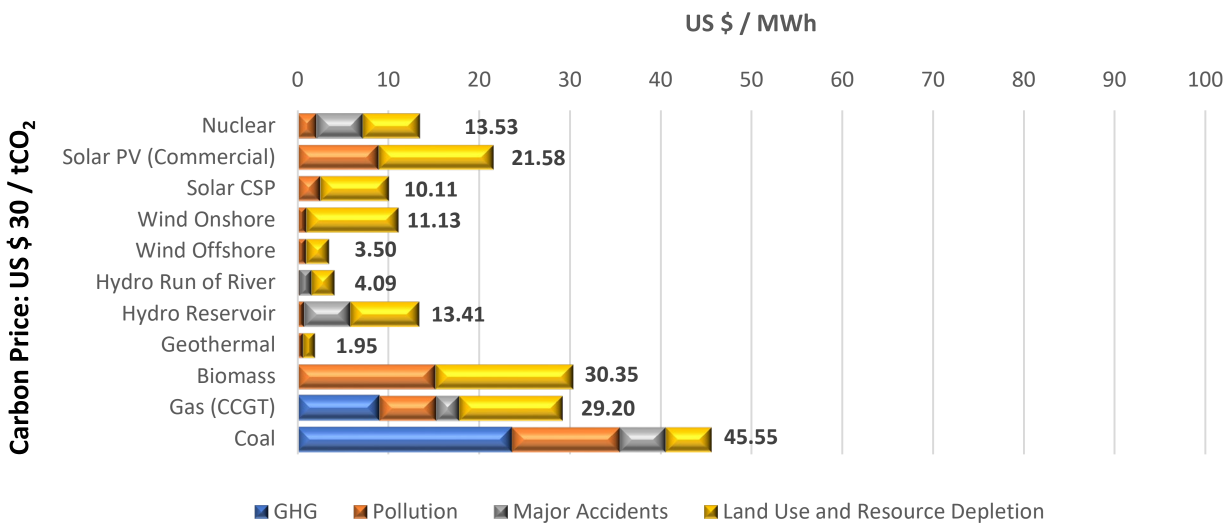
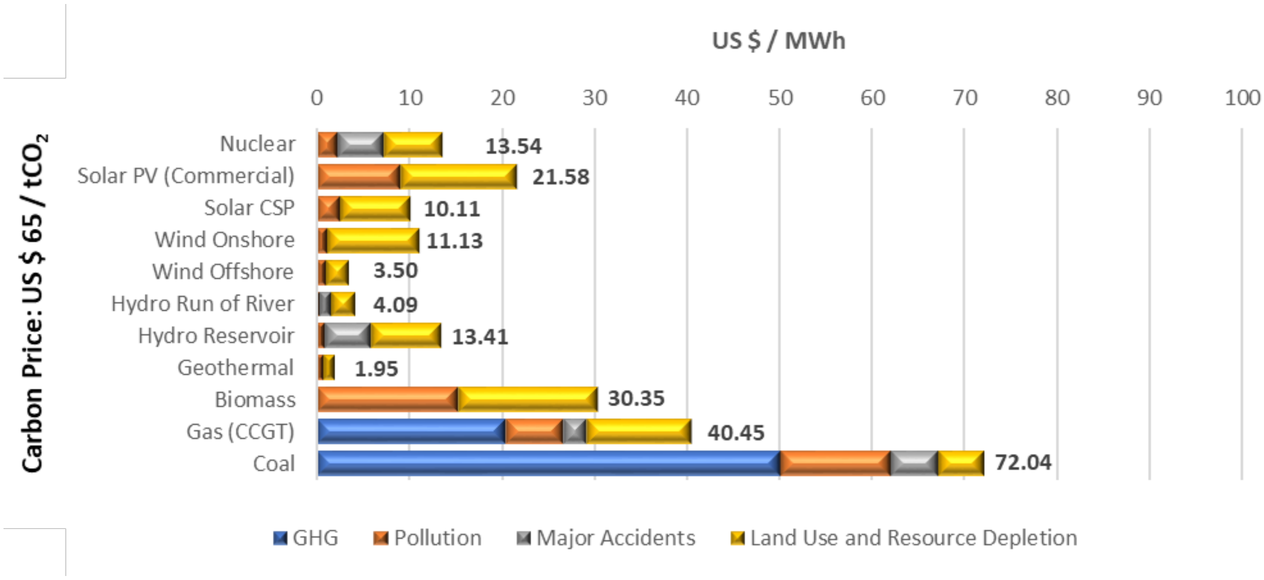
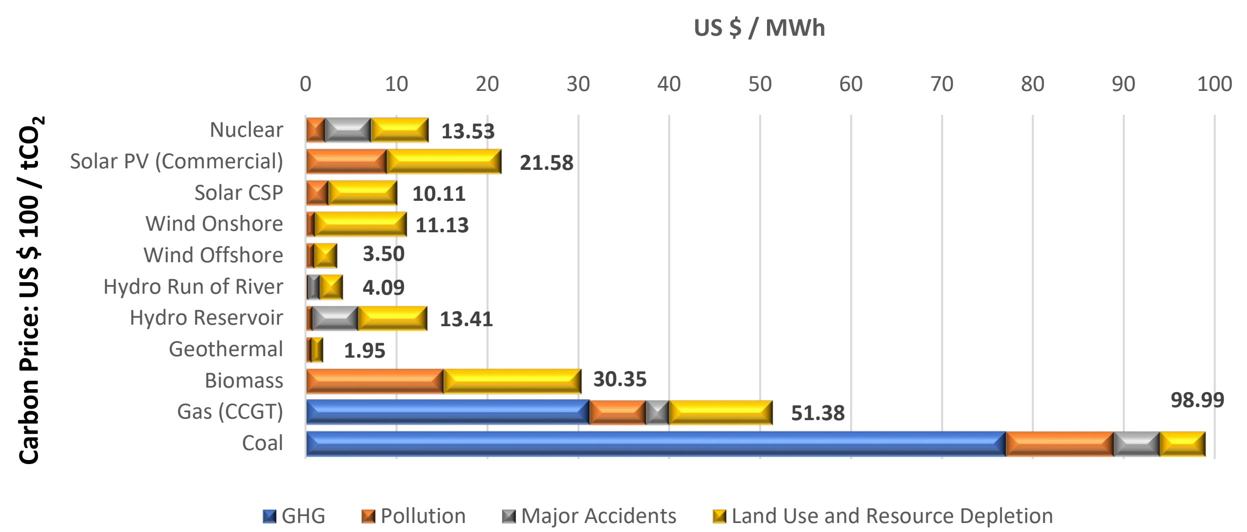


Figure 13 below illustrates the effects of combining both climate change (GHG-related) and non-GHG related societal costs, when various levels of carbon pricing are taken into consideration.

FIGURE 13 - INDICATIVE LEVELS OF TOTAL SOCIETAL COSTS RELATED TO VARIOUS GENERATION TECHNOLOGIES



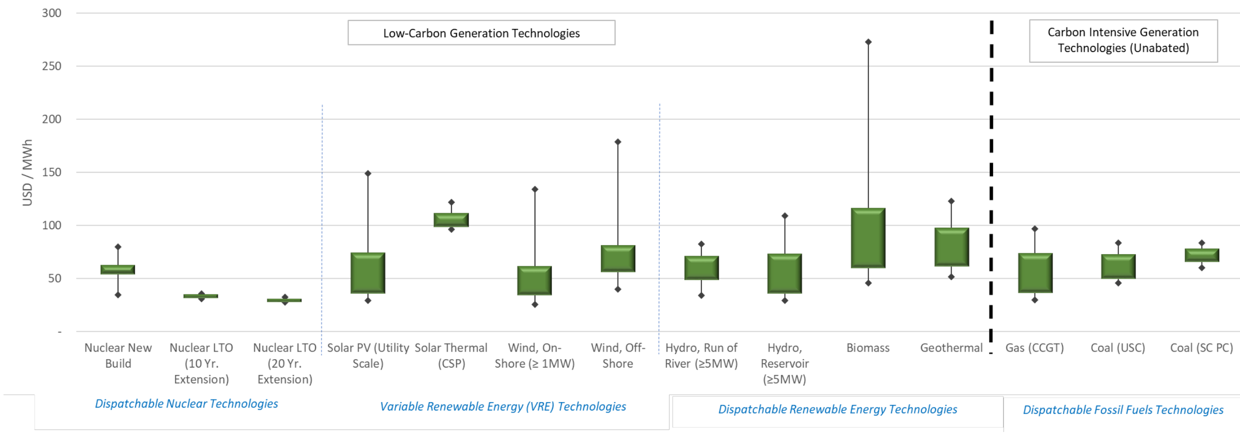




Data Sources: [19], [22] & [23] – (data adapted).

Based on the above methodologies and available source data, SAG has conducted an independent VALCOE assessment of the total costs of nuclear generation relative to VRE (non-dispatchable) and dispatchable renewable generation technologies as well as fossil fuels. We have not included any comparison to CCUS technologies as these technologies are currently largely unproven from both a technical and commercial standpoint. From this VALCOE comparative analysis, we have then derived the comparative "clean premia" or "clean spreads" relative to unabated fossil fuel generation (before including carbon pricing).

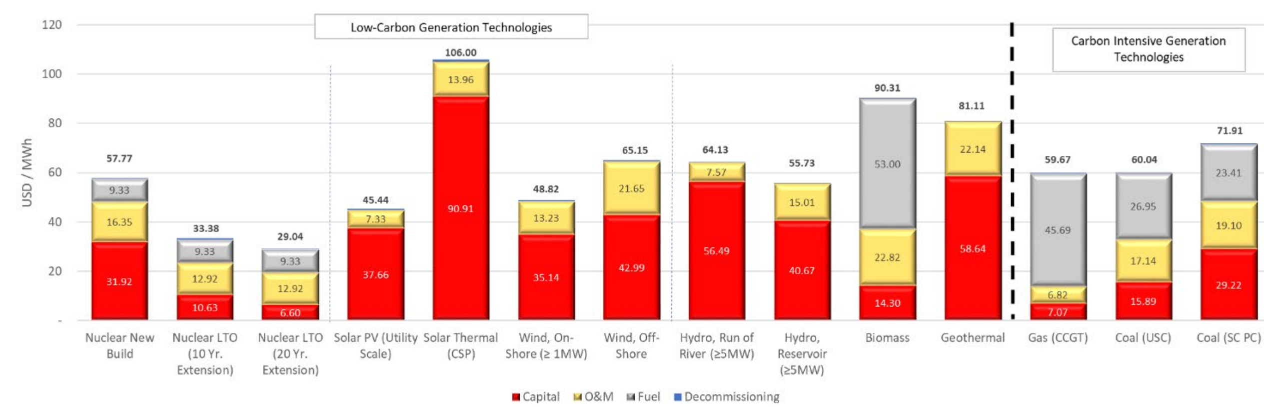
FIGURE 14 - COMPARATIVE WHOLE LIFE PLANT LEVEL COSTS (LCOE) NOT INCLUDING CARBON COSTS



Data Source: [21] (data adapted). Green boxes indicate +/- 50% of the global data cases above or below the global medians. Whisker lines and end points indicate global outlier cases outside the +/- 50% range for each technology. Assumes 5.0% median cost of capital across all generation technologies.

The above chart indicates that based on global median data, nuclear generation (plant level LCOE costs) already offers amongst the least cost generation technologies compared across both competing low -carbon generation technologies as well as fossil fuel generation technologies. This is before even considering the additional system level and societal level costs. The below chart illustrates the composition of the comparative global median plant level LCOE costs for the various technologies.

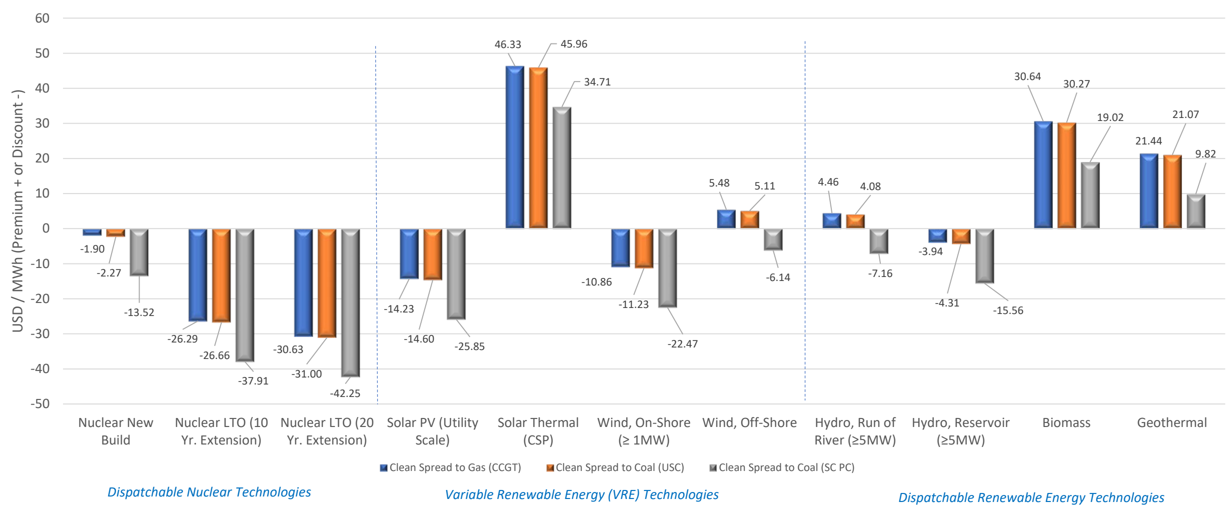
FIGURE 15 - COMPOSITIONS OF GLOBAL MEDIAN WHOLE LIFE PLANT LEVEL (LCOE) COSTS FOR ALTERNATIVE GENERATION TECHNOLOGIES, WITHOUT CARBON PRICING



Data Source: [21] (data adapted). Assumes 5.0% median cost of capital across all generation technologies. Capital costs include capital invested and return on capital invested.

The global median "clean spreads" of all forms of nuclear generation are shown to be negative relative to unabated gas and coal generation technologies, before considering either carbon pricing or "system level costs”. The following chart illustrates the comparative low carbon “clean spreads” prior to carbon price and system level costs.

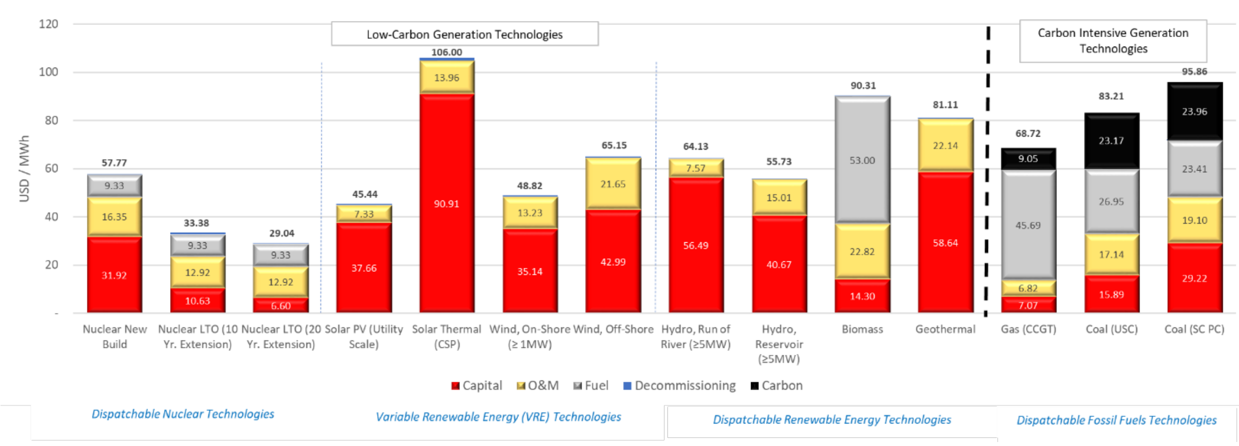
FIGURE 16 - COMPARATIVE CLEAN SPREADS FOR VARIOUS LOW CARBON GENERATION TECHNOLOGIES RELATIVE TO UNABATED FOSSIL FUEL TECHNOLOGIES, WITHOUT CARBON PRICING



Data Source: [21] (data adapted). Assumes 5.0% median cost of capital across all generation technologies.

While nuclear new build tends to be capital-intensive relative to gas fired generation, all other forms of low carbon generation (except, in some cases, biomass) are also similarly capital intensive. It should also be noted that life extensions and renewals (LTO) of the existing nuclear fleet offer the most cost competitive and least capital-intensive plant level costs across all generation technologies. Therefore, the existing fleet of nuclear reactors should be extended to their maximum safe total extended operational lives (which will be an IBNI supported priority objective).

FIGURE 17 - COMPOSITIONS OF GLOBAL MEDIAN WHOLE LIFE PLANT LEVEL (LCOE) COSTS FOR ALTERNATIVE GENERATION TECHNOLOGIES, INCLUDING CARBON PRICING

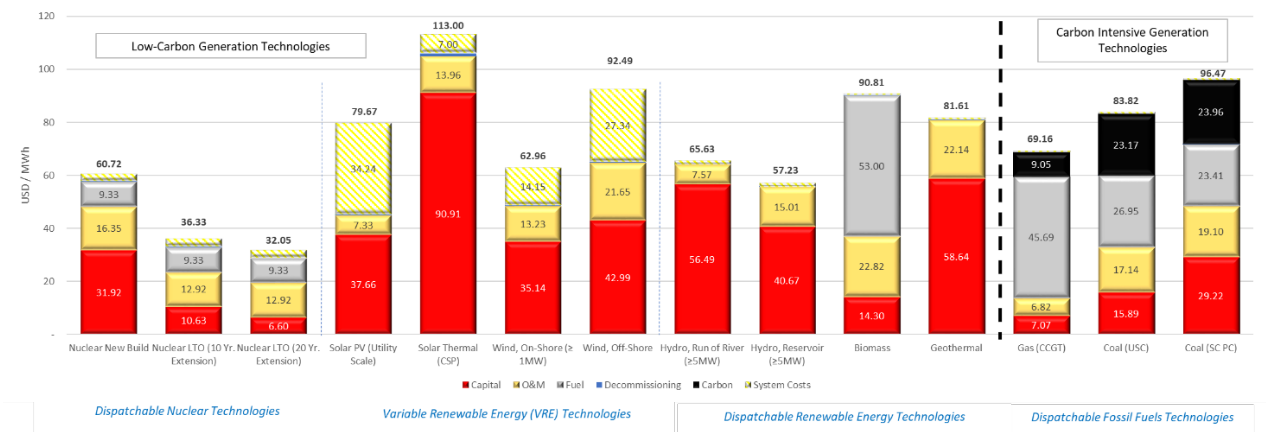


Data Source: [21] & [23] (data adapted). Assumes 5.0% median cost of capital across all generation technologies. Capital costs include capital invested and return on capital invested. Assumes US $30 / tCO_2 carbon price.

When considering reasonably significant carbon pricing levels, both median nuclear new build plant level (LCOE) costs as well as PV solar and wind are increasingly attractive relative to fossil fuels. Life extensions and renewals of existing reactors (LTO) clearly offer the least cost generation across all technologies.

It is not until we look into the "system level" and "societal level" costs under the VALCOE methodology that nuclear new build costs can be clearly shown to be materially less relative to PV solar and wind generation costs. The chart under the below Figure 18 clearly demonstrates the *least cost advantage* of nuclear relative to other competing generation technologies, including incremental "system level costs" in the case where VRE penetration reaches 50% of the global generation mix by 2050. Note that if we consider VRE penetration levels above 30%, the additional "system level" costs related to VRE will be significantly higher.

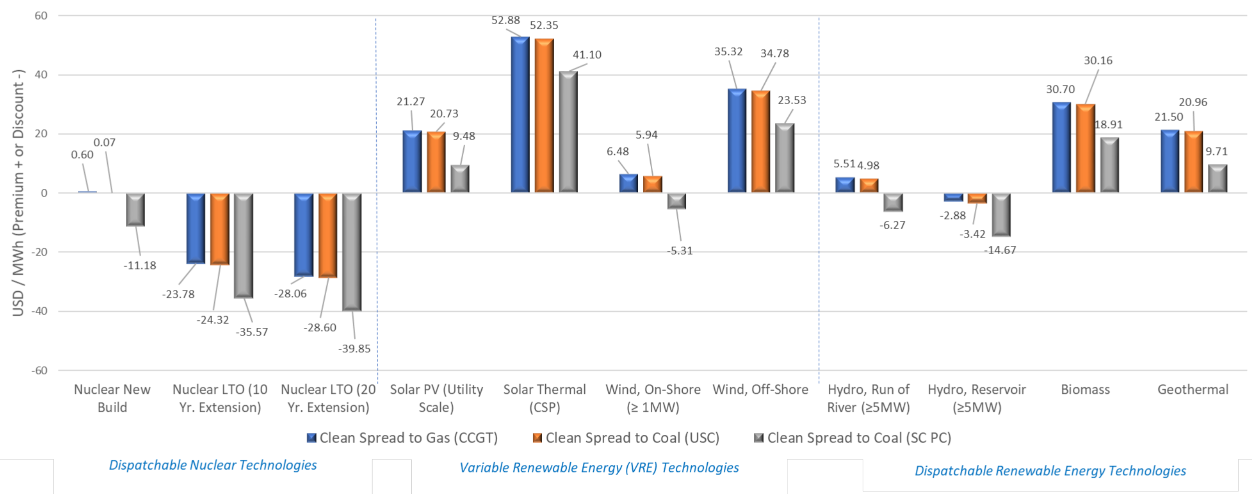
FIGURE 18 - COMPOSITION OF GLOBAL MEDIAN WHOLE LIFE VALUE ADJUSTED (VALCOE) GENERATION COSTS FOR ALTERNATIVE GENERATION TECHNOLOGIES, INCLUDING CARBON PRICING AND SYSTEM COSTS WITH 50% VRE PENETRATION



Data Sources: [19], [21], [22] & [23] (data adapted). Assumes 5.0% median cost of capital across all generation technologies. Capital costs include capital invested and return on capital invested. Assumes US $30 / tCO_2 carbon price.

After taking into account the "system level costs", the "clean spreads" of nuclear generation are shown to be increasingly attractive relative to competing VRE technologies. The following charts illustrate comparative "clean spreads" of nuclear relative to other low carbon technologies with 50% VRE penetration (32% nuclear).

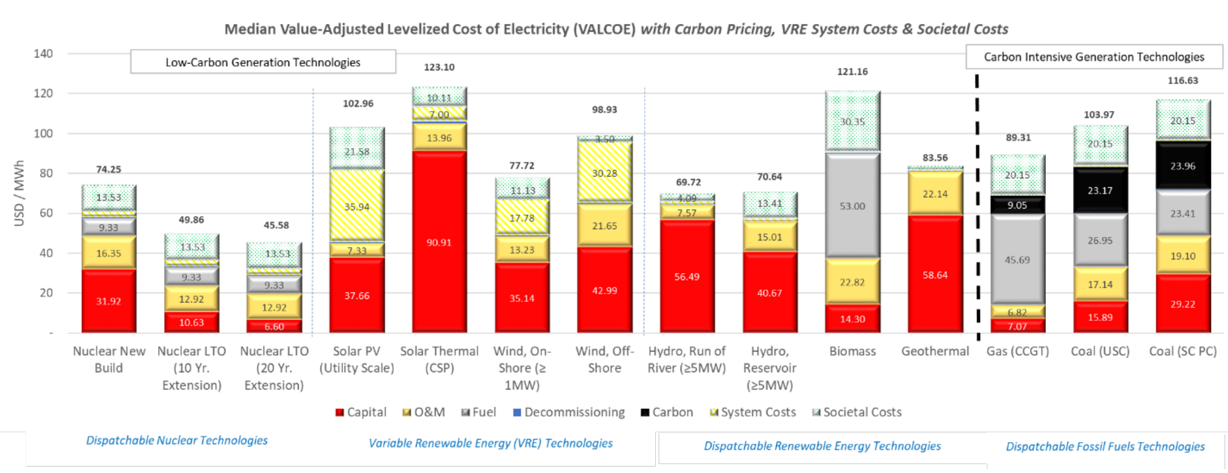
FIGURE 19 - COMPARATIVE CLEAN SPREADS FOR VARIOUS LOW CARBON GENERATION TECHNOLOGIES RELATIVE TO UNABATED FOSSIL FUEL TECHNOLOGIES, <u>WITH</u> SYSTEM COSTS AND <u>WITHOUT</u> CARBON PRICING (<u>50% VRE PENETRATION</u>)



Data Sources: [19], [21], [22] & [23] (data adapted). Assumes 5.0% median cost of capital across all generation technologies. Capital costs include capital invested and return on capital invested.

If non-GHG related "societal costs" are to be included in the analysis, comparing to VRE (at a relatively large 50% total 2050 VRE penetration rate), nuclear exhibits its clear cost advantage. The chart below in Figure 20 demonstrates that nuclear remains amongst the least cost forms of low carbon generation when considering "plant level", "system level" and "societal level" cost elements (assuming a relatively large 50% VRE penetration by 2050). This is illustrative that as VRE penetration rates increase over 30% of the global generation mix, then the associated "system level costs" increase significantly, which render new build nuclear as the clear least cost low carbon option.

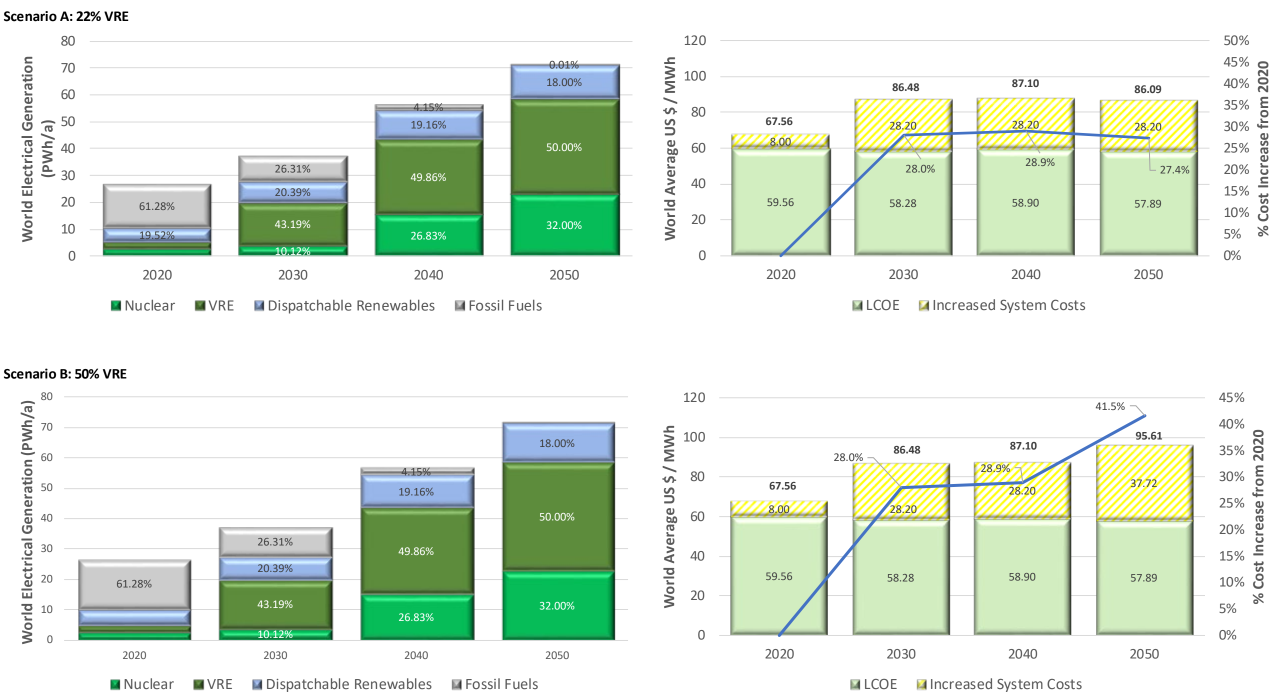
FIGURE 20 - COMPOSITION OF GLOBAL MEDIAN WHOLE LIFE VALUE ADJUSTED (VALCOE) GENERATION COSTS FOR ALTERNATIVE GENERATION TECHNOLOGIES, <u>INCLUDING</u> CARBON, SYSTEM AND NON-GHG SOCIETAL COSTS WITH 50% VRE PENETRATION

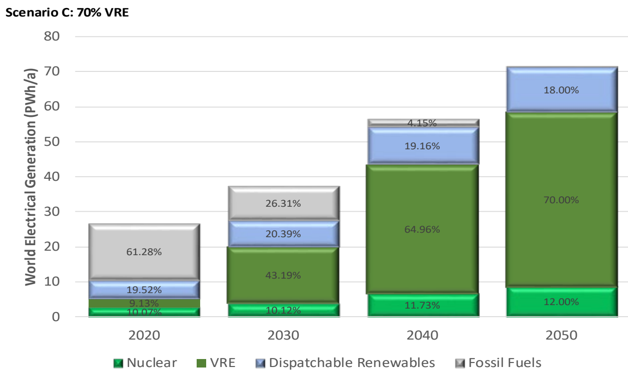


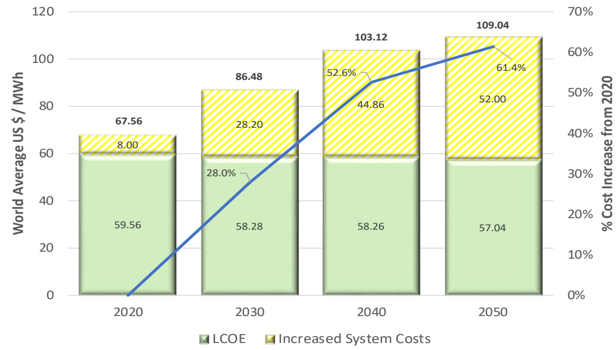
Data Sources: [19], [21], [22] & [23] (data adapted). Assumes 5.0% median cost of capital across all generation technologies. Capital costs include capital invested and return on capital invested. Assumes US \$30 / tCO_2 carbon price.

One of IBNI's core missions will be to minimize the cost of low carbon generation by supporting a significant expansion of global nuclear capacities. The following charts below in Figure 21 illustrate the potential direct and tangible increased cost impacts related to increasingly higher VRE penetrations. By significantly scaling-up nuclear generation, the world will be able to avoid electricity generation cost increases that could potentially almost double by 2050. Please note that IEA's NZE 2050 pathways scenario envisages 70% VRE penetration in 2050.

FIGURE 21 – ILLUSTRATION OF POTENTIAL 2020 – 50 WORLD GENERATION MIX EVOLUTION SCENARIOS FOR LOW CARBON GENERATION AND UNIT COST IMPLICATIONS







The analysis above assumes current global median levelized costs and estimated system cost (stated in nominal 2020 US $ values) assumptions and results set forth previously. The analysis ignores potential future decreases in the overnight and investment costs related to various generation technologies. The of costs PV solar and wind generation costs, battery storage and hydrogen and electrofuels technologies are all predicted by many industry experts to decrease over future years and decades, which could certainly drive down competing VRE plant level and system level costs. However, amongst IBNI's main objectives will also be to drive significant global demand for nuclear technologies and scaling-up of nuclear production and supply chains, increasing competition, innovation and R&D investments across the nuclear industries and their value chains. With IBNI support and catalyzation, the cost of nuclear generation technologies, driven by IBNI's support, is also expected to decrease at rates proportionate to those seen in VRE and storage sectors.

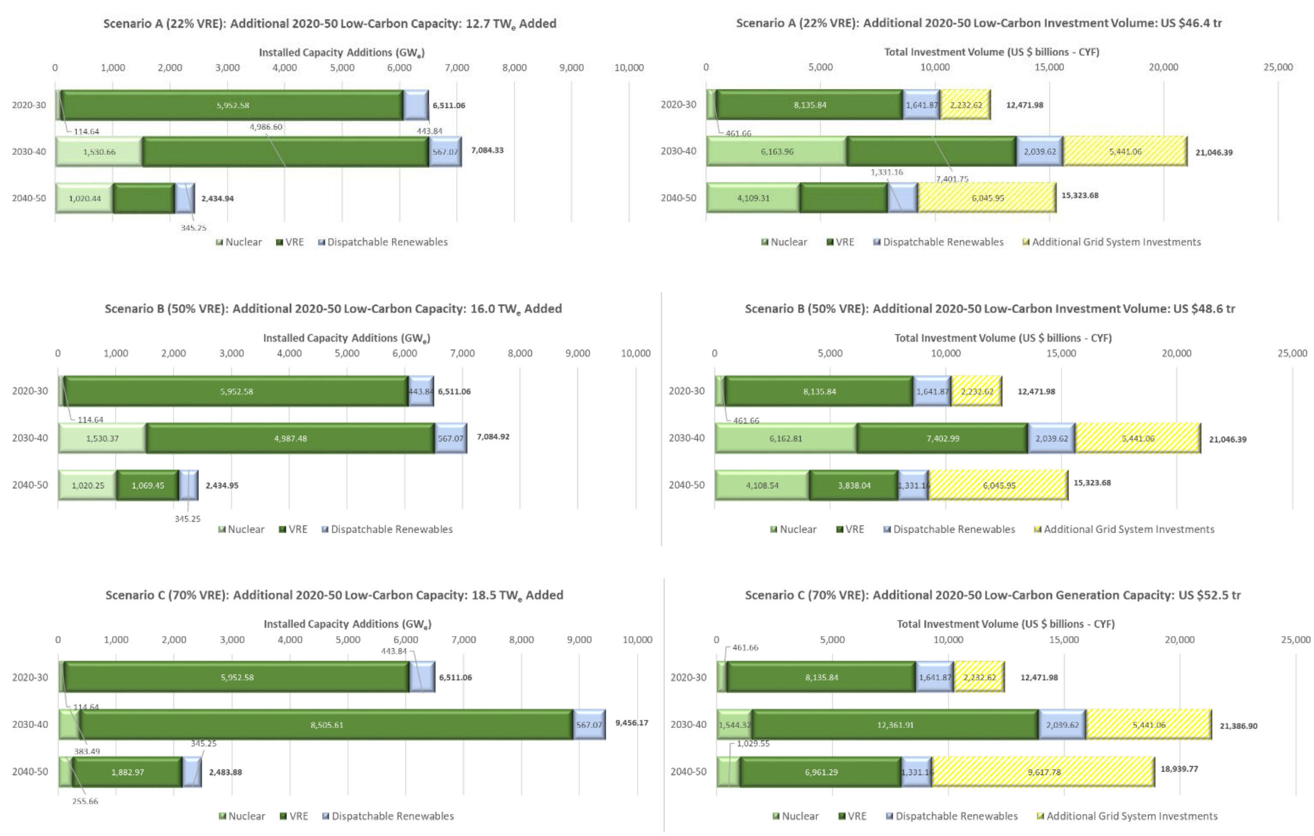
Clearly, from the perspective of minimizing the global cost of generating electricity (and avoiding significant increases in "system level costs") nuclear generation capacity should be maximized. IBNI targets an aggressive goal to achieve at least 60% nuclear share of the global generation mix by 2050 and therefore limiting the need for VRE to no more than 25% of the generation mix.

Capital Investments in Generation Plants and Grid Systems Required to Achieve 2050 Net Zero

Achieving 2050 net zero in the power generation sector, requires not only the massive additional investments related to the replacement of world's existing fossil fuels generation fleet with low carbon generation technologies, but it also entails an even greater investment in additional low carbon generation capacity to meet a potential doubling, tripling or even quadrupling in electricity demand by 2050. As already demonstrated above, the types of low carbon generation technologies that the nations of the world choose to deploy will be critical from an electricity affordability perspective. However, the sheer volume of capital investment that will need to be funded and financed by the world's governments and global capital markets is also daunting. Therefore, we also need to address differences in the total capital investment requirements for different forms of generation pathways and assess whether such volumes can realistically be funded and financed.

Increasingly higher percentages of VRE penetration will require both disproportionately higher installed generating capacities (consuming escalating quantities of land and resources) and direct capital investments in both generating plants and grid system infrastructure. The charts below in Figure 22 illustrate the incremental installed electrical capacity requirements and capital investment cost burden related to increasingly higher VRE penetration rates.

Figure 22 - World Generation Capacities and Generation and Grid Capital Investment Requirements Related to Various VRE Penetration Scenarios



Data Sources: [19], [21], [22] & [23] (data adapted). Assumes 5.0% median cost of capital across all generation technologies. Capital costs include capital invested and return on capital invested. Assumes that 60% of the additional system level revenues related to capital expenses. Capital requirements are calculated based on an assumed cost of capital of 5.0% over a 15 year pay-back time horizon.

The illustrated 'Scenario A' (22% global VRE penetration) above results in an overall additional generation and grid system capital investment requirement that is over 13% lower than in 'Scenario C' (70% VRE penetration), alleviating the need for approximately US $ 6.1 trillion in additional required capital investments over the next thirty years.

It should be further noted that the above capital investment requirements do not consider additional potential *direct cost* impacts such as land and materials resource requirements and costs (and the competition for and opportunity costs related to the use of those scarce resources). 'Scenario C' (70% VRE penetration) entails approximately 16.3 TW_e of additional VRE capacity to be added before 2050. This scenario would require approximately 1.76 million additional square kilometers of the earth's land areas (about 1.7% of earth's total habitable land areas) to be converted to solar and on-shore wind production and an additional 3.7 million square kilometers of the earth's coastal areas would need to be converted to off-shore wind production[40]. Significant amounts of additional land area will also need to be consumed for grid related infrastructure and energy storage.

IBNI to Drive Further Affordability, Cost Reductions and Efficiencies in Nuclear Power

While it has already been demonstrated in this IRAP that nuclear power is the least cost low carbon technology, it is evident that nuclear technology is currently significantly more costly than it could (or should) be. The cost inefficiencies associated with nuclear power over the past decades are well known and documented. The nuclear power industry has clearly suffered from the following issues over past decades:

- **Cost overruns and delays:** it is widely known that many recent NPP projects, particularly in the USA and Europe have experienced very significant cost-overruns and delays which has in some cases resulted in much-higher-than anticipated costs borne by utilities, governments, shareholders and electricity consumers, or in other cases the cancellation or abandonment of projects due to escalating costs.
- **Lack of Access to Affordable Financing:** The dominating nuclear development and financing model in Europe and North America has been one where electric utilities finance NPPs as system assets, on-balance sheet. Much of the rest of the world relies on state-supported financing models. Given the very high up-front capital costs of developing NPP's, very few utilities in the world have sufficient balance sheet capacity to self-finance single, multi-billion dollar assets like nuclear plants. Unlike almost all other infrastructure asset classes, utilities, governments and other NPP sponsors have not been able to attract commercial project lenders and long-term debt and equity capital (such as pension funds, insurance companies, infrastructure funds, sovereign wealth funds, etc.) to finance NPPs on a project level basis.
- **Lack of Robust NPP Construction Demand.** Over the past three decades, there has been a significant downturn in the quantities for new nuclear reactors being developed worldwide (with exceptions in certain markets such as China and South Korea). This has significantly eroded the nuclear industry's global production and supply chains, where human capital resources in nuclear

[40] Assumes that of the 16.3 TW_e of additional VRE capacity, 33% is PV solar, 15% is on-shore wind and 20% is off-shore wind, where surface area requirements average 10 ha/MW_e, 50 ha/ MW_e and 100ha/ MW_e, for PV solar, on-shore wind and off-shore wind, respectively. Of the total 149 million km^2 of earth's surface area, approximately 71% is habitable (approximately 104 million km^2) - *source:* https://ourworldindata.org/land-use. VRE generation under 'Scenario A' would consume approximately 1.1 million km^2 of surface land and 120 million km^2 of coastal areas. (corresponding to approximately a 35% reduction in required surface land area and 67% reduction in required coastal areas needed for VRE production).

engineering and related specialized fields have become increasingly concentrated scarce and there are fewer nuclear qualified and experienced contractors available in many markets. The lack of resources in the global production and supply chains, combined with lack of experience and "learning by doing" in developing "n^{th} of a kind" nuclear reactor designs has led to many cost overruns and delays. Only a robust and sustained global order flow for nuclear reactors will solve this problem. Under the appropriate market conditions (where there is a market for repeatedly delivering similar reactor designs, in a similar regulatory and market environment) the nuclear industry has demonstrated its capability to deliver on-time and within budget in many cases, including in the USA and Europe in the 1970s and 1980s, in Japan and S. Korea in the 1980's – 2000's, and currently now in China.

- **Lack of Appropriate Risk Allocation:** In many cases, projects have been structured with inappropriate risk allocation, where project risks have been allocated to either to contractor, utility and/or governmental entities. In many cases, these risk allocation structures have resulted in the disproportionate burden on rate payers, contractors, utilities and governments. Inappropriate risk allocation has also contributed to construction cost overruns and delays as well as cancellation and abandonment (in some cases due to contractor bankruptcy).
- **Deregulated Market Models ("Market Failure"):** As many nations have or are now attempting to liberalize their energy markets, in many cases, capital-intensive, base load generation plants have come under significant market pressure when competing against gas fired generation and VRE. NPPs investments require long-term stable and predictable revenues, under such market models where the plant operator is compensated for dispatchable available capacity.
- **Evolving Nuclear Safety Regulations.** In numerous recent cases, well-intentioned nuclear safety regulations have changed during the construction period of NPP projects, resulting in extensive and costly delays and related design changes. While nuclear regulators are independent organizations responsible to the public for nuclear safety, NPP developers cannot and should not be held responsible for the very serious risks of cost increases due to changes in the applicable nuclear safety standards made mid-way through a project construction cycle. In such cases, governments need to provide the appropriate "change-in-law/regulation" compensation provisions to compensate impacted NPP project owner/developers.

IBNI's programs will be focused on making nuclear an even more affordable and lowest cost generation technology by remedying the above deficiencies.

First, IBNI will drive significant global demand-side growth for nuclear generation technologies, creating robust demand for varied nuclear technologies, which will be manifested in terms of escalating order flows for all nuclear equipment and supply chain vendors. IBNI will also promote and foster competition and innovation withing the global nuclear sector. Such demand-side catalytic effect will drive growth in the global nuclear production and supply chains and will also promote investment in nuclear innovation and R&D. The end result will be that the global nuclear industry will be able to deliver significantly lower costs and markedly improved on-time and on-budget performance with respect to delivering "n^{th} of a kind" (NOAK) reactor technologies and designs (and potentially future modularized reactor designs).

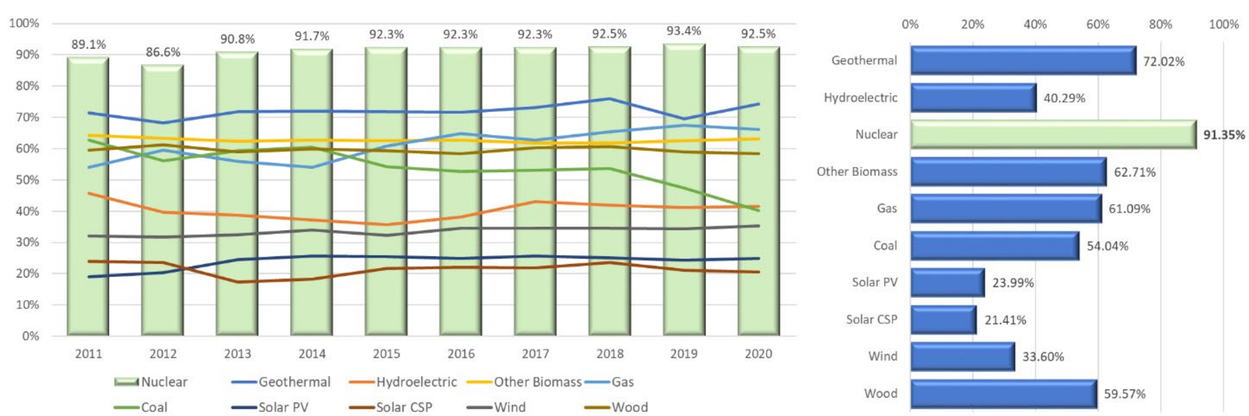
Second, IBNI will directly provide very low cost of capital available for qualified nuclear projects. IBNI's participation will also catalyze participation from other capital markets providers of low-cost long-term capital into nuclear programs. Given that nuclear projects are capital intensive, significant reductions in cost of capital will result in significantly reduced generation costs.

Third, the implementation of IBNI's rigorous standards and criteria (see Section 5) and the creation of a global competitive market framework for scarce IBNI support will drive market and regulatory reform in each country pursuing IBNI's support for their nuclear projects. As many countries realize that IBNI support will be critical (or compulsory) for the success of their nuclear energy and decarbonization programs, policymakers will enact tough decisions that are necessary for support and long-term sustainability of their nuclear programs and achievement of their net zero commitments.

3.2 Nuclear is Reliable & Proven for Grid Scale On-Demand Generation

The nuclear power generation sector has demonstrated, over many decades to offer one of the most reliable sources of dependable "base load" power generation. Year in and year out, nuclear power outperforms all other generation technologies in terms of reliability. After commissioning, modern nuclear power plants can offer design lives of more than sixty (60) and in some cases more than eighty (80) years, thereby providing dependable low-carbon generation 24 hours a day 7 days a week, regardless of whether the sun is shining, or the wind is blowing. Typically, nuclear power reactors only need to be shut down for refueling every 18 to 24 months and perform with very few maintenance outage periods, outside scheduled refueling and maintenance outage periods. Modern nuclear reactors routinely offer average availability and capacity factors of more than 90%, which as can be seen below in the US market (for example) has outperformed every other generation technology in that market.

Figure 23 - Comparison of Nuclear and Other Technologies Capacity Factors in USA (2011 - 20)



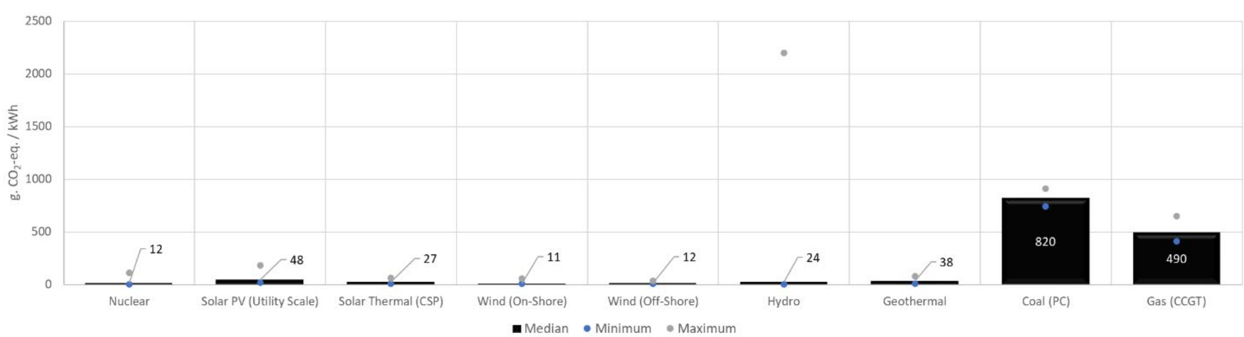
Data Source: [32]

Globally, the World Nuclear Association (WNA) has reported global average nuclear power plant capacity factors have been 83.1% and 80.3% in 2019 and 2020, respectively[41]. One of the main reasons that global nuclear capacities factors were reduced in 2020 was due to lower world electricity demand due to the COVID-19 pandemic. While nuclear availability factors are expected to remain quite high, in many markets, nuclear power plants are increasingly being called upon for “load following” operations as increasingly higher percentages of VRE are introduced into those markets. This suggests that nuclear capacity factors will continue to decrease in those markets until nuclear reactors can be used to generate electricity and heat energy for hydrogen and electrofuels production, heat, cooling and desalinated water during periods where there is lower residual energy demand.

3.3 Nuclear Energy Offers Lowest Whole Life Carbon Emission

Nuclear power and hydroelectricity have the lowest life cycle greenhouse gas emissions of electricity generating technologies[42]. Figure 24 below provides a comparative analysis median values as well as the minimum and maximum observed ranges for GHG emissions of different generation technologies.

FIGURE 24 - COMPARISON OF WHOLE LIFE CYCLE CARBON EMISSIONS FOR VARIOUS GENERATION TECHNOLOGIES



Data source: [23]– Table A.III.2 - pg. 1335.

Data in the chart above are on a ‘life cycle’ basis, and an understanding of the ‘life cycle’ concept is critical to conducting comparative analyses of the greenhouse gas (GHG) emissions per kWh arising from different generating technologies – their respective ‘carbon intensities’. Broadly, the life cycle concept stresses the need to consider the GHG emissions produced at all stages of a given technology’s existence - ‘from cradle to grave’ – including emissions generated during the technology’s resource procurement, construction, deployment, operation and decommissioning phases. Nuclear power plants produce virtually no greenhouse gas emissions or any other pollutants during their operation and only very low emissions over their full life cycle (per kWh generated over their operating lives).

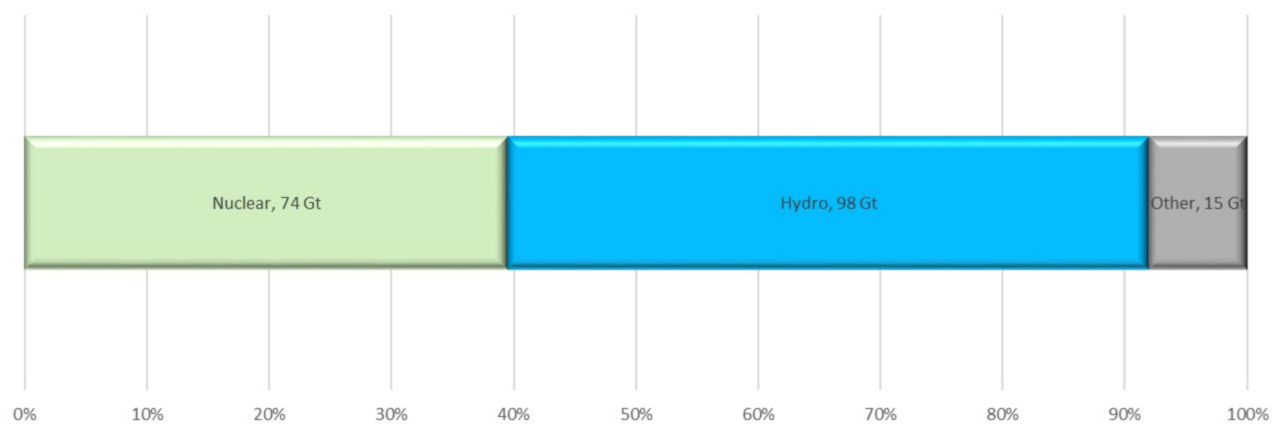
41 Source [33] – Section 1.2 - pg. 6
42 Source: [3] – Section 2.2.1

We have not included Carbon Capture Utilization (CCUS) and Storage technologies in our analyses as these emerging technologies are unproven from both a technological and commercial perspective. It is important to note that emissions associated with Carbon Capture Utilization and Storage (CCUS) on fossil fuel technologies and for biofuel (BECC) are both subject to considerable uncertainty – given the state of development of this technology – but such technology is not expected to capture all emissions (while quoted figures often suggest capture rates of around 85%[43] – other analysis of CCUS technologies are more skeptical[44]).

Nuclear power now provides approximately 10% of the world's electricity, but it contributes almost 30% of all low carbon electricity. Given that the energy sector is currently responsible for approximately two-thirds of global greenhouse gas emissions (see Figure 6)[45], an enhanced role for nuclear power will be essential for achieving the low carbon future which world leaders have agreed to strive for, but which current commitments are not set to deliver[46].

Nuclear power, currently being generated in 32 countries[47], is already reducing carbon dioxide emissions by about two gigatonnes per year. That is the equivalent of taking more than 400 million cars off the road — every year[48]. Only hydropower has played a greater role in avoiding carbon emissions over the past 50 years[49].

FIGURE 25 - AVOIDED ELECTRICITY SECTOR GHG EMISSIONS (1971 - 2018)



Data source: [31]– pg. 4

[43] Source: [24] – Table 8.1 – pg. 343
[44] Source: [25]
[45] References: [6] – pgs. 13, 48 & 92, [26], [27], [28] – pg. 60, [29] – Fig. 12, pg. 14
[46] Source: [6] – pg. 29
[47] Source: [30]
[48] Source: [3] - Foreword
[49] Source: [31] – Section 1.2

As shown above in Figure 25, nuclear power is a low-carbon energy source that has avoided about 74Gt of CO_2 emissions over this period, nearly two years' worth of total global energy-related GHG emissions.

3.4 Nuclear Energy is Amongst the Safest Generation Technologies

Over the past nearly seven decades of continuous commercial production, the world's nuclear power plant operators have demonstrated an extremely remarkable track record of safety. Nuclear energy is responsible for far fewer human fatalities and human morbidity issues, per unit of generation output, than many other sources of power generation. Aside from human casualties, the discussion about nuclear safety should encompass the broader topic of nuclear 'safety, security and safeguards'. Below we investigate the following areas of concerns:

- Human fatality rates related to power generation technologies
- Environmental contamination related to power generation
- Nuclear security and safeguards issues

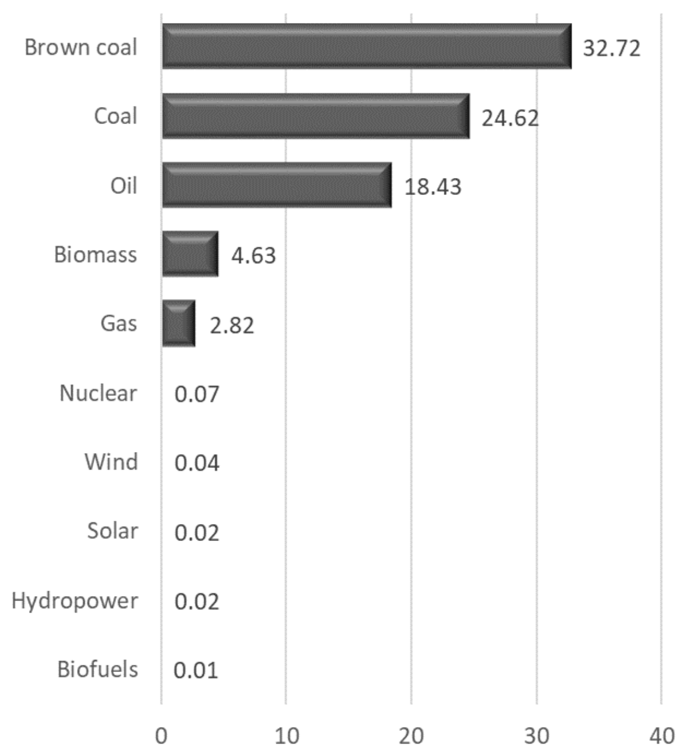
The analysis of (and the ongoing debate) related to nuclear safety is perhaps most well established by the *'JRC Science for Policy Report - Technical assessment of nuclear energy with respect to the 'do no significant harm' criteria of Regulation (EU) 2020/852 ('Taxonomy Regulation')'* (the "EU Taxonomy Report"). The ultimate conclusion of the JRC's EU Taxonomy Report can be best summarized as follows *"The analyses did not reveal any science-based evidence that nuclear energy does more harm to the human health or to the environment than other electricity production technologies already included in the [EU Environmental Sustainability] Taxonomy as activities supporting climate change mitigation."*[50]

Fatality Rates Related to Nuclear and Other Power Generation Technologies

When considering any generation technology's risk to human health, one must first consider the risks of human fatalities and human morbidity (illness and health issues) directly related to any particular generation technology's activities throughout its entire life cycle (including materials and fuels, construction, operations decommissioning and disposal/repository/recycling). For example, fossil fuel generation technologies have led to considerable levels of human fatalities and morbidity issues through air, water and soil pollution (in addition to accidents throughout their respective value chains). It is more difficult to assess the true impacts of PV solar and wind generation technologies as each technology, being extremely resource intensive, involve global supply chains including raw materials extraction and mining activities whether the human costs of such activities may not be well accounted for. Based on best available data, the following chart illustrates the total number of human fatalities directly caused by a certain form of generation, nuclear generation has amongst the lowest fatalities per TWh of generation and is similar to renewables.

[50] Source: [18] – pg. 182

FIGURE 26 - HUMAN FATALITIES PER TWH OF POWER PRODUCTION



Data source: [34], with data adapted from [35] & [36].

While nuclear power plant accidents are very rare, their local and regional impacts on humans (fatalities and morbidity caused by exposure to high levels of ionizing radiation) can be severe and have long-lasting implications. Over the nuclear power industry's nearly seven decades of operating history, there have been only three major nuclear accidents in the world: Three Mile Island (USA, 1979), Chernobyl (Ukraine, USSR, 1986) and Fukushima Daiichi (Japan, 2011). In terms of direct deaths, the Chernobyl accident was the worst[51]. However, as disastrous as these three accidents each were within the impacted regions, the rates of human fatalities and morbidity are far less than many other forms of generation (in particular, in comparison to the human impacts related to fossil fuels generation).

After the Chernobyl accident in 1986, the global nuclear industry responded by becoming increasingly focused on major safety enhancements in "generation III" (Gen III) reactor designs. In their 'taxonomy' report, the EU's JRC wrote, *"After the Chernobyl accident, international and national efforts focused on*

[51] Source: [36] World Health Organization (WHO) – the most-widely cited figure – estimates that approximately 4,000 people have, or will die, from the Chernobyl disaster. This includes the death of 31 people as a direct result of the disaster and those expected to die at a later date from cancers due to radiation exposure. Although estimation this is considered to be too high by several other researchers, including a later report by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

developing Gen III nuclear power plants designed according to enhanced requirements related to severe accident prevention and mitigation. The deployment of various Gen III plant designs started in the last 15 years worldwide and now practically only Gen III reactors are constructed and commissioned. These latest technology developments are reflected in the very low fatality rate for the Gen III EPR design ($\approx 8 \cdot 10^{-10}$ *fatalities/GWh). The fatality rates characterizing state-of-the art Gen III NPPs are the lowest of all the electricity generation technologies."*[52]

Aside from the above widely known nuclear disasters mentioned above, there have not been any significant known incidents where involving human fatalities and human morbidity implications related to excessive radiation exposure or environmental contamination issues related to operating nuclear power plants, decommissioning and within the nuclear fuel cycle.

Part of the reason that the nuclear industry demonstrates such a strong track record of safety is that the nuclear industries are amongst the most regulated industries in the world (and this also includes the nuclear fuel cycle industries, from mining and milling to waste storage and disposal). *"Nuclear regulation is a mix of international and national laws. The International Atomic Energy Agency (IAEA) works to provide a strong, sustainable, and visible global nuclear safety and security framework for the protection of people, society, and the environment. This framework provides for the harmonized development and application of safety and security standards, guidelines, and requirements; but it does not have the mandate to enforce the application of safety standards within a country. [which is the regulatory mandate of the given country's nuclear regulatory authority]"*[53].

As nuclear safety is largely underpinned by very strong regulatory conditions, IBNI will reinforce global best practices through its standards and conditions (see section 5) that will be applied and enforced throughout the entire value chain related to nuclear programs and projects supported. Such standards and conditions will compel project sponsors to implement not only the minimum required safety, security and safeguards standards, but to achieve international best practices in term of "smartest" regulatory standards designed to further minimize the possibility of future nuclear accidents.

Environmental Issues Related to Nuclear and Other Power Generation Technologies

It is widely known and accepted that nuclear power plants have virtually zero emissions of air and water[54] pollutants during their operational phases. Virtually all life-cycle emissions of GHGs and all other potential GHG, particulate and chemical emissions of NPPs over their whole life cycles are derived from their materials, construction, maintenance, decommissioning and fuel-cycle activities.

[52] Source: [18] – pg. 1
[53] Source: [39] – pg. 106
[54] However, as set forth in the EU Taxonomy Report, potential thermal heat pollution from NPP's is an identified issue of concern. This issue relates both to NPP siting as well as technology and cooling system requirements.

During proper operations, radiation exposure levels to workers within NPP facilities, and to the public near such facilities have been demonstrated to be orders of magnitude less than many other common atmospheric and environmental sources of very low-level radiation exposures that people and animals are routinely exposed to. However, the potential for release into the environment of radiation from an NPP or within the nuclear fuel cycle, of course, cannot be entirely excluded. Potential exposure to excessive amounts of radiation exists at all points in the nuclear fuel cycle, from mining and milling until long-term repository.

With respect to the risks related to any potential radiation contamination related to many elements of the nuclear life cycle, the EC's JRC Taxonomy report also reveals the following conclusions of their analysis:

"Management of radioactive waste and its safe and secure disposal is a necessary step in the lifecycle of all applications of nuclear science and technology (nuclear energy, research, industry, education, medical, and other). Radioactive waste is therefore generated in practically every country, the largest contribution coming from the nuclear energy lifecycle in countries operating nuclear power plants. Presently, there is broad scientific and technical consensus that disposal of high-level, long-lived radioactive waste in deep geologic formations is, at the state of today's knowledge, considered as an appropriate and safe means of isolating it from the biosphere for very long time scales."

"Measures to ensure that radioactive waste does not harm the public and the environment include a combination of technical solutions and an appropriate administrative, legal and regulatory framework. Although there remain contrasting views, it is generally acknowledged, that the necessary technologies for geological disposal are now available and can be deployed when public and political conditions are favourable. No long-term operational experience is presently available as technologies and solutions are still in demonstration and testing phase moving towards the first stage of operational implementation. Finland, Sweden and France are in an advanced stage of implementation of their national deep geological disposal facilities, which are expected to start operation within the present decade[55]. The radiological impact of nuclear energy lifecycle activities, including radioactive waste management and disposal, is regulated by law in the [EU] Member States, setting the maximum allowed releases and radioactivity exposure to the professionally exposed groups, to the public and to the environment. Respecting these limits, establishing the boundaries below which no significant harm is caused to human life and to the environment, is a precondition for any nuclear lifecycle activity to be authorized and is subsequently monitored by independent authorities."[56]

[55] Note that Finland has since broken ground on their Deep Geological Repository (DGR) project.
[56] Source: [18] – pg. 8

4. Why IBNI is needed to achieve 2050 Net Zero

Key Points

- IBNI will serve as both a *leader* and a *catalyst* on behalf of the global nuclear industry.
- Based on proven multilateral IFI models, IBNI will unlock vast amounts of new and incremental cost-efficient capital available for IBNI-supported nuclear projects and programs.
- IBNI is both a "game changer" and the "missing link" in global nuclear finance.

In Section 3 we have already established the very strong case for *nuclear energy being a significant component of any 2050 net zero pathway.* Here we examine the question as to *the necessity of IBNI in support of the significant required scaling-up of global nuclear capacity which will be required as a major component in achieving 2050 net zero* in the most feasible and fiscally prudent manner possible. Under an optimal scenario, the nations of the world and their financial markets may need to invest up to approximately US $21.5 trillion[57] in additional nuclear capacity over the ensuing 30 years. This will necessarily require "unlocking" and deploying vast quantities of long duration, cost efficient capital from the global capital markets[58] that can be deployed into nuclear energy projects. As is widely recognized, a very large share of the global capital markets is currently not able or willing to participate in the nuclear sector under current circumstances.

While there is currently an ongoing initiative by many in the nuclear industries to broadly 'qualify' nuclear energy sector projects, assets and companies as 'ESG investable' based on the technology's climate mitigation attributes and a broad range of other ESG criteria, in the opinion of the SAG, simply qualifying the nuclear sector as an 'ESG investable asset class' is not likely to result in any significant movement in additional global capital into the nuclear sector without IBNI. There are many other fundamental economic, commercial, policy, reputational and other impeding elements and risks which will likely continue and make it very difficult for many investors to participate in the nuclear sector, with or without favorable

[57] See section 3.1, Figure 22.

[58] Corresponds to the IBNI-IO SAG's optimal (high case) scenario where nuclear generation achieves 60% of total world power generation by 2050. This results in the addition of 5.3TW_e of additional nuclear generation capacities, at an average cost of US $ 4,068 / kW_e (world average) in total average investment costs, in current values (which ignores a key objective of IBNI, which is to cause nuclear overnight costs to progressively decrease over time as the pace of demand for nuclear technology increases, repetitive NOAK installation occur and innovative new nuclear technologies become commercially viable). IBNI-IO SAG has projected that the US $ 21.5 billion 30-year total nuclear capital investment could be reasonably decreased, through progressive cost decreases for nuclear technologies, to approximately US $ 13.8 trillion (ca. US $ 2,600 / kW_e 30-year weighted average total investment costs)

determination or resolution on the 'nuclear ESG question'. Simply stated, without IBNI taking on a leadership and catalytic role in promoting nuclear energy as an profitable and sustainable, sufficiently de-risked, appropriate and ESG compliant investment class, it is highly unlikely that the nuclear nations, the nuclear industry and the global financial markets will each be able to become galvanized behind common objectives, which would enable such a necessary large-scale deployment of capital into the nuclear sector required for nuclear to 'actually make a difference' in achieving 2050 net zero.

IBNI will act as a nuclear specialized 'anchor investor/lender' in projects, setting new rigorous standards and criteria for project structuring, due diligence and compliance. Only this leadership that only IBNI can provide will enable significant global capital markets participation in the nuclear energy sector. IBNI's approach will be persistent and incremental to demonstrate to the world (once again) that large-scale investment in nuclear energy is fundamentally solid investment proposition for many different investors and creditors and their stakeholders.

As mentioned above, IBNI will need to play both the primary *enabling* and *catalytic* role in promoting a new wave of global capital markets participation in the nuclear sector over the next 30 years. Simply stated, IBNI will need to take on the leading and indispensable role in advancing and achieving nuclear's prominent role in realizing 2050 net zero.

The availability of and access to cost-effective financing for nuclear infrastructure is clearly an issue which significantly impacts the ability of nuclear power generation to be scaled-up and compete globally, with other forms of generation on a least cost basis[59]. The issue of access to and the affordability of existing nuclear financing sources varies significantly from country to country, market to market and from situation to situation. Generally, there are currently many major impediments impacting nuclear project development and financing, which are present both in many well-established nuclear markets and also in many newcomer countries seeking to develop their first nuclear plants. IBNI's financing and support programs will be designed to provide solutions whereby nuclear energy programs can rapidly develop and/or expand in all market and economic situations applicable across IBNI's highly diversified membership base, which will range from advanced economy countries with already well-established nuclear generation and domestic nuclear industries to developing countries aspiring to implement new nuclear programs but have no existing nuclear industries. To enable and achieve the targeted overarching goal of a very significant 30 years scaling-up of global nuclear capacities, IBNI will broadly apply the following three key principles:

1. **Qualification.** IBNI financing and other support will be available and provided on a competitive, open/fully transparent, and technology -neutral basis to project sponsors within all IBNI member countries. Nuclear project sponsors within member states will need to apply and compete for IBNI support. Such finite support will always be preferentially offered to only those best-qualified

[59] Nuclear energy projects, like all other proven low-carbon generation technologies (except biomass, generally) are capital-intensive, resulting in high fixed costs relative to variable costs. Therefore, the cost of capital component of nuclear (similar to virtually all other low carbon generation technologies) is a key determinant of the relative cost and affordability of nuclear-derived energy generation.

applicant nuclear programs and projects which most fully adhere to IBNI's pre-established Standards and Criteria (see Section 5). For all hopeful competing recipients of IBNI financing and support, IBNI's Standards & Criteria will compel the project sponsors, together with their governments and institutions to enact market, regulatory and policy frameworks and decisions that allow nuclear generation to be supported and fairly compete in their energy markets, in a long-term sustainable manner. IBNI's support programs and Standards and Criteria will also be purposefully tailored to enable IBNI supported nuclear projects to report well under emerging ESG metrics, which will be an essential driver for the nuclear sector to emerge as an investable 'ESG compliant asset class'.

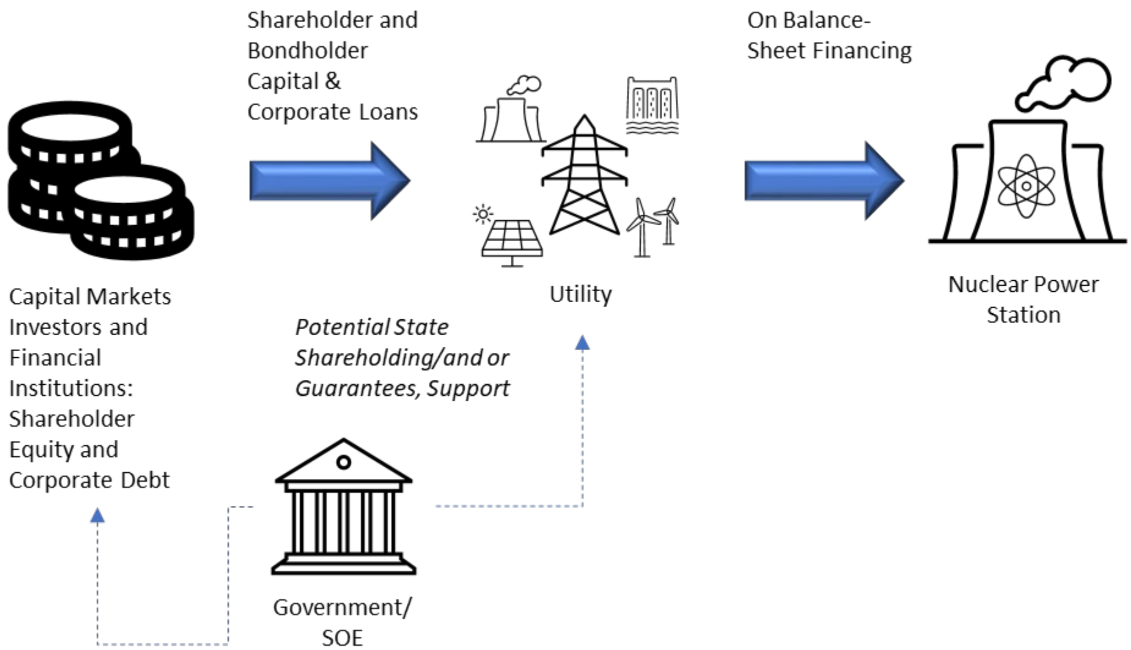
2. **Access.** IBNI financing (and IBNI initiated co-financing) and other support will provide NPP project sponsors and owner/operators in IBNI members states with access to sufficient and cost-effective financing for well-qualified NPP projects that may otherwise not exist (and without necessarily being tied to any particular type or vendor of nuclear technology).
3. **Affordability.** Amongst of IBNI's key goals will be to drive-down and minimize the cost of nuclear power generation relative to all other low carbon generation technologies, drive-up nuclear's share of global generation and thereby minimize overall energy costs to consumers. The low cost of IBNI's direct financing, together with the cost of capital from lenders and investors that participate alongside IBNI are expected to represent amongst the lowest cost of capital in the world available to nuclear project sponsors[60]. Simultaneously, IBNI's programs will drive significant reductions and efficiencies related to the capital and life-cycle costs.

Historical Perspective on the Financing of Nuclear Power Projects and Potential New Structures

From a historical perspective, there have been only two mainstream, very simplistic funding and financing models employed for developing nuclear projects: a) utility financed projects (on-balance sheet financing); and b) government financed projects. While elements of non-recourse project financing have been introduced and incorporated in numerous nuclear financing structures, despite some valid attempts, there has never been a case to date where an NPP has ever been financed on a "pure" project finance basis anywhere in the world. These two historical mainstream nuclear financing models are illustrated in the below diagrams.

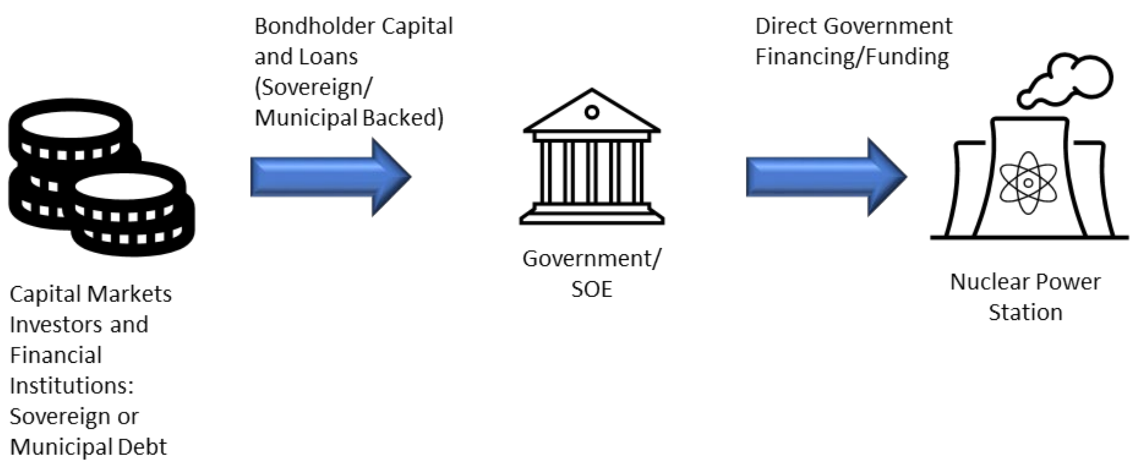
[60] In many cases, IBNI will directly provide a significant component of the financing for a nuclear project. Similar to all other existing multilateral IFIs, it is expected that IBNI will maintain 'AAA' rated senior unsecured credit ratings, which will allow IBNI to attract the lowest possible cost of capital in the global financial markets, and such low underlying costs will be passed along to IBNI participants. In addition, it is anticipated that IBNI's participation and serving as the "lead/anchor" investor in a nuclear financing, will attract other capital markets sources of low-cost, long-term capital, such as commercial lending institutions, infrastructure funds, pension funds, insurance companies, sovereign wealth funds, ESG funds, etc.

FIGURE 27 - ILLUSTRATION OF TYPICAL UTILITY FINANCED NPP



Source: IBNI-IO SAG

FIGURE 28 - ILLUSTRATION OF TYPICAL STATE FINANCED NPP



Source: IBNI-IO SAG

In many major world nuclear markets such North America, Western Europe, Japan and South Korea, nuclear power plants have mainly been financed by large electricity or combined utilities (in some cases investor-owned and in others, government-owned or hybrid – in both USA and Finland, for example, there are also numerous examples of municipal-owned utilities and cooperatives owning, operating and financing NPPs).

Normally, the funding of costs of such utility financed nuclear plants have ultimately been borne by the utility system rate payers (and in some cases and to a more limited extent, taxpayers). Historically, utility financed NPPs have been a outstanding success during the periods of time when electricity markets were regulated in markets such as North America and in Western Europe. In fact, utility financing of NPPs has been the primary model implemented during the periods of unprecedented historical growth of global nuclear generation capacities, which achieved average annual growth rates of approximately 32% from 1960 – 70 and 22% from 1970 – 80[61]. Under regulated energy markets, these (in most cases, vertically integrated and monopolistic) utilities were able to ascertain predictable future revenues from future electricity tariffs, which allowed them to invest significant sums of capital in long-duration assets like NPPs, which were financed mainly through corporate debt and equity raised in the capital markets and from financial institutions (on-balance sheet financing)[62].

Since the 1990s, whereby many of these same electricity markets have become subject to liberalization and in some cases also to unbundling policies, it has become increasingly challenging for utilities in deregulated market environments to invest in nuclear power projects. NPP projects, like almost all other forms of low carbon generation have a high ratio of fixed costs, which generally necessitates a stable and long-term predictable revenue stream related to a plant's available capacities. Deregulated energy markets have introduced a significantly greater degree of short-term wholesale electricity price volatility. In some cases, electricity market price decreases and volatility have also been driven by competing and very low fossil fuels-derived electricity prices and together with subsidized renewable generation technologies (generally, through technology specific subsidy policies), has created a very challenging economic case for nuclear power in these markets. In such deregulated market environments, utilities and other nuclear power producers have generally and rationally come to favor investing in smaller, less capital intensive and flexible generation capacity such as gas generation plants that have often been viewed by utilities as an ideal and cost-optimal means of providing either "base load" or "load following/peak" generation capabilities. This has dynamic (where there is generally insufficient or non-existent carbon pricing) has become self-reinforcing in many markets as increasingly higher VRE penetration levels has necessitated the need for dispatchable back-up and reserve generation to meet residual demand. However, the "game changer" going forward as nations develop their plans to achieve and deliver upon 2050 NDC's will be that continued investment in new fossil fuels generation capacities will no longer be a feasible option under any 2050 net zero framework.

NPP projects have also tended to require very large capital investment volumes and long-duration construction periods[63] and have also been subjected to increasingly complex regulatory regimes. In many

[61] Source: [16]. According to source, world nuclear operational capacities in 1960, 1970 and 1980 were 1,087 MW_e, 17,656 MW_e, and 133,037 MW_e, respectively. Accordingly, these increases accounted for a 32.1% CAGR from 1960 to 1970 and a 22.4% CAGR from 1970 to 1980.

[62] In some cases, such as in the United States, governments have also offered specific loan guarantee programs for nuclear projects which have been designed to increase private investment in nuclear power generation.

[63] Note that emerging new SMR and AR reactor technologies may offer potential lower capital investment volumes and shorter development and construction periods. However, these technologies have not yet been proven to be commercially viable and scalable.

cases, despite being statistically amongst the safest generation technologies (as discussed in Section 3.4), public opinion of the nuclear industry tends to remain unfavorable in numerous countries. All these factors have translated into very material financial risks from the point of view of investors and creditors, all of which have further contributed to challenges of both utilities and governments to justify large and long-duration capital investments in nuclear projects to their shareholders, investors, consumers and citizenry. Beyond the challenges of investing in new-build nuclear capacity projects, deregulated markets have also created challenging economic circumstances for the investment by power plant owner/operators in reactor life extensions (LTO)[64] of ageing global fleet of existing low-cost, safe and reliable nuclear reactors. It will be amongst IBNI's highest priorities to provide programs and support tailored to facilitate and enable economic reactor life-extension and re-start initiatives which allow for the prevention of early decommissioning of some of the safest, lowest-cost, reliable low-carbon generators available in any market.

In markets such as Russia, China and India, where both the entire nuclear industry and the utilities are largely state-owned and controlled, governments and SOEs have taken the lead role in financing all nuclear projects in those countries and also many of the export markets that Russia and China and their stated supported industries cooperate with abroad.

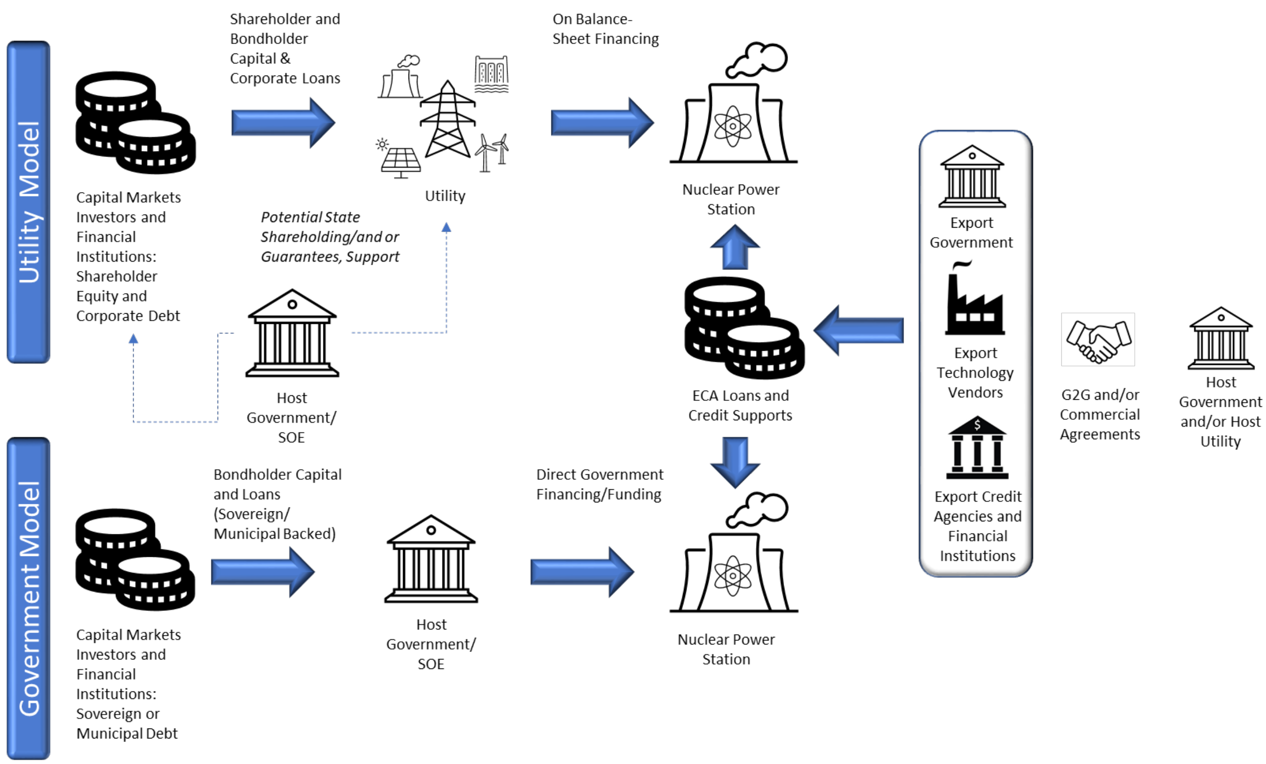
Until the 1990's the majority of nuclear finance models around the world involved domestic utilities and/or governments/SOEs developing NPP projects within the borders of the same country (however, in many cases utilizing licensed nuclear technologies and technology transfer arrangements from, exporting nuclear industries). However, since the 1990's both the utility and Sovereign/SOE models have been applied in the cases of nuclear export and cross-border projects. For example, in the United Kingdom (UK) there is already a long history of attracting other European utilities and other foreign project vendors and equity sponsors which have expanded the UK's nuclear program and capacities. Most recently French utility Électricité de France (EDF) and China General Nuclear Power Group (CGN) have formed a venture to develop the Hinkley Point C (HPC) project. EDF and CGN are financing HPC through their own resources employing a traditional on-balance-sheet utility financing arrangement. Korean utility, Korean Electricity Production Company (KEPCO) serves as a joint venture partner with Emirates National Energy Corporation (ENEC) (in both cases, SOEs) with respect to the Barakah NPP in the United Arab Emirates (UAE).

While the United States had been the dominant exporter of nuclear energy technologies until the 1970's, since the 1970's many other nuclear exporting countries have emerged as their own domestic nuclear programs developed, including France, Canada, Russia, South Korea, Japan and more recently, China. Accordingly, as the world markets for nuclear technologies exports have become increasingly competitive, trade finance such as Export Credit Agency (ECA) and similar export-oriented financing has also become increasingly prominent as it relates to cross-border nuclear transactions. The following diagram illustrates

[64] Even though nuclear LTO offers the lowest VALCOE generation costs in comparison to other technologies (see Section 3.1), market distortions in some deregulated energy markets have made even LTO projects uncompetitive to the extent the utilities may be forced to decommission safe, clean and reliable nuclear reactors well before their potential operational lives, purely based on financial considerations.

the application of ECA/export financing for either the previously described utility or state/SOE led nuclear financing models.

FIGURE 29 - APPLICATION OF ECA/EXPORT FINANCING TO UTILITY OR STATE/SOE MODELS



Source: IBNI-IO SAG

Proposed new IBNI models applicable for Nuclear Power Projects

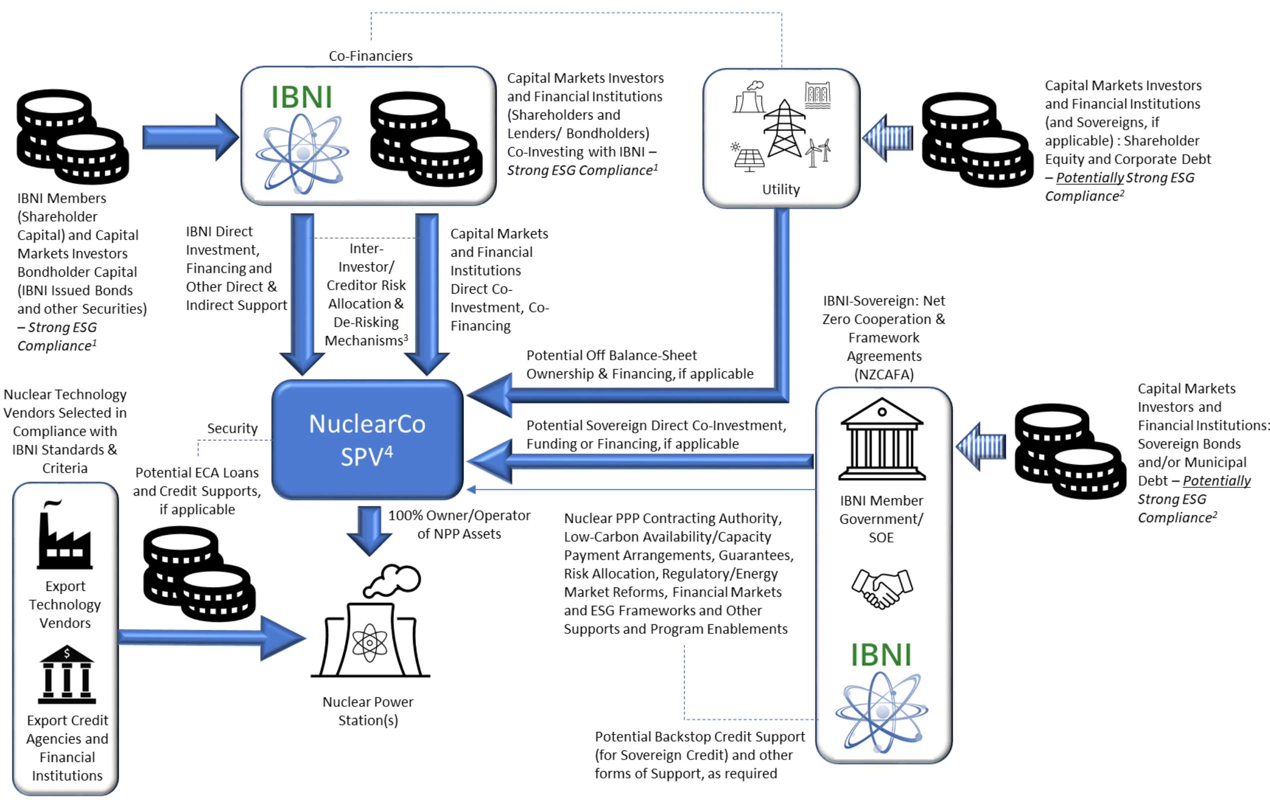
Under some limited circumstances, IBNI may provide direct financing and support to utilities and to governments/SOEs (as illustrated above in the case of traditional nuclear financing) for the development of nuclear projects within IBNI Member States using historical nuclear financing models as described above. However, in most cases the ideal and most suitable financing model will involve the utilization of some variation of a public-private partnership (PPP) model, which in the case of nuclear financing, represents a relatively new and innovative project delivery and financing model[65]. PPP development and financing models

[65] Worldwide, there is one successful PPP-model currently under development, namely the Akkuyu NPP Project in Turkey, which is being delivered under a form of PPP called "Build [Finance]-Own-Operate" (or 'BOO'). However, the Akkuyu project is a G2G transaction which was negotiated between the governments of Turkey and Russia and involves Russian state arranged financing via Russian SOEs involved in the project. Given the G2G framework of Akkuyu, categorizing that project as a PPP transaction may be considered controversial.

have been successfully utilized worldwide across a broad range of sectors and for many applications in countries and markets ranging from highly developed to developing economies.

Application of proven PPP models and structural elements will provide maximum opportunities for private sector investment and participation in IBNI-supported nuclear projects, which will be amongst the central objectives of IBNI in its quest to unlock new sources for capital markets participation in the nuclear sector. Promotion of IBNI and IBNI supported nuclear projects as investments that enable *very strong compliance with ESG performance and reporting* metrics will be a critical and requisite component of IBNI's leadership and catalytic role in driving vast new sources of capital into the nuclear energy sector. IBNI supported PPP models will be applied and will benefit nuclear projects entailing both existing and proven large reactor (generation III/III+) technology as well as new emerging SMR/AR/Generation IV technologies, when they become commercially viable in the future. The following diagram illustrates a potential PPP model and how it will be deployed for a nuclear project.

FIGURE 30 - ILLUSTRATION OF A PROPOSED IBNI-SUPPORTED PPP FINANCING STRUCTURE



Source: IBNI-IO SAG. Notes: (1) IBNI itself shall be structured to achieve strict compliance with a broad range of ESG criteria, which will enable IBNI to report maximum compliance with all relevant international ESG criteria which are evaluated by potential IBNI bond investors and investors in other IBNI-issued securities. Maximum compliance with ESG metrics and maintenance of 'AAA' long-term unsecured credit ratings is expected to maximally drive down IBNI's own costs of capital, which will be passed along to project participants in IBNI Member States. (2) One element of IBNI's Standard and Criteria, will require all IBNI-supported projects to strictly comply with a broad range of ESG performance and reporting criteria. This will enable

IBNI-supported nuclear projects to be considered 'ESG investible assets' by the largest possible number of potential investors, credit providers, insurers and institutions in the global financial markets. (3) The extent to which potential investments in utilities and/or sovereign governments and SOEs (IBNI Member States) are also able to perform and report well under ESG metrics depends on all ESG-related activities of those entities. However, it is envisaged that entering into and complying with long-term Net Zero Cooperation and Framework Agreements (NZCAFA's) will also strongly compel utilities and sovereign entities to also significantly improve their own compliance with a broad range of ESG criteria. (4) A 'Nuclear Company Special Purpose Vehicle' (NuclearCo SPV) will be a new (in most cases) special purpose vehicle (SPV) created for the sole or primary purpose of financing, developing, constructing, owning, operating, maintaining and decommissioning one or more nuclear power stations or nuclear fuel cycle projects. There may be many variants of this structure, based on specific circumstances and local law and regulatory requirements. Readers should specifically observe that use of an SPV does not imply that investment and financing of the SPV will need to be on a full non-resource (project finance) basis, as in almost every case third-party financiers and investors will be insulated from nuclear-specific project risks (which will be provided for through various sovereign and/or IBNI guarantees, risk allocation and de-risking mechanisms, which will essentially de-risk participation in a nuclear project to provide risk and returns profiles that are commonly acceptable to investors in most other infrastructure asset classes and project financings).

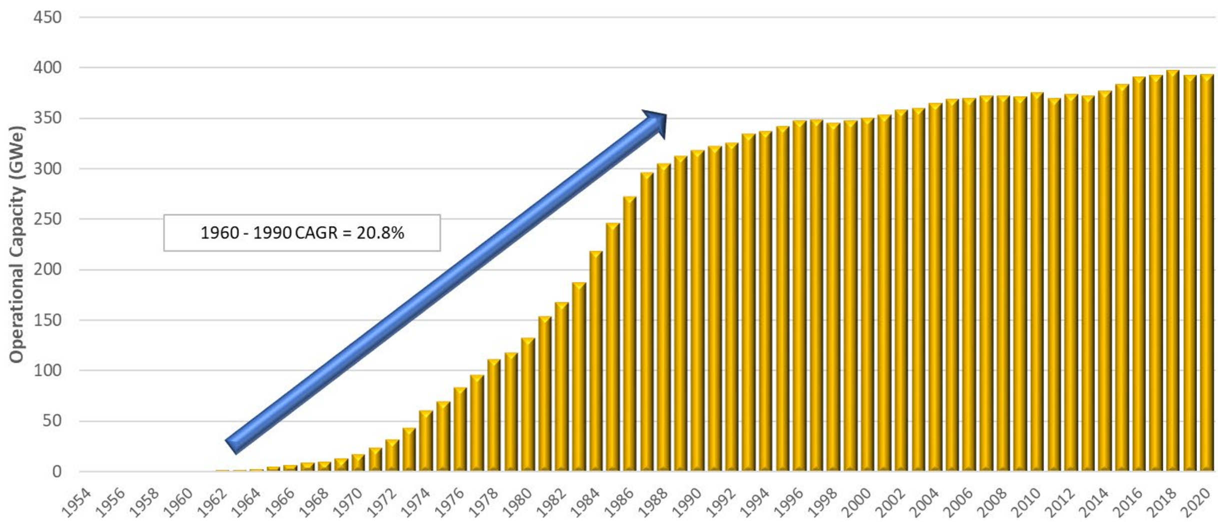
As the above illustration provides, under the IBNI-enabled PPP framework, it should be noted that this model does not attempt to replace or supplant existing sources of capital deployment that are currently available for nuclear projects which currently may come from utilities, governments/SOE's, ECA's etc. Instead, the IBNI support model is purposely designed to unlock and enable vast new sources of cost-efficient and long-tenor forms of global capital to participate in well-qualified IBNI-supported nuclear projects through various means.

4.1 Current Status of the Nuclear Energy Sector and Nuclear Finance

As mentioned above, while the nuclear industry is currently undertaking applaudable efforts toward broadly categorizing nuclear projects, assets and companies to be included within an 'ESG investable asset class', such categorization will not be nearly enough to persuade a new wave of global investors and financial institutions to participate in the nuclear sector. Over the past four decades, the universe of investors and financial institutions able and willing to support nuclear energy projects (and the broader nuclear industries) has become increasingly limited. Consequentially, access to affordable sources of financing for the entire nuclear value chain is constrained in comparison to most other infrastructure asset classes, which tend to have relatively broad access to financing from cost-effective sources of global financing. These are both the realities and the fundamental problems that IBNI will address and proposes to resolve.

There are numerous explanations for the current condition of the nuclear financing landscape. Much of it is principally 'cause and effect'. Amongst the primary causal factors have been the trends toward energy market deregulation beginning in the 1990s (and in many cases simultaneous subsidization of the fossil fuels and renewables industries), which had the effect of severely contracting both domestic nuclear industries, specifically in North America and Western Europe and which also has precipitated a decline in many countries' nuclear export capabilities. As global demand for new nuclear construction has severely contracted since the global nuclear expansionary period between the 1960s and 1990s, nuclear production and supply chains, including pools of nuclear engineering and other highly skilled and nuclear specialized human capital have greatly diminished in many markets.

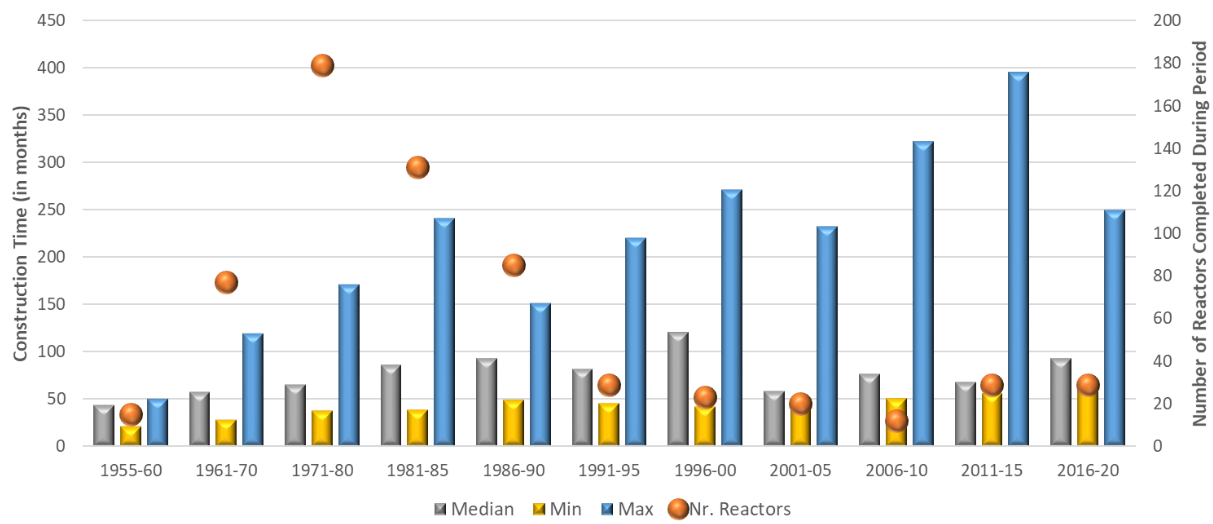
FIGURE 31 - WORLD NUCLEAR INSTALLED GENERATING CAPACITIES (1954 - 2020)



Data Source: [15]

The contraction in global demand for nuclear construction over the last several decades has correspondingly led to significantly diminished resource capabilities throughout the entire value chain ranging from nuclear and specialized manufacturing to local nuclear experienced subcontractors, suppliers and pools of nuclear specialized skilled human resources. The diminished condition of the global nuclear industries and their supply chains, lack of experience and "knowledge-by-doing" and ability to deliver repetitive "n^{th} of a kind" nuclear reactor installations, in combination with increasingly complex and unpredictable regulatory regimes in many countries have been amongst the main contributors toward the trend of very significant cost increases, longer construction times, significant cost overruns and delays for nuclear projects (in particular, in North America and European markets).

FIGURE 32 - HISTORICAL WORLDWIDE NPP CONSTRUCTION TIME SPANS



In many cases, liberalized and unbundled markets have also rendered capital intensive forms of generation, such as nuclear technologies, as uncompetitive against other less capital intensive, smaller and flexible dispatchable fossil fuel technologies (such as gas-fired generation) and technology-specifically subsidized renewables. Additionally, the nuclear industry continues to suffer from a negative public opinion in many markets, which stems from many legitimate concerns about the safety of nuclear reactors (nuclear accidents), storage of radiative waste, and security concerns ranging from terrorism and proliferation of nuclear technologies for military purposes.

All of the above elements have led to a rational determination by the global financial markets that nuclear investments are often viewed as being too large and too risky (both from a financial and reputational standpoint), and ultimately do not have a strong case for long-term sustainability of profits. While solving the 'Nuclear ESG question' is certainly a necessary hurdle to cross and is one key element of the solution, it alone is not likely to be the sole solution that changes global investors' and financial institutions' views on the investment fundamentals of the nuclear sector. The multifaceted issues that are currently inhibiting financial markets from participating in nuclear need a comprehensive solution that only IBNI's leadership and catalytic roles can deliver.

While the nuclear industries in certain countries such as South Korea, Japan, Russia, India and China have been and continue to be more active in nuclear project developments in the decades since the 1970s, this has not had much of an impact on the nuclear markets from a global perspective. Until very recently, of these countries, only Russia has been focused on nuclear export markets to any material extent, while from the 1970s until the early 2000s, Japan's, S. Korea's and China's nuclear industries had each been mainly focused on developing nuclear reactors within their respective domestic markets. Russia has been the most active and most successful nuclear exporter during recent decades, with active and/or completed NPP projects in Egypt, Turkey, Bangladesh, Belarus, Hungary and Uzbekistan. S. Korea's foray into the nuclear export market has been with respect to the Barakah project in the UAE. China is currently active in the HPC project in the UK and developed the reactors in Pakistan (Chashma 1-4). The United States has also recently signed nuclear export cooperation agreements in Poland and Romania. The French nuclear export industries have recently been active in Finland (Olkiluoto 3) and in China (Taishan). In each if these cases there has been a significant component of export-related financing arranged on a G2G basis involving the respective exporting state, their nuclear export industries and export financing institutions.

Currently, there are some 30 countries that have been involved in the IAEA's Integrated Nuclear Infrastructure Review (INIR) programs[66]. These INIR participant countries are predominantly 'newcomer' countries aspiring to develop domestic nuclear energy programs through the import of nuclear technologies. A common theme amongst all the recently completed, ongoing and new nuclear build projects in such 'newcomer' nuclear markets is that in each case they rely heavily on export financing (in most cases, have been and are dependent upon G2G arrangements between the governments of the host and the nuclear exporting counties). The following table illustrates the financing models and the sources of financing deployed for recent and planned NPP projects worldwide.

TABLE 1 - RECENT AND PROPOSED NUCLEAR POWER PLANT FINANCING STRUCTURES

Country	Plant Name	Capacity	Construction Start	Financing Model	Financing Sources
Bangladesh	Rooppur 1-2	2x1200MW$_e$	2017	State	Sovereign funding and export credit provided by Russian SOEs
Belarus	Belarusian 1-2	2x1100MW$_e$	2013	State	Sovereign funding and export credit provided by Russian SOEs
Brazil	Angra 3	1x1340MW$_e$	2010	Utility	Eletrobras Elecronuclear S.A. (SOE)
China	Changjiang 3	1x1000MW$_e$	2021	State	Chinese State/SOE equity, China Development Bank, Bank of China
China	Fangchenggang 3-4	2x1000MW$_e$	2015	State	Chinese State/SOE equity, China Development Bank, Bank of China
China	Fuqing 6	1x1000MW$_e$	2015	State	Chinese State/SOE equity, China Development Bank, Bank of China
China	Hongyanhe 5-6	2x1061MW$_e$	2015	State	Chinese State/SOE equity, China Development Bank, Bank of China
China	Sanaocun 1	1x1117MW$_e$	2020	State	CGN (CEO) equity, China Development Bank, Bank of China
China	Shidao Bay 1 (HTGR)	1x500MW$_e$	2012	State	Chinese State/SOE equity, China Development Bank, Bank of China
China	Taipingling 1-2	2x1116MW$_e$	2019	State	Chinese State/SOE equity, China Development Bank, Bank of China
China	Taishan 1-2	2x1750MW$_e$	2010	Utility, JV	EDF and CGN equity (SOEs) , China Development Bank, Bank of China, Société Générale
China	Tianwan 5-6	2x1000MW$_e$	2015	State	Chinese State/SOE equity, China Development Bank, Bank of China
China	Xiapu 1 (FBR)	1x642MW$_e$	2017	State	Chinese State/SOE equity, China Development Bank, Bank of China

[66] Source: [40]. Reference is made to the number of countries where IAEA has provided INIR missions to since 2009.

Country	Plant Name	Capacity	Construction Start	Financing Model	Financing Sources
China	Xudabu 3	1x1200MW$_e$	2021	State	Chinese State/SOE equity, China Development Bank, Bank of China
China	Zhangzhou 1-2	2x1126MW$_e$	2019	State	Chinese State/SOE equity, China Development Bank, Bank of China
Egypt	El Dabaa 1-4	4x1200MW$_e$*	2021*	State	Sovereign funding and export credit provided by Russian SOEs
Finland	Olkiluoto 3	1x1720MW$_e$	2005	Utility (Mankala)	TVO (Cooperative) Equity and Credit, SEK and Coface (BPI France) (ECAs) and Commercial Bank Credit Facilities[67]
France	Flamanville 3	1x1650MW$_e$	2007	Utility	EDF (SOE) equity
Hungary	Paks II 1-2	2x1200MW$_e$	2021	Utility	MVM (SOE) equity funding and export credit provided by Russian SOEs
India	Kakrapar 3-4	2x700MW$_e$	2010	State	Indian State budget
India	Kundankulam 3-4	2x1000MW$_e$	2017	State	Indian State budget
India	Prototype Fast Breeder Reactor	1x500MW$_e$	2009	State	Indian State budget
India	Rajasthan 7-8	2x700MW$_e$	2011	State	Indian State budget
Japan	Ohma	1x1328MW$_e$	2010	Utility	J-Power (IOU) equity
Japan	Shimane 3	1x1325MW$_e$	2006	Utility	Energia (IOU) equity
Pakistan	Chashma 3-4	2x340MW$_e$	2005	State	Host government funding and Chinese (exporter) sovereign and bilateral financing
Pakistan	Kanupp 2-3	2x1100MW$_e$	2015	State	Host government funding and Chinese (exporter) sovereign and bilateral financing
Poland	Zarnowiec 1-6*	6x300MW$_e$*	2025*	Utility	PGE (SOE) and USDFC (ECA) Credit Facility
Romania	Cernavodă 1-4 (LTO & New Build)*	2x650MW$_e$ 2x720MW$_e$*	2022*	Utility	SN Nuclearelectrica (SOE) and USDFC (ECA) Credit Facility
Russia	Akademik Lomonsov 1-2 (Floating)	2x30MW$_e$	2007	State	Rosatom Group (SOE) Russian state funding
Russia	Baltic 1	1x1109MW$_e$	2012	State	Rosatom Group (SOE) Russian state funding
Russia	Kursk II 1-2	2x1175MW$_e$	2018	State	Rosatom Group (SOE) Russian state funding
Russia	Leningrad II 1-2	2x1066MW$_e$	2008	State	Rosatom Group (SOE) Russian state funding
Russia	Novovoronezh II 1-2	2x1100MW$_e$	2008	State	Rosatom Group (SOE) Russian state funding
Russia	Rostov 3-4	2x1000MW$_e$	2008	State	Rosatom Group (SOE) Russian state funding
Saudi Arabia		2x1000MW$_e$*	2025*	State*	TBD – Ongoing competitive process for technology vendor(s) and potential financing sources.

[67] Source: [41] – Slide 41. Includes a consortium of commercial banks, including Bayerische Landesbank, BNP Paribas, JP Morgan Chase, Nordea and Svenska Handelsbanken.

Country	Plant Name	Capacity	Construction Start	Financing Model	Financing Sources
S. Korea	Shin Hanul 1-2	2x1340MW$_e$	2012	Utility	KHNP (KEPCO) (SOE) equity
S. Korea	Shin-Kori 5-6	2x1340MW$_e$	2017	Utility	KHNP (KEPCO) (SOE) equity
S. Korea	Shin-Wolsong 1-2	2x997MW$_e$	2007	Utility	KHNP (KEPCO) (SOE) equity
Turkey	Akkuyu 1-3	3x1200MW$_e$	2018	BOO (PPA)	Rosatom Group (SOE)
United Arab Emirates	Barakah 1-4	4x1345MW$_e$	2012	Utility (PPA), JV with Sovereign and ECA Financing and Support	ENEC & KEPCO Equity (SOEs), Government of Abu Dhabi Direct Loan, First Gulf Bank, National Bank of Abu Dhabi, HSBC, Standard Chartered, KEXIM and USEXIM (ECAs) Loans
United Kingdom	Hinkley Point C	2x1630MW$_e$	2018	Utility (CfD), JV	EDF & CGN equity (SOE)
United States	Vogtle 3-4	2x1250MW$_e$	2013	Utility	Southern Company (IOU) equity and USDOE Loan Guarantees
Uzbekistan		2x1200MW$_e$*	2023*	State	Sovereign funding and export credit provided by Russian SOEs

*Data Sources: [16], [41], press releases, company websites and other publicly available information. * Indicates projects that are proposed or planned and such dates and other parameters may be subject to change.*

As the preceding table indicates, there are currently a dearth of options for financing models and sources of financing for most nuclear energy projects outside the historical utility and state/SOE financed models and the government-to-government (G2G) nuclear export models described above.

Currently, there is a major transformation occurring in the global financial markets, where investors are increasingly demanding that the assets and companies that they invest in meet emerging new ESG sustainability metrics and criteria. While ESG-focused investor initiatives and “sustainability taxonomies” are increasingly driving large sources of capital into many low carbon and “green” industries and asset classes, including renewables, hydrogen and energy storage, ESG has not yet unlocked prospective additional new sources global capital available for nuclear industry projects and investments. The ESG transformation should be viewed as an enabling condition, but it alone is not likely to be sufficient to unlock significant new sources of capital available for nuclear power projects. IBNI will need to take the leading and catalytic role in driving new sources of capital into nuclear sector projects.

Under G2G and nuclear export transactions, financing from Export Credit Agencies (ECAs) and similar export-oriented trade credit institutions have become prominent financing sources for many nuclear export projects. However, these ECA-dependent financing models tend to tie nuclear technology choices to financing availability, often distorting host countries choices of the best technological and value solutions most appropriate for the needs and applications within the host country’s energy markets. The G2G models often lead to expansion in nuclear capacity being dependent on the strategic and diplomatic contingencies and geopolitical relationships.

Furthermore, the existing multilaterals, including World Bank Group, ADB, EBRD, AIIB, etc.) are currently unable or unwilling to finance the nuclear sector; and many are explicitly prohibited from doing so (EBRD will finance decommissioning and certain spent-fuel related projects, but not new construction, reactor life extensions or refinancing of nuclear power plants). However, to the extent that any existing or other new MDB becomes able and willing to financing nuclear power in the future, this would be a most welcome development and IBNI would work along-side other IFIs, similar to the way in which existing MDBs often work in collaboration to finance large infrastructure projects in other sectors. The potential for future participation by other MDBs and IFIs in nuclear infrastructure does not obviate or diminish the need for and the rationale for IBNI, as nuclear financing is very different from other forms of infrastructure and development financing, which requires specific leadership and specialized skill sets that only IBNI will be able to deliver.

Similar to most other forms of low carbon generation, nuclear new-build projects are extremely capital intensive – with capital and investment costs often making up more than 50% of the levelized cost of electricity from such projects[68] – meaning that the cost of financing is a key determinant of project viability and the affordability and competitiveness of nuclear power and a clean and reliable generation option. The current nuclear technologies and markets have evolved toward very large reactor sizes (typically in excess of 1 GW_e installed capacity), which has resulted in very large (multiple US $ billions) capital costs and long construction periods (often in excess of seven (7) years). The required total investment volumes, long construction time frame and potential for cost overruns and delays, and many other unique characteristics, each present unique and challenging financing risk elements which pertain to nuclear[69].

IBNI is needed to accelerate investment in a vast global expansion in and also to drive affordability of nuclear capacity, including supporting the deployment of new innovative nuclear technologies, life extensions and restarts of existing nuclear reactors and nuclear fuel -cycle projects.

It should be emphasized that IBNI will be a technology/vendor neutral multilateral institution dedicated to financing nuclear energy projects at all stages of their development. A key IBNI offering will be support for technology neutral project development work (e.g. incentives for project sponsors to conduct open and transparent international procurement of nuclear technologies).

IBNI will establish and enforce rigorous standards and criteria (see Section 5) that all project sponsors receiving IBNI support will be compelled to adhere to, which will ensure the highest possible adherence to safety, security & safeguards; environmental, social and governance (ESG); commercial/risk allocation; market; regulatory; economic development, procurement and other key standards and criteria.

In contrast to private sector banks' overriding focus on maximizing shareholder value as measured in purely financial returns over the short-term, IBNI will recognize the broader societal benefits (and returns) arising

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[68] However, nuclear life-extension and renewal projects (LTO) are typically significantly less capital-intensive. See discussions in Section 3.1.

[69] Emerging new Small Modular Reactor (SMR) and Advance Reactor (AR) designs and related technologies and their associated business models offer promising solutions that may help mitigate many of the financing and risk challenges facing the nuclear industry. However, SMR and AR technologies are generally not commercially proven at this time and therefore the initial and immediate focus of IBNI shall be on financing and rapidly deploying existing and proven nuclear technologies (generation III/III+ reactor designs), while at the same time supporting rapid development, commercially proving and scaling-up new emerging SMR/AR technologies and applications and further innovation and R&D in these areas.

from investments in low carbon nuclear generation – including valuing returns in the form of GHG mitigation benefits and related performance-based indicators - and will also take a more long-term and flexible approach to lending and investing in nuclear projects (as is appropriate for very long-lived capital-intensive assets which typically have 5–7 year construction durations and 60+ year effective operational lives).

IBNI will structure its financing instruments in ways that reflect an understanding of the unique risk profile of nuclear projects, and a willingness to appropriately share these risks, by taking a longer-term view on a total project life-cycle risk basis – albeit in the limited sense appropriate for a lending institution, by applying established international best practices in operation, financing and risk management for IFI organizations.

IBNI will build on its institutional understanding of the risks attendant on nuclear projects – and approaches to their mitigation - to determine and encourage appropriate 'ownership' of residual risks in any nuclear power plant transaction in which IBNI supports.

There is a clear and justifiable public policy rationale for governments' support for nuclear in a space in which there is textbook 'market failure' (the existence of externalities in the form of GHG and other emissions) which may be only partially monetized for nuclear generation - and internalized for fossil fueled generation - by carbon pricing and other arrangements; a case could likely also be made for intervention to support the diffusion of new technologies such as Small Modular and Advanced Reactors.

4.2 Critical Leading Roles that IBNI will play in the Nuclear Power Sector

As mentioned above, IBNI will need to take on both a *leadership* and a *catalytic* role in the global nuclear energy sector. IBNI will serve as the lead "anchor" investor and/or lender directly in well-qualified nuclear power projects within IBNI member countries that apply for IBNI support. IBNI will take on a lead role both in appropriately structuring a project (from a commercial/risk, financial, legal and technical perspective) and also a higher-level leadership role which will compel the member country to enact necessary energy market and regulatory and other policy frameworks that will support nuclear on a "level playing field" together with all forms of low-carbon generation in a long-term fair, equitable, affordable and sustainable manner. In each IBNI supported project, the Bank will impose and enforce a rigorous set of internationally accepted standards and criteria, specifically including uniform and harmonized ESG performance and reporting criteria (see Section 5 for more details on IBNI Standards and Criteria) amongst other standards and criteria. IBNI's participation in well-qualified nuclear projects that it supports will be designed to encourage and promote incremental participation in IBNI and in IBNI supported projects from a large share of the global capital markets and financial institutions. This 'multiplier effect', where every dollar of government shareholder investment in IBNI results in multiple dollars of nuclear infrastructure investment, is a model analogous to those that have been implemented and proven successful by many of the world's IFIs that have been in existence for many decades. See Section 4.3 below for a discussion on how IBNI will attract new source of capital for nuclear projects.

IBNI will achieve the aim of significantly expanding nuclear capacities in an affordable and sustainable manner through three levels of leadership.

First, at the country level, for each IBNI member states that requests participation in IBNI's support program, that country will be obligated to sign a long-term Net Zero Cooperation and Framework Agreement (NZCAFA). The NZCAFA will be a comprehensive legally binding agreement (between IBNI and the sovereign) and enforceable through cross-default mechanisms across all IBNI financing agreements and other support agreements issued through IBNI and each of its co-financiers within that country. Amongst other items, each NZCAFA may encompass that member country's specific commitments toward broad net zero/decarbonization commitments and firm policies (enforcement of NDC commitments); energy market, regulatory, environmental and economic reform policies; transition away from fossil fuels; electrification policies; carbon pricing; and many other elements which will be tailored to reflect the specific circumstances, realities and preferences of each member country. The consequences of an IBNI member country defaulting under its NZCAFA obligations will be intentionally quite severe and are therefore expected to result in an extremely low default rate.

Second, at the IBNI supported nuclear project level, the terms and conditions within each IBNI financing and other IBNI support agreement will be project specific. Project level IBNI financing and support agreements will contain terms and conditions that are specific to the requirements of the project but will require compliance with IBNI's applicable Standards and Criteria[70]. Project level IBNI agreements will also become the basis for the optimal *downside* risk and *upside* profit potential amongst the project stakeholders, which may include the IBNI, the IBNI Member State government/SOE, third party co-financiers, utilities, contractors/vendors, etc.

Third, in each IBNI-supported project the Bank will take on a leadership role as the long-term *patient* investor and/or lender. Providers of commercial debt capital (such as bond investors or and commercial lending institutions) are understandably focused on "full and timely payment" of scheduled principal and interest and protections against *downside* risk and stress case scenarios. Providers of equity capital (equity sponsors) are typically focused on the prospect of earning at least a targeted minimum rate of equity return over a finite time horizon, in exchange for prudently managing a project and controlling *downside* risk elements. In both cases, IBNI's leadership as the long-term *patient* investor or lender will be critical. In each IBNI supported project, IBNI will be in a unique leadership position to optimally structure the project agreements, inter-

[70] IBNI Financing and Support Agreements will be negotiated between the specific nuclear project sponsor(s) in the IBNI Member Country. The terms and conditions under each agreement will be discretely enforced for each project (e.g. will not trigger cross-default on other IBNI supported projects in the country). However, the participating IBNI Member State will also be a party to each IBNI Financing or Support Agreement issued in the country and the terms of that country's NZCAFA will be enforceable under each project level agreement. Therefore, default under the terms of the NZCAFA will trigger a cross default across all IBNI and other co-financiers' financing and support agreements in that country. Project level participants would be indemnified in the case of the IBNI member state's default under the terms of their NZCAFA.

shareholder and inter-creditor agreements, where project *downside* risks, *upside* profits potential are optimally allocated amongst all project stakeholders, and in particular, amongst project's co-financiers.

4.3 IBNI Will Attract New Sources of Capital for Nuclear Sector Projects

As described above, one of IBNI's critical and overriding objectives will be to *catalyze* additional and incremental private capital into the nuclear energy sector on a global scale. This will include a deliberate effort to drive new and additional sources of capital from the global financial markets and from financial institutions into the nuclear energy space. IBNI will target such capital investments from the financial markets at two levels: 1) as direct investments in IBNI's bonds and other IBNI securities issued in the global markets; and 2) as co-investment alongside IBNI in well-qualified IBNI-supported nuclear projects within IBNI Member States. The specific plan to catalyze capital investments at these levels is more fully described below.

Global Capital Markets Investments in IBNI

It is proposed that IBNI will initially be capitalized with shareholder (common equity) capital from the coalition of IBNI Member States. A portion of the shareholder capital from the IBNI Member States will be paid-in shares and another portion will be in the form of callable shares. The allocation of shareholder pledges amongst the IBNI membership is likely to be allocated on the basis of national GDP or other equitable and fair methodology. It is further envisaged that ratio of paid-in equity to callable equity capital will gradually decrease over time as the credit fundamentals of the Bank evolve over time. This capitalization structure is analogous to the models that have been in existence and proven amongst the universe of major MDB's that been in existence for many decades. This proposed ownership, governance and capitalization structures of IBNI are more fully described in Section 6 of this report.

In addition to the shareholder (equity capital) component of IBNI, the Bank will also raise debt capital (and in the future may also include preferred equity and other forms of quasi-equity capital) in the global financial markets. Issuing long-term bonds and other forms of securities is also common amongst the major existing MDBs. Also, as all of the major MDBs have successfully achieved and continue to maintain the highest 'AAA' long-term credit ratings, it is expected that IBNI will also achieve such highest 'AAA' category ratings. IBNI will also be structured "from the ground up" to achieve the very highest 'ESG performance criteria' and allow the Bank to report in the most favorable manner against a broad range of uniform 'ESG performance metrics' applicable to inter-governmental organizations (IGOs).

The combination of highest possible credit rating and strongest ESG reporting metrics (so-called 'ESG ratings') will allow IBNI to attract a broad range of investor interest. Existing MDB's such as World Bank Group, EBRD, ADB, AfDB, AIIB, etc. attract many of the same investor classes that typically invest in other sovereign based securities. This includes a universe of investors including governments, sovereign wealth funds, sovereign bond funds, corporations, investment and asset managers and other investor classes. Globally, the size of the Sovereign, Supranational and Agency (SSA) bond market is currently estimated to be US $87.5 trillion[71].

It is proposed that IBNI will offer its bonds sand other securities on many of the world's established public exchanges and also through private placements and/or limited offerings in a variety of currency denominations within numerous IBNI Member States, where it is cost efficient. As a large and repetitive issuer, IBNI will also be ideally suited to become a lead "market maker" for 'highest investment grade green/sustainable SSA bonds' and other ESG compliant securities in many diverse markets. Combining all of these elements will create the mutually beneficial circumstances for IBNI and its program member participants, whereby:

- IBNI will be able to access a very significant and broadly diversified global pool of investors, which will maximally drive down its own cost of capital, which will be passed along to IBNI program participants;
- IBNI will diversify its currency exposures across many different currencies in the markets that it serves, which will allow IBNI to accept increased local currency exposures in many of the IBNI member states markets that it serves;
- IBNI will serve as a lead "market maker" for 'green/sustainable bonds' and other ESG compliant securities in many of the capital markets within IBNI members states; and,
- IBNI will routinely also enter into derivative transactions, such as interest rate, currency and inflationary swaps and other hedging products with qualified broker-dealers and using its 'AAA' ratings, will minimize the credit spreads on all such transactions.

None of the above represents anything representing anything necessarily "new, different and unproven". Existing world MDBs have been implementing and continue to successfully implement many similar programs for the benefit of their members.

Global Financial Markets Participation in IBNI-Supported Nuclear Projects

The second and extremely important leg of global financial market participation, entails IBNI's leadership and catalytic roles in driving global capital markets and financial institutions into IBNI-supported nuclear projects at the project level.

IBNI will be uniquely situated to restore and build market confidence in the global nuclear sector from a broad universe of investor and lender co-financiers, who will be expected to participate along-side of IBNI in the nuclear projects that it supports. Adopting the same proven fundamentals used by existing MDBs to catalyze co-investments in otherwise challenging market situations, amongst IBNI's main objectives will be to realize a similar "multiplier effect". The main principle that for every dollar of IBNI's direct support in a

[71] Source: [42]. The largest component of the SSA bond market includes sovereign bond issues from many of the world's highest rated issuers.

project, additional multiples of cost-efficient capital will become available from the global financial markets. While it is anticipated that IBNI will need to provide a more significant share

Acting as the 'patient long-term' provider of capital, IBNI will have a great deal of flexibility to access a wide array financial tools and strategies in effort to sufficiently 'de-risk' each nuclear project in effort to attract a broad universe of cost-efficient capital sources from the global financial markets. IBNI will lead the negotiations and structuring of project agreements and will be a party to numerous agreements, including inter-shareholder and/or inter-creditor agreements, which will be tailored to efficiently, cost-effectively and appropriately allocate risks and upside profit potentials amongst IBNI and its co-financiers (which may also include utilities, ECA's, other public or private sector shareholders and lenders, as the circumstances may be), the host government/SOE and contractors. For example, in current market environments project cost overrun and delay risks may not be efficiently absorbed by entirely by nuclear EPC contractors and equipment suppliers, and these risks are also too great for the financial markets, IBNI's unique 'patient investor' role may allow it to provide necessary contingent equity, contingent credit facilities and backstopping guarantees.

Sufficiently 'de-risking' nuclear projects from a financial markets perspective, may also take on many other forms. It is intended that IBNI will have a very high degree of flexibility and latitude to tailor solutions to the wide and diverse array of specific needs and challenges that different nuclear projects face in different countries and market environments. In some IBNI cases may be willing to provide a disproportionately higher share of its capital injected during the early stages of the development and construction period, allowing co-financiers to inject a greater share of their capital later in the construction period ("back-loading" the private sector capital) after certain milestones have been achieved and the project is less risky. In other cases, IBNI and a group of initial co-financiers (and the host government) may determine that it is preferential to take on all of the "greenfield" construction risks and then sell shares at a premium and/or refinance, at gain, all or most participation in project after it achieves commercial operations and the assets are fully 'de-risked' from a development and construction risk perspective. This latter scenario may be appropriate in the case of new market scenarios, "first of a kind" (FOAK) reactor technologies, demonstration projects, etc. where there may be inadequate investor interest from cost-effective sources of capital.

IBNI may provide both senior *pari passu* and subordinated loans and other credit facilities, minority common or preferred equity shareholding, mezzanine financing, convertible loans, letters and lines of credit, guarantees, and hedging solutions (including interest rate, inflation and currency swaps). In addition to direct provision of financial products and solutions, IBNI will also assist qualifying project sponsors in IBNI Member States by providing a range of professional transaction and financial advisory services. Please see Section 7 for details on IBNI's proposed programs and operations.

Through NZCAFA and other agreements between IBNI and the IBNI member government, certain risk elements such as change in law, change in tax, change in regulation risks will also be allocated amongst IBNI and the host government. Generally, those risks directly and indirectly relating to *political force majeure* and/or *events of government action or inaction* (EGAI) will constitute relief events secured by government guarantee. Any breach in the terms of the NZCAFA, which triggers cross-default at the project(s) level would be an example of an EGAI where the host government would typically be expected to provide relief to the project counterparty (given compliance with all NZCAFA contractual items will be deemed to be under the control of the host government). In cases where it is necessary or desired for sovereign guarantees to be in place, and where the host government's (or SOE's) sovereign credit may be insufficiently strong, IBNI may also provide sovereign credit backstop or guarantee or credit wraps using it 'AAA' credit rating to further credit enhance the strength of sovereign guarantees.

Given the current status the global nuclear industries and insufficient global financial markets' participation in nuclear projects, it is expected that IBNI will generally provide a higher share of direct financing in projects in the early program years and the ratio of IBNI to co-financing from the financial markets with progressively decline over the next three decades. It is envisaged that IBNI will directly finance between 20% and 70% of total project capital costs (including contingencies, interest during construction, financing costs, etc.) As the financial markets become sufficiently experienced and confident in IBNI-supported projects, and therefore a successful track record of many projects can be demonstrated, this is expected to translate into the availability of a large global universe of cost-efficient private sector debt and equity capital available for nuclear projects, which will decrease the need for a large share of direct IBNI capital in projects. As the program evolves into the 2030's and 2040's, IBNI's primary role is expected to transition more toward the role of transaction facilitator, arranger and structuring agent and to a lesser degree on the role of direct financier.

4.4 IBNI and Sustainable Investment Criteria

As mentioned above, IBNI will be in a unique position to lead the global nuclear industry in the new and emerging era of sustainable investment initiatives developing in global financial markets. IBNI, as an IFI organization will be "designed from the ground up" to perform and allow it to report well against a broad range of ESG criteria. Taking all reasonable efforts to comply with emerging ESG investment standards and criteria, 'green taxonomies' and 'sustainable taxonomies' will not only allow IBNI to access the broadest universe of global investors for IBNI issued bonds (including "green and sustainable bond", "climate impact bond" and "social impact bonds" programs and other similar bond programs) and other securities, will not only benefit IBNI and its members by minimizing its cost of capital, but will also compel all stakeholders in IBNI-supported projects to comply with such requirements. These stakeholders will include IBNI's co-financiers (including equity investors, financial institutions, bond investors, and utilities), contractors, suppliers, insurers and host governments.

Imposition and enforcement of IBNI's uniform set internationally accepted nuclear-specific Standards and Criteria (See Section 5) will provide assurance that all stakeholders in each IBNI-supported project will adhere to a rigorous set of standards, ranging from nuclear safety, security and safeguards; ESG performance and compliance; procurement and anti-corruption frameworks; sensible commercial and risk-allocation principles; sustainable long-term energy market, regulatory, industrial and economic development policies;

and many other sets criteria. Unlike almost all other infrastructure asset classes, there are currently no uniform sets of criteria specific to nuclear projects similar to existing criteria applicable for other asset classes, such as the World Bank's Environmental and Social Standards (ESS); IFC E&S Performance Standards; EBRD Environmental and Social Policy Guidelines; ADB Environmental and Social Safeguards Framework; Equator Principles V; World Economic Forum ESG Principles; SASB ESG Standards and Frameworks and TCFD ESG Recommendations and Disclosures. IBNI's Standards and Criteria will provide a uniform integrated set of nuclear-specific standards, performance and reporting criteria which will allow IBNI-supported projects and their related stakeholders to achieve the highest levels of performance and report well against a very broad range of criteria.

ESG and other sustainability performance and reporting requirements under IBNI's Standards and Criteria will be enforced through various project agreements ranging from the NZCAFA (signed between IBNI and the host government), financing agreements (signed between IBNI and co-financiers with the project company) and other project agreements which have each will have performance and reporting implications for contractors, suppliers, utilities, ECAs, etc.)

IBNI will enhance the ability of nuclear assets and projects to comply with the foundational principle of all ESG evaluation regimes, which are the SDGs. Below, we assess both the 'stand alone' nuclear asset classes' contribution to SDGs and also the additional contributions under IBNI frameworks.

FIGURE 33 – NUCLEAR ASSET CLASS AND IBNI'S CONTRIBUTIONS TOWARD SUSTAINABLE DEVELOPMENT GOALS (SDGS)

Sustainable Development Goal	Nuclear Energy as an Asset Class		Nuclear Energy with IBNI S&C
1 No Poverty	●		●●
2 Zero Hunger	●	●●	●●
3 Good Health & Well-Being	●	●●	●●●
4 Quality Education	●		●●●
5 Gender Equality	●		●●
6 Clean Water & Sanitation	●	●	●●●
7 Affordable and Clean Energy	●●		●●●●
8 Decent Work & Economic Growth	●●		●●●●
9 Industry, Innovation & Infrastructure	●	●	●●●●
10 Reduced Inequalities	●		●●
11 Sustainable Cities & Communities	●	●	●●●
12 Responsible Consumption & Production	●	●	●●●
13 Climate Action	●●	●●	●●●●
14 Life Below Water	●	●●	●●●
15 Life on Land	●	●●	●●●
16 Peace, Justice & Strong Institutions	●		●●●
17 Partnerships for the Goals	●●	●	●●●●

● ● Nuclear energy (asset class) contributes directly

● Nuclear energy (asset class) contributes indirectly

● Nuclear energy (asset class) performs well compared to other energy technologies

● Nuclear technologies contribute

● ● Elements taken into consideration and evaluated under IBNI Standards & Criteria

● ● ● Elements with strong incentives and synergies under IBNI Standards & Criteria

● ● ● ● Elements with specific long-term impact goals and targets under IBNI Standards & Criteria

Sources: Nuclear as an Asset Class: [44]. Nuclear Energy with IBNI S&C: IBNI-IO SAG.

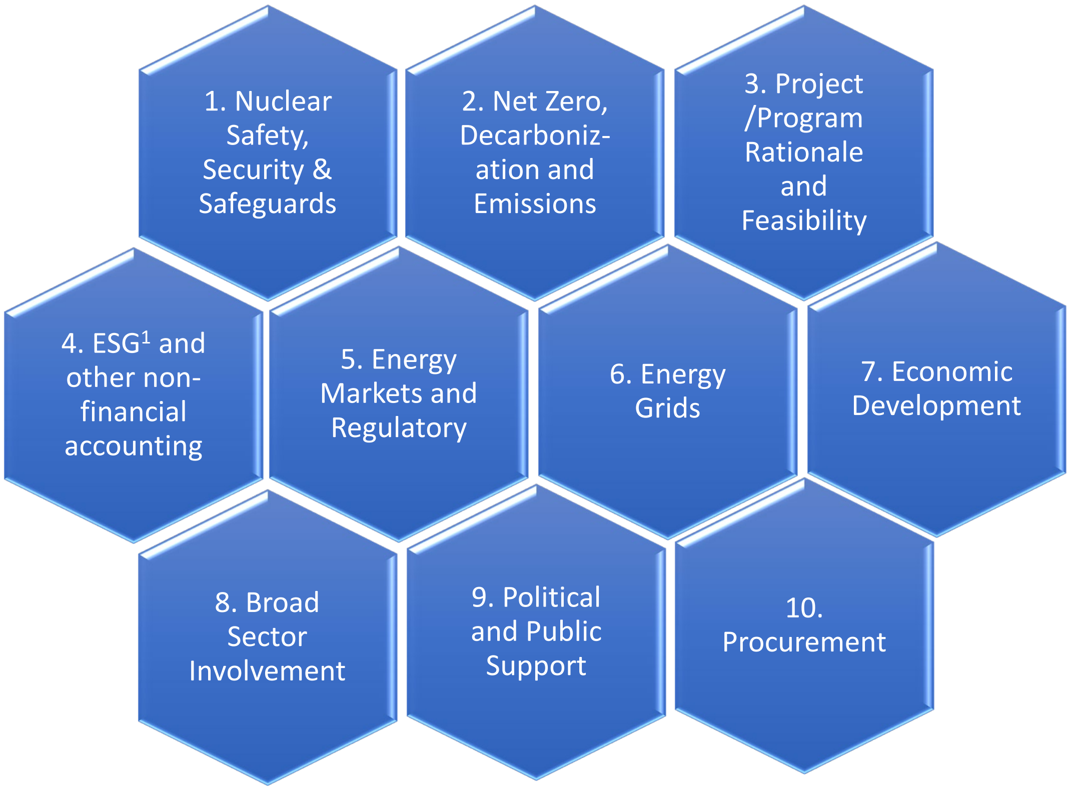
5. IBNI Standards & Criteria

Key Points

- IBNI will adopt and enforce international standards and criteria applicable to the nuclear projects and programs that it supports.
- State level agreements (NZCAFAs) will contain bind 2050 Net Zero commitments and other sustainability requirements.
- IBNI will serve as the global benchmarking institution and leader in establishing nuclear as a sustainable investment asset class.
- IBNI will become a data aggregator for nuclear ESG metrics on a global scale.

A key pillar of IBNI's programs will be the adoption of international IBNI Standards and Criteria (S&C) that will be uniformly applied to and enforced on all projects and programs receiving IBNI support. Such S&C will not only need to be complied with at the project level, but there will also be contractually binding elements for all stakeholders ranging from the IBNI Member State host government/SOEs through the contractors, suppliers, co-financiers, utilities, insurers and other project and program participants. IBNI's S&C will encompass ten (10) critical elements. The following diagram sets forth the ten (10) elements of IBNI's proposed S&C elements.

FIGURE 34 - PROPOSED IBNI STANDARDS AND CRITERIA



Source: IBNI-IO SAG. Notes: (1) Environmental, Social and Governance (ESG) criteria.

The above S&C elements contain specific items that will each be classified as either a "standard" or a "criteria". IBNI's "standards" are envisaged to be binary "pass or fail" compliance items. IBNI's "criteria" are envisaged to be items where strong performance and compliance will be encouraged and incentivized through competition for IBNI's scarce resources but may not necessarily be an absolute requirement. For example, within category nr. 1 *Nuclear Safety, Security and Safeguards* elements, adoption and full compliance by the IBNI member project host country with international nuclear treaties will be considered to be a "standard" and therefore an "absolute requirement". On the other hand, IBNI's "criteria" will be competitively evaluated and may be the basis for the objective decision to support a project in IBNI member country 'A' as opposed to country 'B' if in the case the country 'A' offers strong compliance with a set of IBNI's "criteria" elements. Where IBNI's offers support to a program applicant on the basis of strong commitments to criteria elements, such commitments will become contractually binding on the project applicant and/or on its host IBNI member country. For example, for each supported project, IBNI will generally endorse open, fair and transparent international competition amongst nuclear technology vendors will be a part of the item Nr. 10 - *Procurement* criteria. All other things being equal, if country 'A' agrees to utilize a competitive international tender process (adopting IBNI recommended best practices procurement procedures) for the selection of nuclear technology contractors and suppliers and country 'B' proposes an exclusive G2G transaction, which precludes international competition, then in this example IBNI would generally support country 'A' on a preferential basis.

At the highest level, each IBNI Member State receiving IBNI's financing and support will enter into a comprehensive long-term Net Zero Cooperation and Framework Agreement (NZCAFA) with IBNI. The NZCAFA will set out specific S&C that the host government will need to comply with. The NZCAFA will contain items such as long-term policy commitments related to each of IBNI's 10 S&C elements. The set of IBNI S&C in the NZCAFA will be enforceable through cross-default mechanisms across all IBNI and co-financier financial agreements within the relevant host country.

At the project level, IBNI's S&C relating to a specific project's performance and reporting requirements and will also be embedded within all specific financing agreements that IBNI, together with its co-financiers enter into with the project company (owner/operator), utility, SOE or other project counterparty, as the case may be. As is customary under many existing MDB-led financing structures, the counterparty to the financing agreements will also be responsible for the performance and compliance of each of its contractors and suppliers. In this regard flow-down performance and reporting requirements will be required throughout the project agreements, to ensure that the project's entire value chain remains in strong compliance with IBNI's Standards and Criteria.

TABLE 2 - DETAILED OVERVIEW OF ELEMENTS OF IBNI STANDARDS AND CRITERIA

IBNI S&C Element	Standards	Criteria	Rationale
1. Nuclear Safety, Security and Safeguards	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• Host country adoption of and compliance with relevant international nuclear treaties and conventions[72] • National nuclear legislative and regulatory framework covering safeguards,	• Additional nuclear safety, security and safeguards measures voluntarily undertaken and contractually agreed to be the host country will be favorably evaluated by IBNI	• It shall be a mandatory obligation (a Standard) for each IBNI Member State to comply with all the provisions of all internationally accepted nuclear safety, security and

[72] There are two major international conventions and systems in existence governing international third-party nuclear liability: 1) the "Vienna Convention on Civil Liability for Nuclear Damage of 1960", and 2) "Convention on Liability of Third Parties in the Field of Nuclear Energy of 1960 (the "Paris Convention") that nuclear nations have become a party to. Furthermore, the "1988 Joint Protocol on the Application of the Vienna Convention and the Paris Convention" also represents a mechanism to bridge together the two major systems and conventions. All IBNI Member States with new or existing nuclear energy programs will be required to become a party to one or more of the international conventions. In addition, IBNI Member States (non-nuclear weapons states) will be required to have signed the "1968 Treaty on Non-Proliferation of Nuclear Weapons" (NPT). The IBNI Board of Directors may also implement certain incremental multilateral policies and standards regarding nuclear fuel enrichment, together with the safe and secure extraction, fabrication, transport and storage of radioactive materials throughout the nuclear fuel cycle. All such requirements will be imposed as "standards" that IBNI's Member State's agree to adhere to.

IBNI S&C Element	Standards	Criteria	Rationale
	safety, security and nuclear liability • Independent national nuclear regulatory body • Licensing process for life cycle of nuclear projects • Adoption of IAEA Safety Standards[73] and Safeguards[74] or similar adopted standards • Nuclear emergency planning procedures • Radioactive waste and spent fuel management plans and procedures • Decommissioning and back-end liabilities plans and procedures		safeguards treaties, conventions, standards, guidelines and best practices. • Additionally, each IBNI Member State applying for IBNI support shall have the competitive incentive to enact incremental commitments regarding nuclear safety, security and safeguards in order to achieve even higher standards to protect people and the environment.
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Continuous compliance with all licensing, regulatory and legal obligations, which will collectively reflect all state-level IBNI S&C performance and reporting obligations passed down to individual owner/operators and their contractors.		• Compliance with each country's licensing, regulatory and legal frameworks will be the appropriate mechanism to ensure that each nuclear project in the IBNI Member State remains in compliance with all safety, security and safeguards S&C elements.
2. Net Zero, Decarbonization & Emissions Commitments	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• Binding commitments and actionable national plans supporting 2050 Net Zero (or earlier) IBNI	• Commitments to phase out fossil fuels • Elimination of fossil fuels subsidies	• IBNI support for nuclear programs shall compel and incentivize IBNI Member States to

[73] See: https://www.iaea.org/resources/safety-standards for more details on IAEA Safety Standards.
[74] "The objective of IAEA Safeguards is to deter the spread of nuclear weapons by the early detection of the misuse of nuclear material or technology." More details on IAEA's Safeguards measures can be found at: https://www.iaea.org/topics/basics-of-iaea-safeguards

IBNI S&C Element	Standards	Criteria	Rationale
	Member Country's NDC pledges[75].	• Technology neutral carbon pricing regimes	enter into binding and enforceable commitments supporting 2050 NDCs
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Project whole life cycle and supply chain GHG emissions reporting requirements in accordance with TCFD Scope 3 requirements.	• Commitments of local project stakeholders to develop and expand non-electrical low carbon energy markets and infrastructure, including hydrogren, storage, electrofuels, heat, cooling and desalinated water offtake.	• Flow down requirements under financing and project agreements for reporting of whole life cycle GHG emissions • Expansion of non-electricity low carbon energy capacity demand further improves the economic rationale for nuclear and improves the case for integrated VRE/nuclear systems efficiency
3. Project or Program Rationale and Feasibility	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• Integrated long-term energy market studies, energy market models and market designs – *strong evidence that local/regional energy markets can sustain and support low carbon dispatchable generation technologies and programs over the long-term*	• Uniform, low-carbon government evaluation criteria and incentive programs for government-sponsored funding and financing programs for low carbon generation projects.	• IBNI Member State will need to provide a strong rationale and justification that their nuclear program is feasible, affordable, sustainable within their energy markets over the long-term, relative to other low

[75] NZCAFA's are envisaged to include comprehensive, long-term binding agreements between IBNI and the IBNI Member State regarding enforceable net zero requirements, supporting each country's NDC pledges (which will need to provide for 2050 net zero commitments for the relevant country). Such binding net zero commitments will be results-oriented and will provide the IBNI Member State with a fair amount of latitude as to the actionable plans and steps that will determine exactly *how* the country will be able achieve net zero not later than 2050. IBNI will objectively review such plans and assess and consult the country on the achievability, affordability, sustainability, reliance on unproven technologies and other considerations. The applications from IBNI Member States that provide a stronger case, may be ranked as higher priority in the overall scoring/ranking and will impact decisions of IBNI for allocating scarce financing and other support resources.

IBNI S&C Element	Standards	Criteria	Rationale
	• Tariff affordability and sustainability studies		carbon generation options • Strong evidence that nuclear will be able to fairly compete with other low carbon technologies the energy markets.
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Project feasibility studies, business models, least cost options analysis, cost-benefit studies and value-for-money studies – *providing strong rationale for a specific nuclear project.*	• International best practices for project contractual structuring risk and upside allocation • Strong government guarantee and support package • Diversified funding and financing support from public and private stakeholders.	• Strong evidence that the proposed nuclear project is feasible and has a strong rationale relative to other competing low carbon technologies. • Project structures and risk allocation (and specifically considering those risk elements that IBNI and the government will absorb) will enable the project to be financed in the international financial markets.
4. Environmental, Social and Governance (ESG), data collection and other non-financing metrics	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• National adaptation of internationally aligned ESG reporting standards, which include nuclear sector projects, assets and companies as an 'ESG compliant assets class' and on an equal and consistent basis with all other asset classes.		• IBNI Member State governments and their institutions will be required to sign up to uniform ESG performance and reporting standards. • Global/international cooperation with respect to ESG frameworks will be incentivized.
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Project owner/operators and their contractors and suppliers will be	• Project owners/operators and their contractors and	• IBNI will enforce IBNI ESG Performance Standards and ESG

IBNI S&C Element	Standards	Criteria	Rationale
	obligated to comply with all IBNI ESG Performance Standards[76].	suppliers will be incentivized to achieve the highest possible IBNI ESG Performance Criteria[77] as commercially reasonable.	performance reporting requirements. • Additionally, IBNI will incentivize program participants to achieve an optimal set of IBNI ESG Performance Criteria, where commercially possible.
5. Energy Markets & Regulatory	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• Adequate energy regulatory regimes (reformed, if necessary) which will facilitate and support low carbon dispatchable generation technologies (nuclear) to compete on a "level playing field" with all other forms of low carbon generation. • Nuclear regulatory, licensing and permitting regimes that adhere to best international practices – focusing on safety, but at the same time, protect project developers against uncontrollable risks or regulatory changes and provide for efficient,	• Policy, legal and energy market regulatory reforms that allow nuclear generation (and other low carbon dispatchable generation technologies, on a technology neutral basis) to be supported through PPA's, CfDs, RAB-based regimes, carbon pricing/trading regimes, low-emissions credits, tax credits and other similar mechanisms. • Elimination of technology-specific subsidies on all generation technologies	• In order to support nuclear projects in a specific IBNI Member State, that country will need to demonstrate its commitments to certain energy market and regulatory designs or reforms that will allow nuclear to fairly compete on a long-term sustainable basis against other competing forms of generation (particularly in deregulated market environments). • IBNI Member States will be incentivized to implement energy markets and

[76] IBNI ESG Performance Standards will include standards and guidelines (where many elements may be similar to existing MDB ESG standards, including harmonized criteria derived from SDGs) and will also be influenced by evolving standards within WEF, TCFD and SASB reporting standards. Such standards will also include nuclear-specific environmental, health and safety (EHS) technical guidelines and procedures; environmental and social management systems (ESMS); labor and sound working conditions; good governance principles; risk assessment and management; resources efficiency; pollution prevention; community health safety and security; biodiversity conservation and sustainable management of natural resources; land acquisition and involuntary resettlement; cultural heritage and diversity; and rights of indigenous peoples. Project owner/operators, their financiers, contractors and suppliers will also be required to comply with IBNI ESG Performance Standards.

[77] IBNI ESG Performance Criteria will contain additional recommended guidelines (but not necessarily obligatory) in accordance with Good International Industry Principles (GIIP). Applicants competing for finite IBNI support will have a strong incentive to commit to and comply with the highest possible criteria that are economically viable.

IBNI S&C Element	Standards	Criteria	Rationale
	predictable and streamlined regulatory review and licensing requirements and procedures for new nuclear technologies. • Elimination of fossil fuels subsidies (direct and indirect). • Long-term actionable energy market designs, plans, policies and programs to accommodate rapid and cost-efficient transition to low carbon energy systems and economies, including affordable and low carbon electricity, hydrogen, electrofuels, heat/cooling and desalinated water generation, transmission/distribution and storage systems (while transitioning away from fossil fuels).	(supporting and promoting technology-neutral competition for all low carbo generation technologies).	regulatory reforms that are in accordance with recommended "best international practices" - *IBNI's programs will create very strong incentives for policymakers to make "tough public policy decisions" in order to achieve net zero commitments on time.*
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Project owner/developer shall adhere to all nationally determined energy market and nuclear regulatory, licensing and permitting requirements.		• Market and regulatory decisions to be made at the national or regional level. The process of shaping market and regulatory policies and framework must actively include industry and a broad diversified stakeholder group.
6. Energy Grids	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• Grid infrastructure and capital development plans (including identified financing and funding sources) must	• Long-term national and/or regional plans, policies and frameworks for the cohesive integration of	• IBNI Energy Grid Standards are designed to force national/regional long term energy

IBNI S&C Element	Standards	Criteria	Rationale
	be sufficient in order accommodate nationally or regionally planned expansions of nuclear generation and all other low-carbon generation capacities programmed into long-term energy plans. • Proposed future electricity grid designs and expansions to accommodate integrated expansion of nuclear and renewables capacities must reasonably provide for the economically feasible and technologically practical expansions of transmission and distribution, reserves, connection, interconnection, storage, and distributive grid technologies appropriate and necessary for the reliable and prudent grid operations based on the proposed long-term generation mix.	electricity, hydrogen, electrofuels, heat, cooling, desalinated water (as appropriate) generation/production, transmission & distribution, storage grid designs and market systems.	sector planning authorities to take into consideration the economic, technical and practical feasibility of their proposed 2050 low-carbon generation mix (in particular, promotion of public awareness relating to the incremental cost and scope of required grid systems necessary to accommodate very high future VRE penetration rates). • IBNI Energy Code Criteria provide for the competitive incentive for IBNI Member States to develop grid designs, policies, frameworks and market models for integrated electricity, hydrogen, electrofuels, heat, cooling and desalinated water (as appropriate).
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Project owner/developers (nuclear generation plants) must comply with all applicable grid codes and similar regulatory requirements and laws.	• NPP designs that can accommodate co-generation of hydrogen, heat, cooling and/or desalinated water (as appropriate). • Partnerships and business models that accommodate the local production, grid infrastructure and	• Nuclear plants operate most efficiently at high capacity factors and integrated electrical and non-electrical energy grid designs and systems are an optimal fit for nuclear technologies (particularly in high VRE markets).

IBNI S&C Element	Standards	Criteria	Rationale
		business models related to electricity, hydrogen, electrofuels, heat, cooling and desalinated water (as appropriate).	
7. Economic Development	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• Long range economic and industrial development plans demonstrating the essentiality of nuclear energy as the most affordable source of secure, reliable and safe low carbon generation for national and regional economic and industrial growth plans.	• Policies and frameworks promoting development of national and/or regional nuclear industry production and supply chain development.	• The IBNI Member State must provide the strong economic rationale and justification for their proposed nuclear program that is in-line with international conventions. • Where appropriate, IBNI Member States are incentivized to develop national or regional nuclear industries and supply chains.
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Demonstrable positive near-term and long-term direct and indirect economic benefits specifically related to the project (project economic study).	• Localization of nuclear industries and training and human resource development in the nuclear industries.	• The nuclear project sponsor applicant must provide the strong economic rationale and justification for their proposed nuclear project.
8. Broad Sector Involvement	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• IBNI Member State applicants must demonstrate that there is a strong nexus between their proposed nuclear program and national and regional industrial and "clean growth" strategies,	• IBNI Member State applicants are encouraged and incentivized to develop and cultivate a broad and sectorally diversified coalition of industrial, R&D/university, medical, agricultural	• Evidence suggests that nuclear programs are more successful and sustainable in nations that have a network of diversified sectors involved with and supporting their nuclear programs.

IBNI S&C Element	Standards	Criteria	Rationale
	together with socio-economic development.	and national/regional laboratory stakeholders involved in their nuclear programs.	
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Project sponsors must comply with all nationally or regionally determined policies, frameworks and requirements related to involvement of other sector stakeholders.	• Project sponsors must involve broad sector coalition of stakeholders. In particular, direct engagement of and cooperation with energy intensive industrial; hydrogen and electrofuels industries; and nuclear, medical and agricultural R&D stakeholders is strongly encouraged.	• Individual project sponsors have a strong incentive to enter into innovative partnerships to expand the societal value of any nuclear power station well beyond producing electricity (which also makes any nuclear project more socioeconomically sustainable). • Innovative partnerships and cooperation promote the advancement non-electric clean energy systems and markets and scientific advancements in nuclear applications for medical, agricultural and nuclear applications (and ultimately low carbon and prosperous societies).
9. Political and Public Support	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• Evidence of broad political and public support for national and/or regional nuclear energy programs. • Outreach programs which are open, transparent and inclusive of public, industry and special	• Public campaigns involving objective media coverage, public debate forums, etc. to facilitate public consensus building behind nuclear programs.	• It is a fact that nuclear energy is considered controversial in many countries and markets. A successful nuclear program will require broad political and public support based on the

IBNI S&C Element	Standards	Criteria	Rationale
	interests, particularly with NGOs and anti-nuclear groups, promoting open dialogue and public input on reasonable concerns about nuclear energy.		rationale that the benefits of nuclear (low carbon, affordable, reliable/dispatchable) outweigh the risks.
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Evidence of local political, industrial and public support for the nuclear project from a broad-based and diversified local stakeholder base, including impacted citizens, businesses, industries, special interests (and particularly engagement of NGOs and anti-nuclear interests).	• Public campaigns involving objective media coverage, public debate forums, etc. to facilitate public consensus building behind nuclear programs (key objective is to demonstrate strongest evidence of broad public support for nuclear energy programs and projects).	• Project sponsors will need to build the case for a specific nuclear project attain broad local political and public support. The local communities and region will need to be convinced the benefits (low-carbon, emissions free, affordable and reliable energy, jobs creation, economic development, etc.) outweigh the risks of the nuclear project.
10. Procurement	*NZCAFA (IBNI Member State Level S&C Requirements)*		
	• Ethics and conscientious policies, procedures, mechanisms and preventative measures across the entire value chains of projects and programs (including anti-corruption and anti-bribery policies, procedures and prevention).	• National procurement policies and legal frameworks, which encourage open, fair and transparent international competition.	• All IBNI supported nuclear programs will need to comply with strict anti-corruption and anti-bribery standards. • As a part of IBNI's key objective to expand global competitive markets and foster R&D and innovation throughout the global nuclear industries and supply chains, and drive down the costs of nuclear technologies, IBNI strongly

IBNI S&C Element	Standards	Criteria	Rationale
			encourages and incentivizes open, fair and transparent procurement procedures within all IBNI Member States.
	Project Level Agreements (Nuclear Project Owner/Operator Requirements)		
	• Compliance with national standards, which are influenced by international ESG requirements (see above). • Compliance with all other nationally-determined policies and laws on procurement.	• Voluntary pursuit of competitive tender policies that are not required under national policy and law (to the extent not in conflict with national procurement law).	• All IBNI supported nuclear projects will need to comply with strict anti-corruption and anti-bribery standards. • IBNI strongly encourages and incentivizes open, fair and transparent procurement procedures to be applied in all IBNI-supported nuclear projects.

Source: IBNI-IO SAG

5.1 Need for Universal Nuclear-Specific International Standards and Criteria

Unlike almost every other infrastructure asset class, there are currently no international uniformly accepted standards and criteria applied to and specific to the nuclear asset class. For example, existing international financiers of nuclear projects, such as ECA's and commercial banks may rely on elements of the Equator Principles (EP IV), World Bank EHS Standards, IFC E&S Performance Standards, etc. In the area of ESG data collection and accounting metrics and other non-financial reporting standards, harmonized and aligned international standards derived from WEF/SASB/TCFD/NZAMI/NZAOA/NZBA/NZIA reporting standards and requirements, 'green or sustainable bond principles' or other standards and criteria will also need to apply. IBNI will take on a leadership role in the alignment and harmonization of adopted international ESG criteria and reporting requirements and will serve as both a data aggregator and benchmark in the nuclear sector.

In contrast to other infrastructure asset classes, nuclear technologies are uniquely subjected to international treaties and conventions on nuclear liabilities (which is a good thing). The IAEA acts as the international standards authority for nuclear safety, security and safeguards. Since the major existing MDB's are not involved in financing nuclear infrastructure (to any material extent), these institutions have not attempted to address any nuclear specific issues within their existing standards. IAEA doesn't act as a financier or contractual party in the nuclear programs and projects within its member countries.

The above 'market realities' necessitate the need for a supranational party to adopt, harmonize and align a broad set of nuclear-relevant standards and criteria that will become universally-accepted by governments, international financial markets, the nuclear industries and other stakeholders across all international borders. IBNI, acting as the nuclear-specialized IFI is ideally situated to provide the global leadership role in adopting and enforcing a uniform, harmonized and aligned set of nuclear-relevant standards that will become broadly accepted across the vast majority of the worlds markets and industries. From the standpoint of an 'international standards arbitrator' IBNI will serve in role not dissimilar to the roles of existing MDB's who's standards have become broadly accepted across other (non-nuclear) asset classes and industries.

As set forth above, the ten (10) elements of IBNI's Standards & Criteria will draw from and harmonize and align with many distinct existing and established sources of standards applicable both to nuclear and other asset classes and industries. In this regard, IBNI will also have the benefit of "entering at a higher point on the learning curve" than what other organizations faced when attempting to adopt uniform international standards and criteria. The following diagram illustrates IBNI's uniform and harmonized S&C as the amalgamation of various sets of existing standards and criteria across various sources.

FIGURE 35 - KEY SETS OF STANDARDS & CRITERIA TO BE HARMONIZED AND ALIGNED UNDER IBNI E&C

Source: IBNI-IO SAG

5.2 How IBNI Will Administer and Enforce Standards and Conditions

IBNI's S&C will be applied to achieve a number of objectives. First, IBNI's *Standards* will be uniformly administered as set of the "minimum qualification criteria" applied to both IBNI Member States and nuclear project sponsors applying for IBNI financing and support. Essentially, the set of IBNI *Standards* will be represent clear and unambiguous requirements that a the IBNI Member State and the project-level stakeholders within their country will need to meet and be required to maintain compliance with. IBNI *Standards* will constitute binary 'pass or fail' requirement and will be the basis for rejection, or later breech of obligation if such IBNI *Standards* are not met and maintained. Table 2, above sets forth the proposed IBNI *Standards* that will be required to comply with. Second, a IBNI's *Criteria* will represent a specific recommended criteria item that will be strongly encouraged (but not absolutely required). Table 2, above sets forth the proposed IBNI *Criteria* that applicants will be encouraged to meet and for participants to comply with.

Voluntary agreement of applicants and participants to comply with IBNI *Criteria* will be encouraged and incentivized through 'market principles mechanisms' of supply and demand. As IBNI's programs, which will be designed to offer highly attractive financing and other support for nuclear programs and projects, global demand for such support is expected to increase dramatically. At the same time, IBNI's resources will always be finite and limited (e.g. less supply of support than demand for support). Therefore, IBNI Member State and project sponsors applying for IBNI support will be well-incentivized to tailor their programs and projects to achieve a high degree of conformity with the principles of IBNI's *Criteria.*

IBNI's S&C will be administered and enforced at two levels. First, at the IBNI Member State level and second, at the project level.

As a required pre-condition to IBNI providing any financing or other support for nuclear programs and projects in an IBNI Member State, will be to execute a comprehensive long-term Net Zero Cooperation and Framework Agreement (NZCAFA). The NZCAFA will set out all IBNI *Standards* as well as *any voluntarily agreed IBNI Criteria* that will need to be continuously complied with at the IBNI Member State level. In the case that the IBNI Member State were to be in breech any such IBNI S&C pursuant to the NZCAFA, the agreement will specify certain cure periods and cross-default provisions, cross-termination and cross-acceleration provisions across all IBNI and co-financing agreements in the country, and or other similar penalties, provisions and consequences for any such uncured breech. The intention is that the consequences of a IBNI Member State default under the NZCAFA will be progressively severe, the more IBNI and its co-financiers invest in nuclear projects and programs within the country. For this reason, it is anticipated that there will be extremely low default rates by IBNI Member State governments with NZCAFA's in place.

At the project level, where IBNI and its co-financiers have agreed to provide financing and other support, the specific project level financing/co-financing and project agreements will include all relevant IBNI *Standards* as well as *any voluntarily agreed IBNI Criteria* that will need to be continuously complied with at the IBNI project level. In the case that the project company (owner/operator, utility or other responsible counterparty, as the case may be) were to in breech under any such IBNI S&C pursuant to any of the IBNI financing / co-financing agreements and/or project agreements, those agreements will specify certain cure periods, default termination and acceleration, and or other similar penalties, provisions and consequences for any such uncured breech under each respective agreement. While an uncured project-level IBNI S&C related default under project level agreements would trigger a cross-default across all project level agreements, there would generally be no impact to other IBNI supported projects in the country.

While an uncured IBNI Member State event of default under the NZCAFA would trigger a cross-default across all project-level agreements in the country, the government (or SOE) would need to also guarantee relief payments to the individual project counterparties, providing full recovery of damages caused by such default by the Member State.

6. Proposed IBNI Capitalization and Governance Structure

Key Points

- IBNI's proposed capitalization and governance structures will be similar to the numerous existing MDBs that have been in successful operations for many decades.
- It is envisaged that no fewer than 50 member countries will come together to found IBNI in early 2023, with a total shareholder contribution of US $ 50 billion, and a paid-in capital amount of US $ 25 billion (the remaining US $ 25 billion will be in the form of callable shares).
- As the IBNI program evolves, there may be options for capital market investors to play an incremental role in IBNI's capitalization structure.

It is envisaged that the IBNI capitalization and governance structure should be primarily based on the models that have been successfully implemented by many of the existing Multilateral Development Banks (MDBs), such as the World Bank Group, the European Bank for Reconstruction and Development and, more recently, the Asian Infrastructure Investment Bank (AIIB). These models have already been proven and have been in existence for many decades, and they have enabled the MDBs to advance their individual missions related to global economic development and poverty eradication.

As is the case with the existing MDBs, it is envisaged that the voting members of the IBNI will be nation states, with membership open to any IAEA Member State recognised by the United Nations.

On this basis, the proposed governance structure would be as shown in Figure 36[78].

[78] Note: At a future point in time, the IBNI may establish an Advisory Board of non-voting Sector Members – as is permitted, for example, under the constituting rules of the United Nations International Telecommunication Union. Conceivably, Sector Membership could be open to private sector corporate entities engaged in the nuclear industry, plus capital market participants. However, the initial constituting documents for the IBNI would not include any provisions for such an Advisory Board

FIGURE 36 - PROPOSED IBNI GOVERNANCE STRUCTURE

Source: IBNI-IO SAG

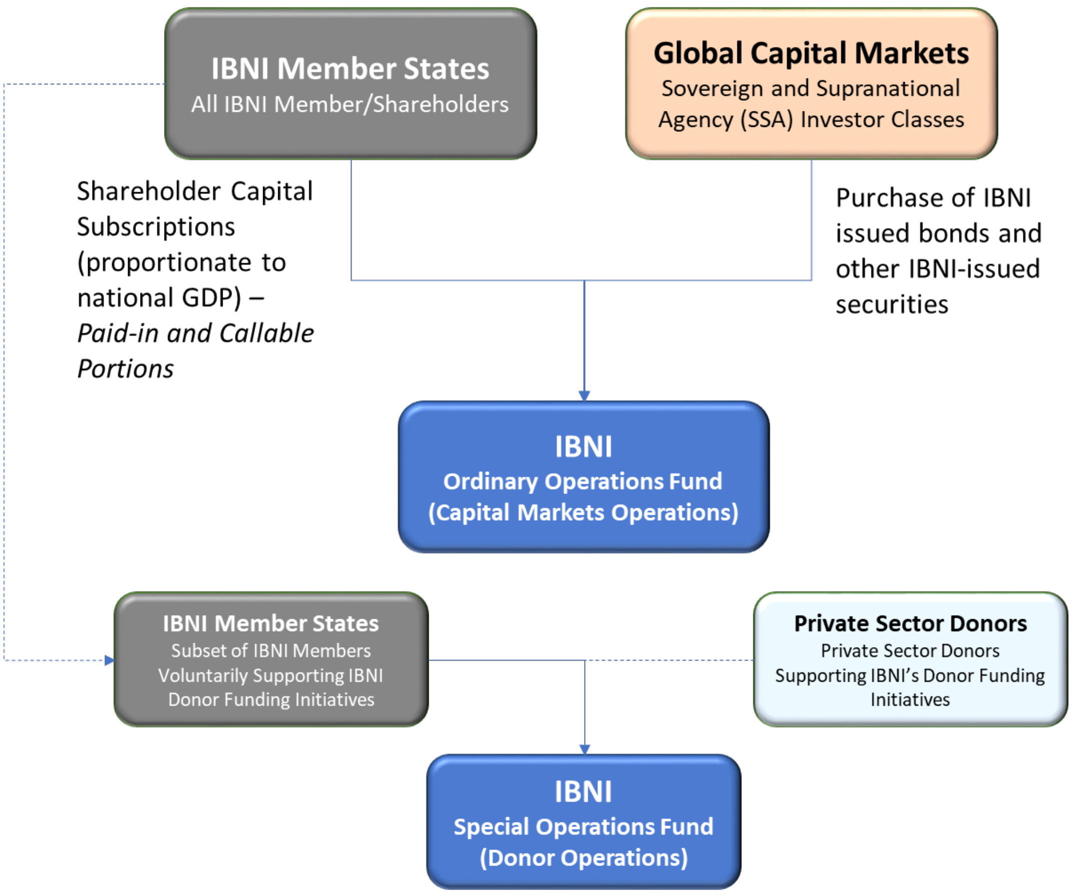
Consistent with the arrangements for most existing MDBs, it is envisaged that IBNI will be capitalized and funded from two primary sources: IBNI Member States (e.g., a multinational coalition of sovereign governments) and from the global capital markets (e.g., investors). Also, consistent with many existing MDBs, IBNI will maintain two separate and distinct operations and associated operational funds:

- **IBNI Ordinary Operations.** The Bank's Ordinary Operations will consist of all commercial and capital markets operations of IBNI. The Bank's associated Ordinary Operations Fund will be capitalized from shareholder (common equity) capital subscriptions from all IBNI Member States and from global capital markets purchases of IBNI issued bonds and other securities.
- **IBNI Special Operations.** The Bank's Special Operations will consist of all donor-funded special programs operations of IBNI. Special Operations programs administered through Bank's associated Special Operations Fund are expected to be funded predominantly through donor funding from various subsets of voluntary IBNI Member States who wish to contribute (earmarked) funds for

specific Special Operations programs and initiatives that they support. In some cases, private donors may also provide matching funds for certain Special Operations initiatives of the Bank.

Proposed Capitalization and Funding of both the Ordinary Operations and Special Operations Funds is illustrated below in Figure 37. Each of the funds (Ordinary Operations Fund and Special Operations Fund) will be segregated and accounted for separately and distinctly. IBNI's operations in both categories will be more thoroughly discussed in the following *Section 7 – Proposed IBNI Operational Plans and Programs*.

FIGURE 37 - PROPOSED IBNI CAPITALIZATION AND FUNDING STRUCTURE



Source: IBNI-IO SAG

6.1 Proposed IBNI Capitalization and Membership/Shareholding Plan.

As indicated in Figure 37, the shareholder (equity) capital contributions into IBNI's Ordinary Operations Fund are proposed to be sourced from each of the IBNI Member States[79], using a combination of paid-in and

[79] It is recommended that the IBNI establishment agreements set forth a mechanism to determine how the total shareholder capital requirement of IBNI will be ratably allocated to each respective IBNI Member/Shareholder. In

callable (committed, but not yet paid-in) capital contributions, as is typical of the major MDBs currently in existence. Using the Asian Infrastructure Investment Bank (AIIB) as an example:

- the AIIB had an initial authorized capital reserve of US $ 100 billion, divided into a hundred million shares with the value of US $ 100 each[80];
- within the US $ 100 billion of authorized capital, US $ 20 billion corresponded to paid-in capital (a portion of subscribed capital already paid) and US $ 80 billion to callable capital; and
- the members of the AIIB contributed with capital subscriptions of different values.

MDBs which were established in previous decades have, over time, significantly reduced the proportion of paid-in capital relative to callable capital shares. For example, the World Bank's International Bank for Reconstruction and Development (IBRD) had an initial ratio of paid-in to callable capital of 20:80 (i.e., the same ratio as initially established for the AIIB). However, during subsequent capital increases, the IBRD Board of Governors specified a higher proportion of callable shares, such that the current ratio of paid-in to callable capital is 6:94[81].

As also indicated above in Figure 37, the IBNI's Ordinary Operations will also utilize debt capitalized through the issuance of bonds and other forms of debt securities which are purchased by global capital market investors, after the IBNI's international credit rating had been established. It is envisaged that treasury and operational arrangements and risk management policies of the IBNI would be designed to ensure that the bonds issued by the IBNI would be rated 'triple A' (which is consistent with precedent as 'triple A' credit ratings have been received and maintained by all major MDB's).

Based on scenario analysis, IBNI-IO SAG recommends that the coalition governments target a total initial shareholder capital subscriptions of US $ 50 billion, with 50% (US $ 25 billion) representing paid-in shareholding subscriptions and 50% (US $ 25 billion) representing callable shareholding subscriptions. Customary with other multilateral IFIs, this initial capital requirement would be allocated across no fewer than 50 IBNI Member States. As the program evolves (and the asset base of loans, equity positions, and contingent receivables increases over time) the shareholders can decide to increase total share capital in a stepwise fashion, which will IBNI's programs to expand after demonstrated successes of the IBNI programs will be apparent.

Under the projected world generation scenario combined with a potential high-case 2050 and high levels of IBNI market share, the total shareholder capital commitments could approach US $ 300 billion in 15 years,

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the case of most precedent MDB's the shareholder members have mutually agreed on an equitable methodology such as relative economic output (such as the ratio of national GDP of each member relative to the total GDP of all members). However, other methodologies could also be considered, such as relative GHG emissions, relative energy consumption, nuclear output, etc. which may be mutually agreed amongst the shareholders as equitable determinants.

[80] Source: [45]

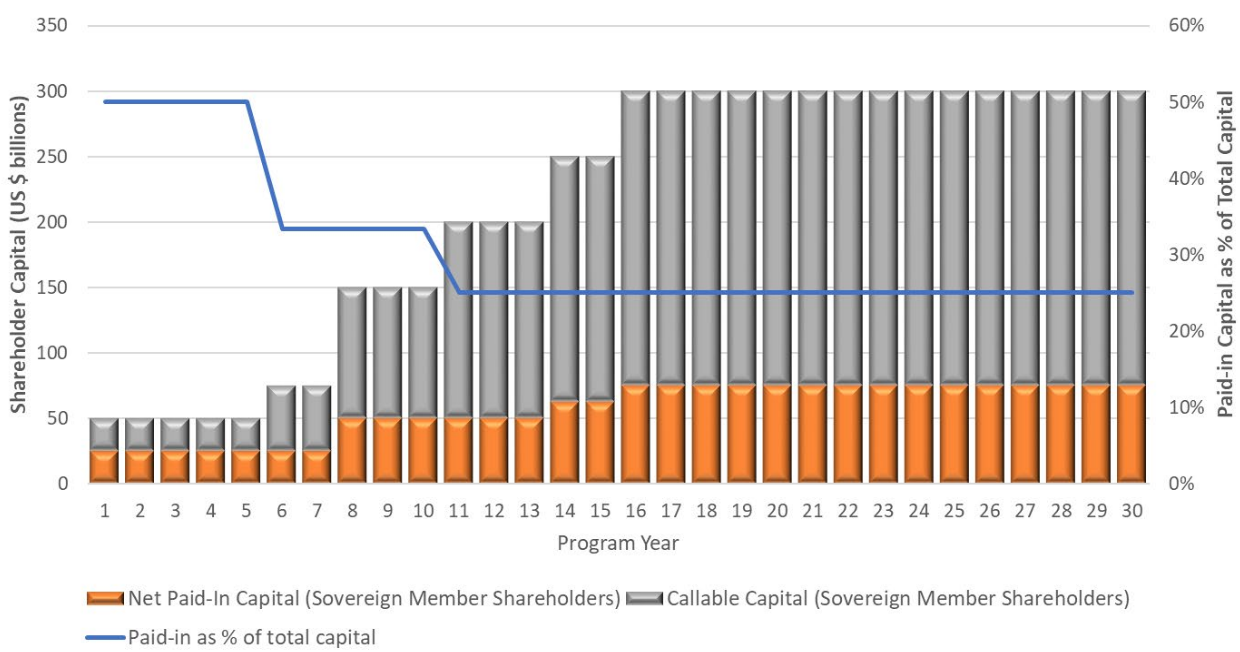
[81] Source: [45]

with the paid-in portion going to US $ 75 billion (or 25% of the total shareholder capital). However, this evolution is dependent on future demand and performances of the program.

In the event of high demand evolutions for the IBNI programs, another possibility may be to offer a preferred equity (non-voting) shareholding position in IBNI. The preferred equity class of shareholder capital would be sourced from global capital markets investors, that would have the capacity to fund all or most of the increased equity capital requirements of IBNI as its programs grow and evolve. The preferred equity class would be given a "preferred" claim on the net revenue (profit) and assets of the IBNI portfolio (ahead of the government Member State shareholders) and on that basis, would offer a lower equity cost of capital (but higher than the Bank's bond yields). This is a solution that would perhaps alleviate the need for governments to pledge and contribute significantly greater amounts of capital as the program evolves in future years. However, additional legal and regulatory due diligence will be necessary to determine whether this option is practical and feasible, should the IBNI Member State shareholders decide to pursue it in the future.

The following chart in Figure 38 below illustrates the projected shareholder capital evolution as the program evolves (under the assumptions that the governmental IBNI Member States continue to entirely fund the capital increases, without the inventions of capital markets preferred shareholders).

FIGURE 38 - PROJECTED IBNI SHAREHOLDER CAPITALIZATION EVOLUTION (WITH POTENTIAL HIGH DEMAND SCENARIOS)



Source: IBNI-IO SAG

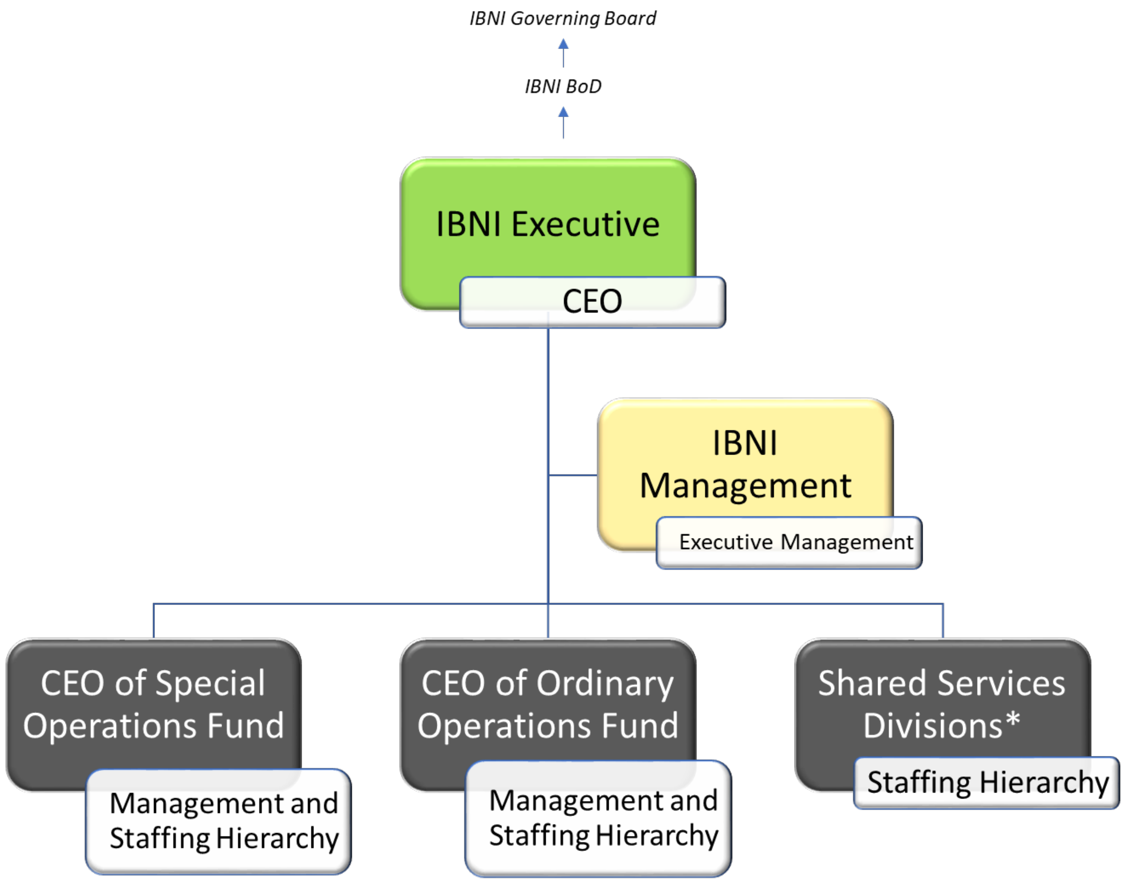
6.2 Proposed IBNI Governance and Management Plan

As set forth above in Figure 36, it is recommended that IBNI established a Governing Board, which would meet on an annual basis. The Governing Board would consist of representatives of each Member State, with each representative having voting rights corresponding to the level of shareholder capital contributions of the representative's state.

IBNI would also have a non-resident Board of Directors, which will meet on a monthly basis. The Board of Directors will consist of nine representatives (directors) chosen by the Governing Board (with a representative balance of the interests of the diverse IBNI membership basis, ranging from highly-developed countries to developing countries), with each representative having voting rights corresponding to the shareholder capital contributions of the IBNI Member States represented by that Director.

The Governing Board will be the senior decision-making body of IBNI and will have the ability to delegate powers to the Board of Directors. The Board of Directors will be responsible for providing direction to senior management for the general operations of the IBNI. The management of IBNI will oversee the activities and operations of the two major funds: IBNI Special Operations Fund (IBNI SOF) (headed by CEO of SOF), the IBNI Ordinary Operations Fund (headed by CEO of OOF) and the shared services divisions. The following organigram (Figure 39, below) details the proposed managements structure as it relates to these three major entity categories.

FIGURE 39 - PROPOSED IBNI MANAGEMENT ORGANIGRAM



*Source: IBNI-IO SAG. * Shared services divisions will include services that are used across both major funds and all IBNI-level services divisions. These service divisions will likely include accounting, finance and tax; information technology; risk management; marketing and communications; facilities management; security; compliance; procurement; ESG data collection and reporting; public relations; IBNI Members State, shareholder relations & IGO relations; economics; data management; publishing and editorial; programs development; etc.*

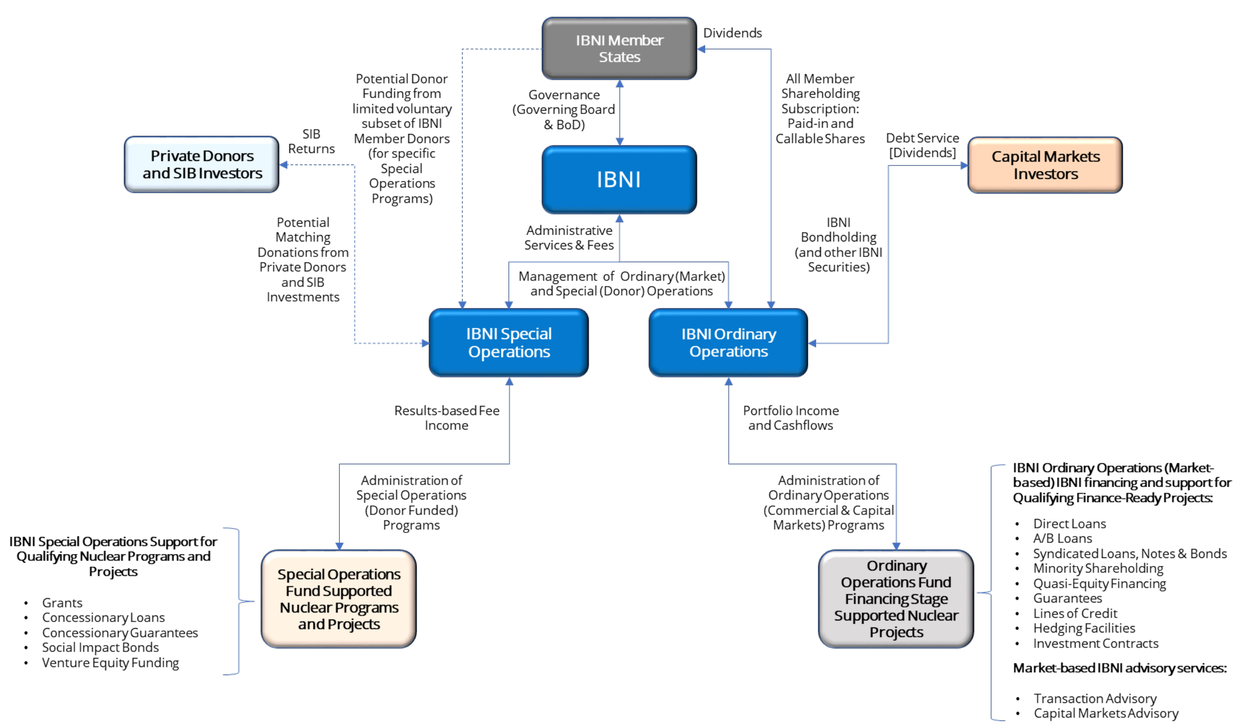
7. Proposed IBNI Operational Plans and Programs

Key Points

- IBNI's proposed operational structure will be based on models currently in existence, utilized by MDBs that have been in existence for many decades.
- IBNI will have two major operational mandates:
  - Ordinary Operations Fund: All market-based programs.
  - Special Operations Fund: All donor-supported programs.
- IBNI shall be established as a results-based organization that can report specific and quantifiable achievements toward 2050 global net zero on behalf of its Member States.

As already briefly discussed in *Section 6 – Proposed IBNI Capitalization and Governance Structure*, it is proposed that IBNI will have two core operations and related funding sources. The following diagram, Figure 40, illustrates the proposed operational structure of IBNI.

FIGURE 40 - PROPOSED IBNI OPERATIONAL STRUCTURE



Source: IBNI-IO SAG

First, IBNI's Ordinary Operations Fund (IBNI OOF) will conduct all of the Bank's global capital markets and commercial activities. The OOF will be a professionally managed financial institution adhering to international banking industry best practices in terms of financial and operational risk mitigation and loss prevention. The IBNI OOF will have a fiduciary duty toward its shareholders (IBNI Member States) to prudently and efficiently manage the Banks's capital markets and commercial operations in order to achieve the Bank's 'patient investor' aims, while managing risks of financial loss. The OOF will also be managed to achieve shareholder returns commensurate with customary sovereign return thresholds. Furthermore, the OOF will have a fiduciary duty toward IBNI bondholders and its other capital markets investors to manage the Ordinary Operations Fund in a manner that maintains sufficient capitalization ratios, liquidity and operating ratios, loss prevention, reserves maintenance and other key parameters to ensure timely payment of principal and interest. As mentioned previously, it is anticipated that the IBNI OOF will be structured to achieve and maintain 'triple A' category credit ratings, similar to those ratings achieved and maintained by existing major MDBs. The details of IBNI OOF's proposed operations and programs are discussed in further detail below in *Section 7.1 – Proposed IBNI Ordinary Operations Plans and Programs*.

Second (and at a smaller scale), IBNI's Special Operations Fund (IBNI SOF) will conduct all of the Bank's donor-funded activities. Unlike the OOF, which will be designed to achieve the Bank's objectives through provision of prudent market-based financing and support to nuclear programs and projects, the SOF will instead focus on the administration of high-impact, results-oriented programs funded by donors. The donor funders to the IBNI SOF are envisaged to be primarily a subset of IBNI Member States who agree to voluntarily provide donor funding to specific programs administered by the IBNI SOF. Additionally, in some cases there may also be private sector and philanthropic donor matching funds for certain programs. The IBNI SOF will mainly be a grant funding and provider of other "subsidized" support for specific IBNI SOF programs and will not have a similar focus on loss prevention, risk and returns as will the OOF. Generally, the SOF programs will be focused on providing needed financial, technical and other types of support for pre-financing stage nuclear programs in developing economies and also supporting and accelerating early stage nuclear technologies. The details of IBNI SOF's proposed operations and programs are discussed in further detail below in *Section 7.2 – Proposed IBNI Special Operations Plans and Programs*.

It will be essential that the IBNI has the resources to attract, hire and retain best-in-class management and staff in order to fulfill the critical missions of the organization. IBNI will need to draw from a highly experienced, talented and resourceful pool of management and staffing resources from global, regional and local banking industry, MDBs and IFIs, IGOs, governments and corporations. The Bank needs to be an organization where management and staff are driven to achieve the highest possible levels of performance and outcomes on behalf of its IBNI Member State shareholders.

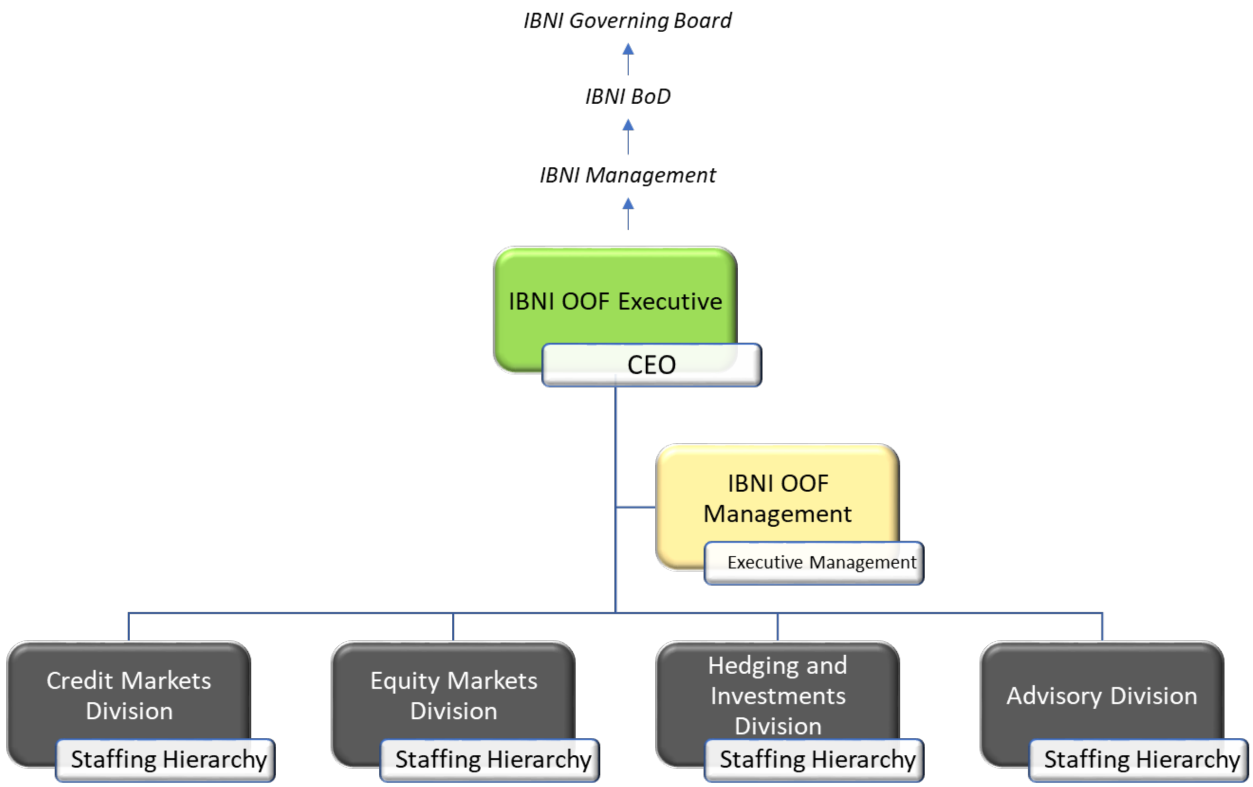
7.1 Proposed IBNI Ordinary Operations Plans and Programs

As discussed above, the predominant focus of the Bank will be on expanding global nuclear capacities through the added value provision of market-based financing and support activities conducted through IBNI's

Ordinary Operations Fund (OOF). The OOF will be managed, operated and accounted for as a segregated and distinct enterprise fund of IBNI. OOF's dedicated management, staff and other resources will be funded exclusively by the financial resources of the OOF. The management of the OOF will hired by and report to the IBNI management (and ultimately to the IBNI BoD and Governing Board). However, the OOF management will have a fair amount of latitude and autonomy in making commercial, risk management and other operational decisions within a defined IBNI framework.

The following organigram illustrates the proposed management and staffing structure of the OOF.

FIGURE 41 - IBNI ORDINARY OPERATIONS FUND PROPOSED ORGANIGRAM



Source: IBNI-IO SAG.

The overriding objective of IBNI will be to assist IBNI Member States in achieving net zero by 2050 (and meet the commitments under NDC pledges) in the most economically efficient manner through the optimal expansion of safe, affordable and reliable nuclear generation capacities. At the IBNI OOF level, this objective translates into providing specific products and services to project sponsors in IBNI Member States that will allow nuclear energy capacities to be delivered better, safer, fast and cheaper. Therefore, the entire suite of market-based financing and support products and services offered through the OOF will be specifically tailored to achieve precisely these outcomes in each and every nuclear project supported by IBNI. The following diagram illustrates the product and service categories that IBNI may offer to assist clients (nuclear project sponsors and IBNI Member States) to achieve these aims.

FIGURE 42 - VALUE-ADDED PRODUCT AND SERVICE CATEGORIES OFFERED BY IBNI ORDINARY OPERATIONS FUND

Source: IBNI-IO SAG

IBNI OOF market-based financing and other support packages will be competitively offered to finance-ready project applicants, on an equal opportunity, open and inclusive basis, within all IBNI Member states that have executed comprehensive long-term Net Zero Cooperation and Framework Agreements (NZCAFAs), as described in *Section 5 – IBNI Standards & Criteria*. IBNI will develop a highly transparent project evaluation methodology for determining which programs and projects will be prioritized based on their relative merits measured against standardized criteria. IBNI's evaluation methodology will include both quantitative and qualitative evaluations of the following elements:

- **IBNI Standards.** Both the IBNI Member State's and the proposed project's adherence to all of the IBNI Standards elements (pass/fail).
- **IBNI Criteria.** The degrees to which both the IBNI Member State and the proposed project conform to each of the IBNI Criteria elements (quantitative and qualitative scoring).

- **Quantum of IBNI OOF Financing and Support.** The total risk-adjusted quantum of financing and support requested by the applying project sponsor (quantitative scoring).
- **Necessity for IBNI OOF Financing and Support ("Additionality").** Demonstration that there is insufficient availability of financing other support available at similar or better cost and terms (which would otherwise allow the project to be delivered as safe, as fast and as cheap), if the requested IBNI financing and support is not granted (quantitative and qualitative scoring).

In general, all of the above evaluation elements are designed to allow IBNI (OOF) to optimally utilize its limited funding resources and capacities to deliver the most capital efficient and impactful worldwide nuclear capacity expansion solutions contributing toward achieving global net zero by 2050.

By requiring all hopeful nuclear project applicants to compete for scarce IBNI financing and support, it is also essential to emphasize that a 'market-based mechanism' is to be applied, which will require applicants and their IBNI Member State governments and institutions to exercise a great deal of discipline and high level of commitment toward their net zero pathways. The objective of all applicants will be to achieve the maximal scoring on the evaluated components of their applications for IBNI support.

It is also envisaged that cost-free information will be published and universally available to all IBNI Member States, project sponsors, stakeholder, advisors and the general public regarding all the current OOF financing and support products, programs and services. IBNI staff and resources will also maintain the capacity to provide free advice to potential applicants and IBNI Member States regarding all products, programs and services offered by IBNI[82]. The following tables (Tables 3 and 4) provide a summary of the main types of financing and support product and services that IBNI OOF will be able to offer in relation to nuclear programs and projects it supports in IBNI Member States.

TABLE 3 - MARKET-BASED FINANCING AND SUPPORT PRODUCTS OFFERED BY IBNI ORDINARY OPERATIONS FUND

Product	Description
Direct Loans	Direct "A-Loans" will be originated by and held[83] on the books of IBNI (OOF). In general, Direct Loans allow for the greatest amount of structuring flexibility and a comparatively very low cost of capital. The following is an illustrative summary of the potential terms and pricing of a IBNI Direct Loan: • *Purpose and Type:* Full range of long-term permanent (amortizing, bullet and sculpted); semi-perm; short-term; revolving, construction, maintenance, life-extensions, refinancing/reconstruction, contingency, working capital and reserve • *Term:* up to 40-years • *Mode:* Fixed or Variable

[82] In addition, OOF will provide fee-based transaction advisory services as set forth in Table 4.

[83] However, as part of OOF's capital markets operations it will routinely sell, securitize or bundle its de-risked performing loans and other receivables to commercial institutions, institutional and capital markets investors. Sales proceeds, including gains would then be "recycled" which will provide additional resources and capacities for OOF to finance and support additional projects (or could be applied toward generating returns to IBNI Member State shareholders, as could be decided by the Governing Board).

Product	Description
	• *Currency Denominations:* Major world currencies where IBNI has capital markets operations (this will evolve as IBNI's operations expand globally) • *Pricing:* IBNI cost of capital, plus credit margins and fees (based on specific sovereign credit and project scoring)
A/B Loans	A/B-Loan structures are loan structures where IBNI serves as the primary lender for the entire loan. The A-Loan portion of the loan will be held on IBNI (OOF)'s books and simultaneously participations in the remaining (B-Loan) portion will be sold to IBNI's network co-financiers. While the pricing and structuring flexibility of the B-Loan component will be limited to consensus views from other co-financiers, this structure may add incremental financing capacity for the borrower and also diversifies credit risk away from IBNI. Similar to the case that currently exists with established MDBs, it is expected that IBNI would attain *'preferred creditor status'* with a large universe of local, regional and global financial institutions and investors, that would routinely participate in IBNI B-Loan programs. Margins and terms on B-Loans are expected to be superior to what is otherwise available in the financial markets.
Syndicated Loans, Notes and Bonds	Syndicated B-Loans are loans, notes or bonds that are underwritten, syndicated, arranged, placed or agented by IBNI to other network financial institutions, investors and other institutions. In most syndicated financings, IBNI would typically also serve as the lead "anchor" direct lender (or "A/B Lender") in the financing and IBNI would work with one or more commercial lender(s) or investment bank(s) that facilitate the structuring, underwriting, syndicating, arrangement, placement or agenting the remainder of the loan to a universe of other participating lender or investor co-financiers. IBNI's "anchor" lender role will be seen as critical in convincing other institutions and investors to participate and at more favorable pricing and terms than what would otherwise be the case.
Minority Equity Participations	IBNI will offer minority (up to 49%) common equity shareholding in the nuclear project companies in projects that it supports. IBNI shall be precluded from maintaining a majority shareholding position in any project. In general, having IBNI OOF take on a minority common shareholder role will be the least preferred option (generally lender and quasi-equity roles are preferred) but will be considered under some circumstances if there is a strong fundamental justification. For example, in some cases, IBNI may be willing to accommodate inter-shareholder risk allocation where IBNI would inject a disproportionate higher share of project equity injections in the early stages of a project construction period and a lower share in later periods. In other cases, IBNI may be willing to provide "contingent equity" financing, where IBNI would provide additional shareholder equity in the case of construction delays and cost overruns. In situations where IBNI were to participate as a minority shareholder, it would expect concessions from its co-shareholders in terms of lower equity returns (lower equity risk premiums) and lower energy costs than would otherwise be the case.
Quasi-Equity Financing	Quasi-Equity facilities generally include preferred equity, mezzanine financing, convertible loans, subordinated loans and other similar facilities that are 'in between' senior debt and common equity claims on revenue and assets. Where there is a strong rationale to do so, IBNI will offer these types of financing facilities (usually as a part of a larger IBNI financing structure that also includes other types

Product	Description
	financing and support for a project) in an effort to achieve financial feasibility and lowest cost of capital. In general, it will be preferred by IBNI to provide quasi-equity financing rather than minority shareholding (common) equity commitments, in cases where projects may have certain 'gaps' between the project's capital funding and contingency requirements and other available sources of debt and equity financing. In comparison to shareholder (common) equity, quasi-equity offers IBNI a stronger claim on revenue and assets, lowering the project cost of capital which is aligned with IBNI's goal of driving down the cost of nuclear generation. Pricing on IBNI 'quasi equity' financing will be generally between the cost of shareholder (common) equity and senior debt but will be driven by the specific circumstances including the type of product, terms and risk factors.
Guarantees (Letters of Credit)	IBNI (OOF) will offer various types of commercial guarantee instruments applicable for nuclear projects. IBNI guarantee instruments will generally be in the form of commercial letters of credit (standby or direct-pay), providing either or both credit enhancement (based on IBNI's targeted 'AAA' ratings) and/or liquidity support. IBNI guarantee instruments can be used to provide a credit/liquidity wrap for third-party loan and bonds, sovereign guarantees (where the sovereign has an insufficient credit rating), guarantee in-lieu of cash reserve deposits, payment and performance guarantees from equity sponsors and contractors and for other project purposes.
Lines of Credit	Lines of Credit are credit facilities are typically in the form of revolving credit facilities that can be flexibly drawn and repaid in accordance with the borrower's available funds. IBNI will offer lines of credit for various project purposes, including for project contingencies, working capital, debt service reserves, operating reserves, maintenance reserves, decommissioning reserves, taxes/VAT and other uses.
Hedging Facilities	Hedging facilities (contracts) consist of interest rate, currency, inflation and commodity financial derivatives products. IBNI will generally offer swaps, caps, floors, collars, puts, calls and futures contracts as appropriate for project risk mitigation purposes. IBNI (OOF), through its capital markets operations would enter into 'back-to-back' contracts with a network of qualified broker-dealer counterparties in these contracts (similar to the practice of other major existing MDBs). Based on IBNI's targeted AAA credit ratings, credit spreads inherent within all such derivatives contracts will be minimized and therefore the benefits may be passed along to the program participants and the project.
Investment Contracts	Investment Contracts are products that offer a fixed or variable rate of return (interest earnings rate) for either a lump-sum project investment amount or fixed or variable schedule of investments over time. From a project perspective, there are numerous potential needs for re-investment. These include the re-investment of project bond proceeds; re-investment of debt service, operating, maintenance and decommissioning reserve accounts; and distributions accounts. As part of its capital markets operations, IBNI (OOF) will offer program participants with attractive market re-investment rates on contracts, based on the significant volumes of re-investment requirements that will result from operations of the entire OOF portfolio.

Source: IBNI-IO SAG

TABLE 4 - MARKET-BASED SERVICES OFFERED BY IBNI ORDINARY OPERATIONS FUND

Service	Description

Transaction Advisory	Transaction Advisory Services (TAS) offered by IBNI (OOF) will be comprehensive advisory services offered to either the project sponsors or to the IBNI Member State (government/SOE). TAS will be tailored to the unique circumstances of the client and the situation of the nuclear programs. The key advantages of engaging IBNI as transaction advisor are that it will be the institution best positioned to help clients optimize conformity with IBNI S&C principles, maximize the benefit and utilization of IBNI financing and support products and achieve a successful transaction. Specifically, under TAS services, the following scope of services could be offered (which would be tailored to the specific circumstances of the client):
	
	• IBNI Member State (government level) nuclear program advisors services
	    ○ NZCAFA agreements, assist governments/SOEs in maximizing conformity to IBNI S&C
	• Project level advisory services
	    ○ Project level, assist project sponsors and related stakeholders in maximizing conformity to IBNI S&C
	• Expert consultancy on IBNI financing programs and services
	• Transaction structuring and optimization
	• Program management
	• Contract negotiations
	• Contractor/subcontractor procurement
	• Financial modeling
	• Market sounding
	• ESG criteria and reporting requirements
	• Competitive procurement/tender development, management and execution
	• Capital markets advisory (see below)
	• Credit rating agency presentations/negotiations
	• Staff training and capacity building
	
	IBNI will be able to engage either as sole advisor or as a co-advisor (typically along with another private sector institution). Clients will be encouraged to engage IBNI as early as possible in the development of the nuclear project or program. Clients will also be encouraged to appoint IBNI as the lead advisor, on the basis that it will then engage a team of other sub-consultants, such as local and international legal, technical, financial/commercial, economic/markets, tax/accounting, risk/insurance, public relations and other necessary areas of program and transactional expertise, as required. IBNI's TAS fees could be typically arranged under a variety of flexible formats, including success-fee based, retainer fee, fees-for-services or combinations of the former.

Capital Markets Advisory	Capital Markets Advisory Services (CMAS) offered by IBNI (OOF) will generally consist of specific services related to the structuring, negotiation and raising of third-party (together with IBNI) debt and equity financing for a nuclear project. IBNI CMAS may either be procured discretely by the project sponsors (or IBNI

Service	Description

	Member State) or as an integral part of the TAS described above. In general, CMAS services will involve the following elements (which would be tailored to the specific circumstances of the client):
	
	• Debt capital raising:
	  ○ Structuring and advising on debt capital structures
	  ○ Financial modeling, sensitivities and stress case scenarios
	  ○ Market sounding
	  ○ Engaging co-advisors, underwriters, arrangers, agents
	  ○ Credit rating agency presentations / negotiations
	  ○ IBNI S&C and ESG compliance
	  ○ Finance and inter-creditor agreement negotiations
	  ○ Execution and signing
	• Equity capital markets:
	  ○ Structuring and advising on equity/quasi-equity capital structures
	  ○ Financial modeling, sensitivities and up-side scenarios
	  ○ Market sounding
	  ○ Engaging co-advisors, underwriters, arrangers, agents
	  ○ IBNI S&C and ESG compliance
	  ○ Shareholder/inter-shareholder agreement negotiations
	  ○ Execution and signing
	
	IBNI will be able to engage either as sole advisor or as a co-advisor (typically along with another private sector institution). IBNI's CMAS fees may be arranged under a variety of flexible formats, including success-fee based, retainer fee, fees-for-services, or combinations of the above.

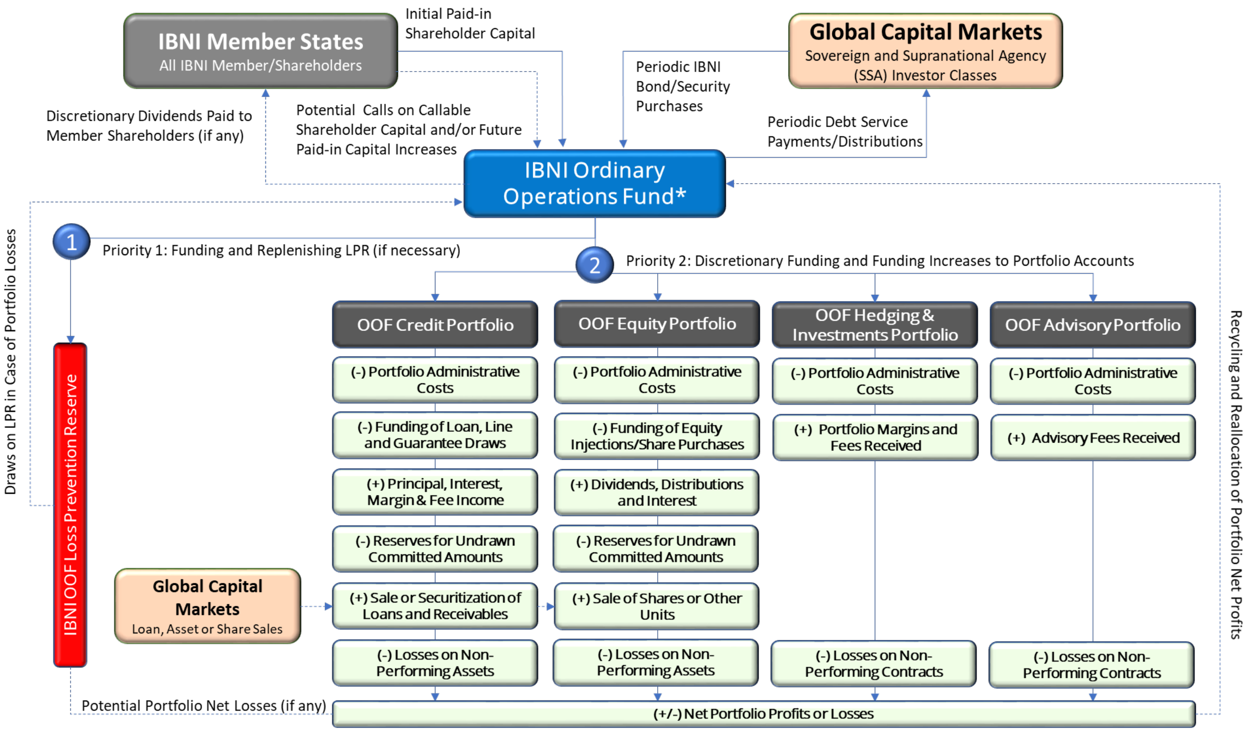
Source: IBNI-IO SAG

From an operations perspective, OOF's market portfolio structure should be allocated to its four key product and service divisions as set forth above in Figure 40:

- Credit Portfolio (Loans, Lines and Guarantees/Letters)
- Equity Portfolio (Minority Shareholding, 'Quasi-Equity' Investments)
- Risk Management and Investments Portfolio (Derivatives and Investment Contracts)
- Advisory Services

It will be critical for the market portfolio to be operated and managed in a manner that is consistent with best industry practices for credit maintenance (AAA long-term unsecured ratings), loss prevention, capital and liquidity thresholds and prudent banking practices. The following diagram illustrates the recommended operational, funding, reserves and cash flow structures of the OOF's portfolio and its four portfolio sub-components.

FIGURE 43 - IBNI ORDINARY OPERATIONS FUND OPERATING AND FUNDING DIAGRAM



*Source: IBNI-IO SAG * While not shown in the diagram, IBNI OOF (at the fund level) will have internal administrative, staffing, other general overhead costs (including general and administrative fees payable to IBNI) and will also need to fund and maintain a senior debt service reserve account and potentially other reserve accounts.*

7.2 Proposed IBNI Special Operations Plans and Programs.

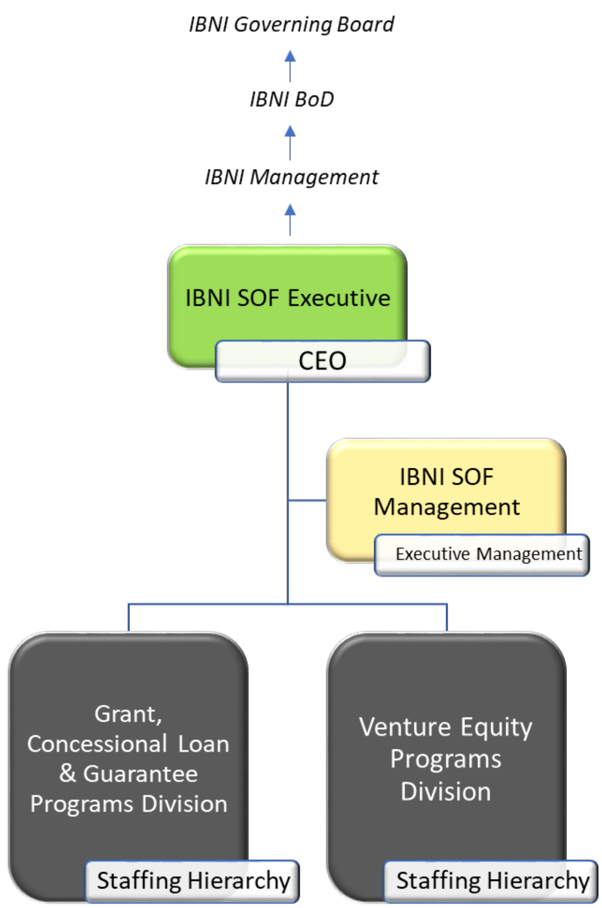
As mentioned above, the second key pillar of IBNI's support activities will be related to administration of certain donor funded "Special Operations Programs" to be offered through the IBNI Special Operations Fund (IBNI SOF). Consistent with the practice of other existing MDBs, it is anticipated that various subsets of IBNI Member State coalitions will routinely provide donor funding for particular programs and initiatives (augmented, some instances, with fund provided by private or non-governmental donors). These coalitions of donors will wish to ensure that their donated funds will be used most effectively for specific nuclear energy related causes. The SOF will offer donor coalitions with a platform and resources to achieve that objective.

In general, the SOF will operate on a not-for-profit basis[84]. However, it is recommended that the SOF should be established as a performance- and results-driven organization, whereby measurable performance indicators will be established and agreed up-front with the donors based on the specific objectives of each of

[84] It is intended that all receipts of principal, interest, fees, dividends, gains from sale of shares/assets will be recycled back into the SOF portfolio programs in accordance with donor funding agreements.

the donor-funded programs. Results-driven performance will be a key element in providing the proper incentives for both internal (SOF management and staff) as well as external contractors to optimally perform and achieve the best possible outcomes for each dollar of donor funding. The following organigram illustrates the proposed management and staffing structure of the SOF.

FIGURE 44 - IBNI SPECIAL OPERATIONS FUND PROPOSED ORGANIGRAM



Source: IBNI-IO SAG.

It is envisaged that many of the donor funded programs may also be enhanced through private sector funded Social Impact Bonds (SIB) initiatives (or similarly climate and sustainability impact bond programs). An SIB program is a type of hybrid investment between a grant and a concessional loan/bond. The SIB provides the investor with the ability to recover capital and earn a return based on the degree to which the SIB program performance objectives (results) have been achieved. SIB programs are expected to be a good complement for many of the SOF concessional grant, loan and guarantee programs which may very well attract additional and incremental private sector capital available to fund these programs. A number of the major MDBs have already successfully initiated SIB programs which complement many of their donor-funded and market-based initiatives.

The SOF should strive to operate as flexibly and adaptively organization as possible. In essence, it will take direction from the IBNI Member State donors and work with those donor groups to most efficiently and effectively achieve the desired outcomes (results).

It is envisaged that the Special Operations Assistance programs will offer qualified applicants with certain types of assistance in the following forms:

- **Grants.** Funds granted to the recipient that are required to be applied to a particular funding purpose, program or project in accordance with the grant funding contract. Grants are not required to be repaid*
- **Concessional Loans and Guarantees.** Loans and guarantees provided to the recipient with below-market interest rates or fees and other favorable terms that are not generally available in commercial lending markets. Concessional loans and guarantees are required to be applied to a particular funding purpose, program or project in accordance with the concessional loan or guarantee contract. IBNI (SOF) will offer the following types of Concessional Loans and Guarantees:
    - **Low-Interest Loans.** Concessional loans where the full amount of principal and interest is required to be repaid.
    - **Forgivable Loans.** Concessional loans where the requirement for repayment of all or a portion of the outstanding principal and interest may be waived under certain circumstances*. However, under ordinary circumstances the loan would be required repaid in full.
    - **Guarantees.** Concessional loan guarantees issued to a recipient, which allow the recipient to attain a loan from a commercial lender that would either not otherwise be available or would be unaffordable or at unfavorable terms. Any draws on the guarantee are required to be fully repaid, with interest in accordance with the terms of the guarantee.
- **Social Impact Bonds (SIBs).** SIB provides are purchased by a private investor and offer the ability to recover capital and earn a return based on the degree to which the SIB program performance objectives (results) have been achieved. In general the SIB investor will have some material degree of control over third-party contractors implementing the program. Note that this category may also include 'Climate Impact Bonds' and 'Sustainability Impact Bonds' and other potential impact bond programs and concepts.
- **Venture Equity (VE).** Venture equity programs offer venture capital (equity) funding to innovative nuclear technology and nuclear fuel cycle companies at various stages of development from seed stage, until growth stage. In addition to donor funding for VE programs, it is anticipated that the SOF VE program will attract other private venture capital co-investors who may invest either in the SOF diversified VE portfolio or as JV partners in specific early-stage companies.

Note: In the case of a default (either by the recipient of the assistance under the terms of the specific grant or loan agreement or in the case of a cross-default by the IBNI Member State under the NZCAFA) all grant amounts disbursed and any forgiven loan amounts will become due and payable (accelerated).

Each type of assistance will be available on a competitive, open and inclusive basis to qualified applicants in any IBNI Member State that has signed a comprehensive long-term Net Zero Cooperation and Framework Agreement (NZCAFA), as described in *Section 5 – IBNI Standards & Criteria*. IBNI will develop an objective and highly transparent evaluation methodology for determining which Special Operations Assistance (Donor Funded) applications will be prioritized based on their relative merits measured against standardized criteria. In general, IBNI's evaluation methodology will include both quantitative and qualitative evaluations of the following elements:

- **IBNI Standards.** Both the IBNI Member State's and the proposed project's adherence to all the IBNI Standards elements (pass/fail).
- **IBNI Criteria.** The degrees to which both the IBNI Member State and the proposed project conform to each of the IBNI Criteria elements (quantitative and qualitative scoring).
- **Program-Specific Standards and Criteria.** IBNI SOF and the donors will determine (within a required framework) any additional program-specific standards and criteria that will apply for the specific grant program (quantitative and qualitative scoring).
- **Quantum of IBNI SOF Assistance.** The total risk adjusted quantum of assistance (grants, concessional loans and guarantees, and venture equity) requested by the applicant (quantitative scoring).
- **Necessity for IBNI SOF Assistance ("Additionality").** Demonstration that there is insufficient availability of alternative funding sources necessary for the nuclear project or program development, if the requested IBNI financing and support is not granted (pass/fail).

Consistent with the organigram illustrated above in Figure 43, it is proposed that there will be two primary divisions within the SOF organizations, namely the Grant, Concessional Loan and Guarantee Program Division and the Venture Equity Program Division. Additional details regarding the activities of each division are, respectively, presented below in Tables 5 and 6.

TABLE 5 - IBNI SPECIAL OPERATIONS FUND GRANT AND CONCESSIONAL LOAN AND GUARANTEE ASSISTANCE PROGRAMS

Assistance Program	Description
Pre-Finance Stage Nuclear Assistance Program	IBNI (SOF) will offer a "Pre-Finance Stage Nuclear Program" to assist both early stage 'newcomer' nuclear program seeking to develop their first commercial reactor (such as in those states that are also participating in the IAEA's INIR program) as well as applicants seeking to expand their nuclear programs in IBNI Member States with existing nuclear programs. IBNI Member States, SOEs and other stakeholders may apply for grants concessional loans and guarantees that will be used to fund both direct and indirect program cost related to developing national or regional nuclear energy programs or nuclear projects. Applicants in IBNI Member States that do not currently have existing nuclear energy programs, will also be required to participate in the IAEA's INIR program as a condition to receiving grant this type of grant funding. Qualification and funding distributions may also be tied to relative performance and progression under the INIR Milestone Reviews. This program will also be open to applicants IBNI Member States seeking

Assistance Program	Description
	early-stage funding to develop new reactors or extend the lives of existing reactors (on as as-needed basis). It should be noted that this program can also be used to pay all or a portion of the IBNI (OOF) Transaction Advisory Services fees and other third-party expert advisory fees.
Finance Stage Nuclear Assistance Program	IBNI (SOF) will offer a "Pre-Financing Stage Nuclear Program" to provide additional supplemental assistance to qualified finance-ready nuclear project sponsors proposing to develop finance-ready nuclear projects. The purpose of this program is to provide supplemental grant, concessional loan and guarantees to project sponsors that have already qualified for one or more forms of market-based financing or support within the IBNI OOF programs. In certain cases, on as 'as-needed basis', qualified projects with residual financing, and/or affordability gaps may receive supplemental assistance in the forms of grants, concessional loans and/or guarantees.
Nuclear Innovation Assistance Program	IBNI (SOF) will offer a "Nuclear Innovation Assistance Program" to assist qualified applicants by providing grant, concessional loan and guarantee assistance for the research, development, licensing, demonstration and commercialization of innovative new nuclear technologies that offer promising scalable global applications for nuclear energy generation; nuclear applications for industry, medicine, agriculture, transport and science; and nuclear fuel cycle applications. The Nuclear Innovation Program shall include both nuclear fission and fusion technologies, as well as all generation technologies for electricity, hydrogen, heat, cooling, desalinated water and propulsion. The program is available to private sector, public sector and university/research/laboratory applicants. The Nuclear Innovation Assistance Program may also be combined with the "Nuclear Innovation Venture Equity" program described below.
Deep Geological Repository Assistance Program	IBNI (SOF) will offer a "DGR Assistance Program" to assist qualified applicants by providing grant, concessional loan and guarantee funding related to the development of new (or expansion or acceleration of development or enhancements of existing) DGR facilities and technologies for long-term storage of high-level radiological waste materials.

Source: IBNI-IO SAG

TABLE 6 - IBNI SPECIAL OPERATIONS FUND VENTURE EQUITY PROGRAM

Venture Equity Program	Description
Nuclear Innovation Venture Equity Program	IBNI (SOF) will offer a "Nuclear Innovation Venture Equity Program" to assist qualified start-up to growth-stage nuclear technologies and fuel cycle companies which offer promising scalable global applications for nuclear energy generation; nuclear applications for industry, medicine, agriculture, transport and science; and nuclear fuel cycle applications. The program will offer venture capital (equity) funding to qualified companies from the seed stage until the growth stage. The Nuclear Innovation Venture Equity Program shall include both nuclear fission and fusion technologies, as well as all generation technologies for electricity, hydrogen, heat, cooling, desalinated water and propulsion. The Nuclear Innovation Venture Equity Program will also aim to attract private sector private equity co-investors in our diversified

Venture Equity Program	Description
	portfolio and also in specific early-stage companies. The Nuclear Innovation Venture Equity Program may also be combined with the "Nuclear Innovation Assistance Program" described above.

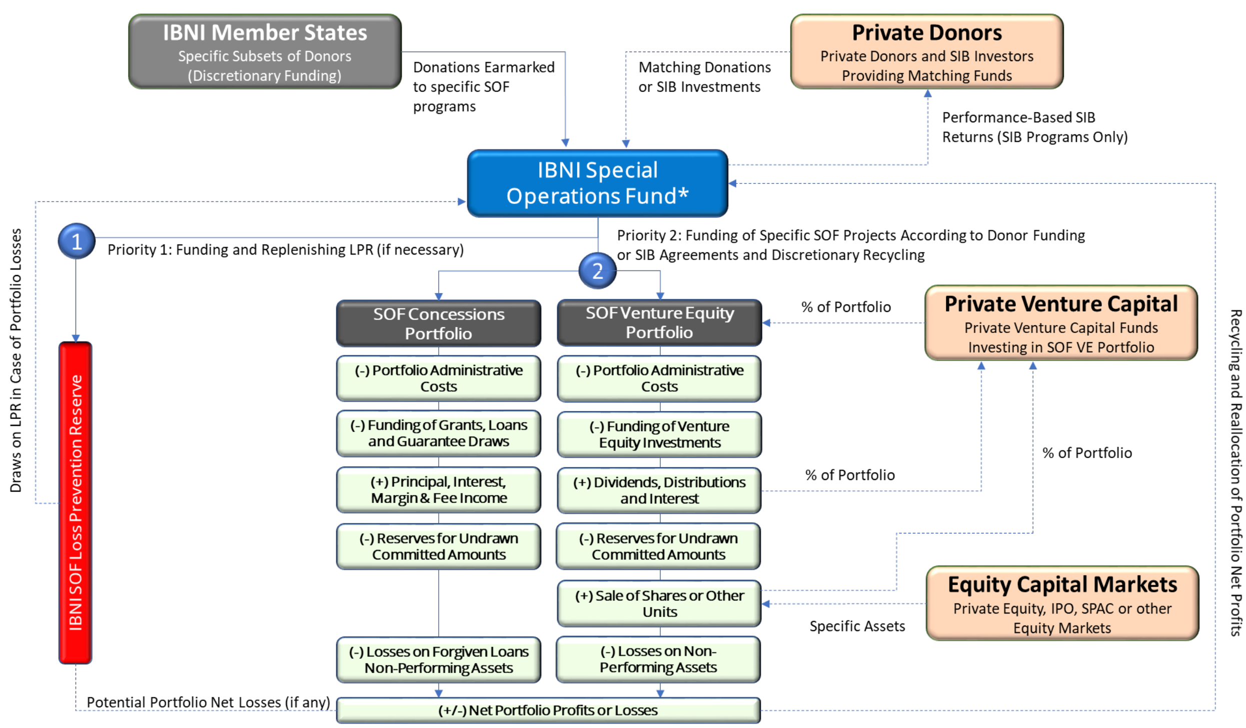
Source: IBNI-IO SAG

From an operations perspective, SOF's market portfolio structure should be allocated to its two key product and service divisions as set forth above in Figure 41:

- Concessional Portfolio (Grants and Concessional Loans and Guarantee programs)
- Venture Equity Portfolio (Shareholdings in early-stage nuclear technology companies)

It will be critical for the SOF portfolio to be operated in a manner that is consistent with best industry practices for donor funded programs and venture capital funds and portfolios. The following diagram (Figure 45) illustrates the recommended operational, funding, and cash flow structures of the SOF's portfolio and its two portfolio sub-components.

FIGURE 45 - IBNI SPECIAL OPERATIONS FUND OPERATING AND FUNDING DIAGRAM



*Source: IBNI-IO SAG * While not shown in the diagram, IBNI SOF (at the fund level) will have internal administrative, staffing, other general overhead costs (including general and administrative fees payable to IBNI). Repayments of outcomes-based payments of principal and returns on SIB programs will paid out of donor and/or SOF sourced funds held in escrow at the fund level (based on highest level of performance outcome). Any unpaid SIB performance funds will be released to SOF for program applications after SIB performance measurement dates.*

8. Proposed IBNI 2050 Global Impact Targets and Goals.

Key Points

- IBNI shall be established as a results-oriented organization that will fulfill its mission to expand global nuclear generation capacities in order to achieve sustainable net zero by 2050.
- IBNI will establish specific measurable targets and goals that related to its direct impacts as well as indirect impacts in all the countries and markets that it supports.
- IBNI's success will be measured by its achievement of various specific goals and targets, but the most important objective will be the achievement of 2050 Net Zero.

Each nation of the world will need to make their own independent decisions on energy and climate change policies and strategies, based on their own unique circumstances. However, given those nations that collectively represent both the vast majority of both global GHG emissions and global energy consumption have already submitted their NDC pledges, each nation needs to formulate their own actionable and achievable plans that will allow for the achievement of all net zero commitments under their respective NDC pledges.

IBNI will offer a powerful set of new tools available to any nation that makes the policy decision to develop, expand and scale-up their nuclear energy program as a significant element of their own pathway to providing a future sustainable low-carbon economy and achieving net zero by 2050. Currently, the challenges for many nations to develop and expand their nuclear capacities are numerous. Significant impediments include access to affordable finance, market and regulatory challenges, ESG issues, uncertainties regarding affordability, status of the nuclear industry and supply chains, safety and security concerns, and numerous other issues. IBNI will offer a comprehensive "game changing" set of solutions to the multifaceted nuclear related challenges mentioned above.

There are effectively only two existing low carbon generation technologies that are technically feasible, commercially proven and scalable: nuclear and renewables. As the world has now become aware, the challenge of achieving 2050 net zero requires nothing short of immediate and drastic action. There is simply no time remaining to wait for hopeful future clean energy breakthroughs that might become commercialized, scalable and affordable in the years and decades ahead[85]. It is clear that the world must take action today

[85] Note that IBNI is fully supportive and is a strong advocate for governments and private sector investment in emerging new low carbon energy generation, grid and storage technologies. Clearly, the world should make every reasonable effort to advance all such promising new technologies as quickly as possible. Irrespective, the main concerns remain with respect to the timeframes and the uncertainties over when and whether many of these technologies may become commercially viable, economical and available at global scale quickly enough to make an impact prior to 2050 (if ever). It is envisaged that IBNI itself will be well-positioned emerge as a global leading

and begin investing in a clean energy future of tomorrow using existing technically and commercially proven generating technologies.

A key question that policymakers in every nation should be asking is not "which low carbon generation technologies should we begin investing in?", but rather "what will be the *cost* of our low carbon future be for our future generations, based on the investment decisions (generation mix) that we undertake today?" It may be technically feasible, using today's technologies, for certain nations of the world to achieve net zero by 2050 through implementation of virtually 100% renewables. *But what at what cost?* Most nations of the world do not have sufficient and affordable dispatchable renewable resources (principally, additional proven and economically exploitable hydrological, geothermal and biomass resources). Therefore, for any nation that chooses an '*all renewables pathway*', there will need to be a reliance on a very high percentage of and investment in VRE generation (mainly wind and solar) together with a correspondingly large investment in related grid, energy storage and other systems costs. Even without considering the practical limitations related to land, coastal area and materials consumption related to very high global VRE penetration levels, the question about *cost* persists. As shown in *Section 3.1 - Nuclear Power is Amongst the Most Affordable Low Carbon Generation Technologies in Existence*, as the VRE penetration rates increase, system costs also tend to increase at a disproportionately high rate.

Considering the context described above, it is SAG's opinion that as many nations of the world (in the very immediate future) will begin to consider their own limited options to achieve net zero in their national context, not an insignificant number of nations will reach their own conclusion that *the significant benefits of developing, expanding and scaling-up* nuclear energy programs over the next 30-years outweigh the *risks of nuclear energy and the significant costs associated with reliance on very high VRE in their 2050 generation mixes.*

Without IBNI, due to the many of the above-mentioned challenges and impediments currently facing nuclear energy, most nations will reasonably determine that it is inconceivable for nuclear to play anything but a very minor role in achieving 2050 Net Zero. However, when IBNI is established, it will play a pivotal "game changing" role in breaking down the many existing barriers and impediments that nations are currently facing in developing, expanding and scaling-up their nuclear capacities. After the establishment of IBNI, all nations ranging from developing countries to the world's most advanced industrialized economies, will have uniform access to all the necessary tools that will allow them to access nuclear energy as a significant component of their energy futures that will also provide the most affordable pathways to their sustainable low carbon future economies.

Many recent and highly credible analyses and projections from reputable organizations have significantly discounted the global role and impact of nuclear generation by 2050. Based on recent meta-analyses of many of these recent studies, the projected 2050 nuclear shares of total world electricity generation range

funder, supporter and catalyst of many new and innovative nuclear generation and nuclear fuel cycle related technologies as set forth in Section 7.

from 4.5% to 25%[86]. However, within those studies, many of the assumptions pertaining to nuclear energy industry and markets and broader energy markets are well understood and are reflective of existing conditions and reasonable forecasts under a 'status quo' state. However, in consideration of IBNI becoming the pivotal "game changer" in the global nuclear landscape, many potential scenarios of much higher growth in nuclear capacities over the next 30-years become entirely plausible.

It is neither the intention nor the objective of the SAG to critique the many studies and analyses from many esteemed organizations, including many that are strong proponents of expanding nuclear capacities. Each of these studies were conducted for specific purposes and rely upon many reasonable and defensible assumptions and modeling outputs. It is clear, at the time of this publication, that none of these studies took into consideration the potential near-term establishment of IBNI and the global impacts that the Bank may have. Taking all of the above points into consideration, SAG's analytical objective was to take an independent and fresh look at what level of additional and incremental impact IBNI, as the pivotal "game changer", could reasonably have on the prospective growth of global nuclear generation capacities and outputs over the next 30 years.

In the IRAP scenarios, we envisage a world where IBNI will offer all nations of the world a comprehensive solution, which removes most of the impediments relating to developing, expanding and scaling-up their nuclear programs. A simple and fundamental decision for most nations charting their low carbon future will become whether:

A. to *scale-up* nuclear generation and rely *less* on VRE; or,
B. to *scale up* VRE and rely *less* on nuclear or not at all.

Certainly not all nations will choose or even consider 'A', and for many well-understood and respected non-economic reasons. However, it is the opinion of the SAG that under the above simplified framework, a great number of the world's nations will choose 'A', for numerous reasons, but overwhelmingly, because of one overriding economic reason: *Because they will determine it is far and away their least cost low carbon solution available in their national context.*

Table 7, below summarizes our three scenarios, which consider worldwide access to IBNI's programs.

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[86] Sources: [3], [5], [6], [43] & [46]. Note WNA, in report *World Energy Need and Nuclear Power (updated May 2021)* ([43]) conducted a comprehensive survey of numerous world energy and nuclear energy forecasts. Within this report, WNA sets forth a "harmony goal" for the world nuclear industry to provide 25% of electricity output by 2050. It should be noted that the IPCC pathway scenario P2 (SSP2-19) also shows 25% nuclear share of generation by 2050. It is noted that OECD IEA/NEA and IAEA have recently projected amongst the most conservative nuclear scenarios for 2050 world nuclear generation shares with declines to 8% and 4.5%, respectively (OECD IEA/NEA [6] & [43] have also assumed 2050 world VRE share of 70%). It should be further noted that each of these studied scenarios utilized different forecasts and assumptions for total 2050 world electricity demand.

TABLE 7 - SUMMARY OF ASSUMED WORLD ELECTRICITY GENERATION, NUCLEAR AND VRE SHARES UNDER SAG SCENARIOS

Scenario			2030			2040			2050		
Nr.	Electricity Generation	2050 Nuclear Penetration	Total Gen. (PWh/a)	Nuclear (PWh/a)	% Nuclear (% VRE)	Total Gen. (PWh/a)	Nuclear (PWh/a)	% Nuclear (% VRE)	Total Gen. (PWh/a)	Nuclear (PWh/a)	% Nuclear (% VRE)
1a	Projected	Low VALCOE	37.3	3.78	10.1(43.2)%	56.6	27.13	48.0(28.7)%	71.2	42.70	60.0(22.0)%
1b	High	Low VALCOE	49.8	3.78	7.6(57.4)%	75.5	35.71	47.3(35.2)%	95.0	57.00	60.0(26.5)%
1c	Low	Low VALCOE	28.5	3.78	16.0(10.2)%	35.8	17.71	49.5(13.6)%	45.0	27.00	60.0(11.5)%
2a	Projected	Mid VALCOE	37.3	3.78	10.1(43.2)%	56.6	15.17	26.8(49.9)%	71.2	22.77	32.0(50.0)%
2b	High	Mid VALCOE	49.8	3.78	7.6(57.4)%	75.5	19.75	26.2(56.4)%	95.0	30.39	32.0(54.5)%
2c	Low	Mid VALCOE	28.5	3.78	16.0(10.2)%	35.8	10.15	28.4(34.8)%	45.0	14.40	32.0(39.5)%
3a	Projected	High VALCOE	37.3	3.78	10.1(43.2)%	56.6	6.63	11.7(65.0)%	71.2	8.54	12.0(70.0)%
3b	High	High VALCOE	49.8	3.78	7.6(57.4)%	75.5	8.35	11.1(71.5)%	95.0	11.40	12.0(75.0)%
3c	Low	High VALCOE	28.5	3.78	16.0(10.2)%	35.8	4.75	13.3(60.0)%	45.0	5.40	12.0(59.5)%

Source: IBNI-IO SAG. Notes: The following three world electricity demand cases apply: "Projected" = OECD IEA/NEA Net Zero Emissions by 2050 Scenario, Source [53]- Table A.3d, pg. 312; "High" and "Low" scenarios are adapted by IBNI-IO SAG from a synthesis of projections from various sources detailed in Figure 5. The following three 2050 World Nuclear Penetrations cases apply: "Low VALCOE" = the IBNI-IO SAG optimistic target case which limits the necessity to scale-up global VRE shares to < 30% under high electricity demand cases, and this also limits annualized growth in nuclear capacity during the 2030 – 50 period to similar levels as the nuclear industry has demonstrated in the 1960 – 1990 growth period (as discussed further below); "Mid VALCOE" and "High VALCOE" were calculated based on a targeted 2050 VRE penetration targets of 50% and 70%, respectively (in the case of "Projected" Electricity Generation). Furthermore, it is assumed that while IBNI would be established by 2023, the nuclear projects that it begins financing in the 2020's will most likely not be operational and connected to the grid until after 2030. Therefore, under all scenarios nuclear generation output for 2030 has been assumed to be 3.777 PWh/a, which is consistent with the NZE scenario. Significant IBNI-initiated growth of global nuclear output becomes most plausible beginning in the 2030 – 2040 decade.

Based on such a wide range of scenarios which consider various levels of electricity demand and nuclear penetration over the next 30-years, the above scenarios indicate a correspondingly wide range in 2050 nuclear generation output ranging from 5.4 PWh/a to 57.0 PWh/a. This corresponds to range of 725.2 GW_e to 7,654.9 GW_e of required total nuclear installed capacity connected to the grids by 2050[87] (representing an average annual capacity growth rate of 2.0% to 10.5% (CAGR) over the 30-year period). Historically, the nuclear industry has already demonstrated its capabilities to deliver even faster growth over similar time horizons. As shown in Figure 31, the growth in nuclear capacity from 1960 – 1990 increased at an average annual growth rate of 20.8% (CAGR)[88]. Under the appropriate frameworks, there is no fundamental reason that global nuclear industries and supply chains of today and tomorrow cannot be reactivated in the 2030's and 2040's to deliver similar or higher growth rates.

Table 8, below summarizes the modeled world nuclear capacity increase requirement associated with the various scenarios show above in Table 7.

TABLE 8 - SUMMARY OF ESTIMATED OF TOTAL REQUIRED GLOBAL NUCLEAR INSTALLED CAPACITIES UNDER VARIOUS SCENARIOS

Scenario			2020	2030		2040			2050		
Nr.	Electricity Generation	2050 Nuclear Penetration	Nuclear Installed Capacity GW_e	Nuclear Installed Capacity GW_e	2020-30 CAGR%	Nuclear Installed Capacity GW_e	2020-40 CAGR%	2030-40 CAGR%	Nuclear Installed Capacity GW_e	2020-50 CAGR%	2040-50 CAGR%
1a	Projected	Low VALCOE	392.6	507.2	2.6%	3,643.5	11.8%	21.8%	5,734.4	9.4%	4.6%
1b	High	Low VALCOE	392.6	507.2	2.6%	4,795.8	13.3%	25.2%	7,654.9	10.4%	4.8%

87 These figures assume an average global capacity factor of 85%.

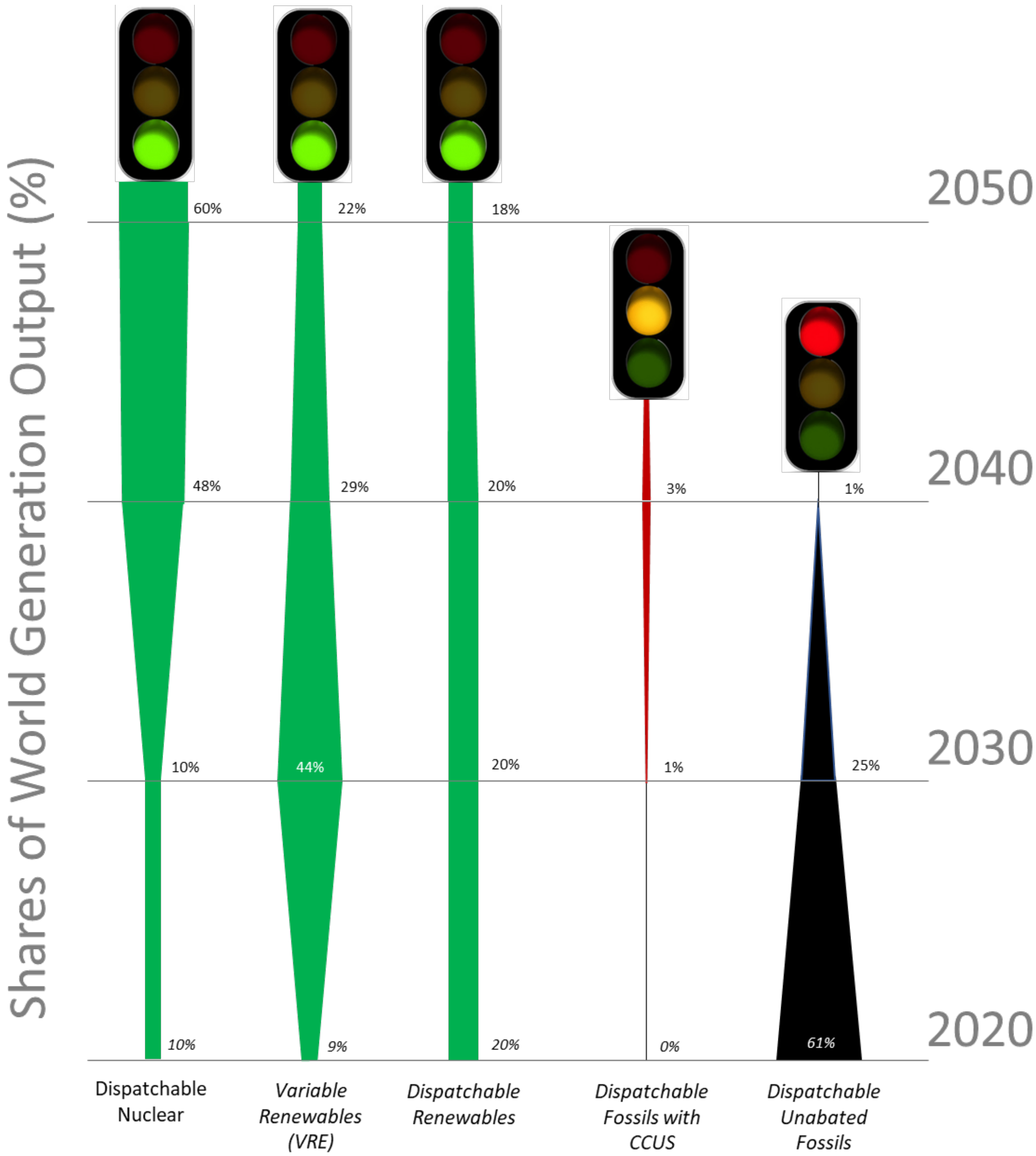
88 Note: Historical world nuclear capacity growth rates averaged 32.1% (CAGR) from 1960 – 70 and 22.4% (CAGR) from 1980 -90 or 27.2% (CAGR) from 1960 – 1980.

Scenario			2020	2030		2040			2050		
Nr.	Electricity Generation	2050 Nuclear Penetration	Nuclear Installed Capacity GW_e	Nuclear Installed Capacity GW_e	2020-30 CAGR%	Nuclear Installed Capacity GW_e	2020-40 CAGR%	2030-40 CAGR%	Nuclear Installed Capacity GW_e	2020-50 CAGR%	2040-50 CAGR%
1c	Low	Low VALCOE	392.6	507.2	2.6%	2,378.6	9.4%	16.7%	3,626.1	7.7%	4.3%
2a	Projected	Mid VALCOE	392.6	507.2	2.6%	2,037.9	8.9%	14.9%	3,058.4	7.1%	4.1%
2b	High	Mid VALCOE	392.6	507.2	2.6%	2,652.4	10.0%	18.0%	4,082.6	8.1%	4.4%
2c	Low	Mid VALCOE	392.6	507.2	2.6%	1,363.3	6.4%	10.4%	1,933.9	5.5%	3.6%
3a	Projected	High VALCOE	392.6	507.2	2.6%	891.0	4.2%	5.8%	1,146.9	3.6%	2.6%
3b	High	High VALCOE	392.6	507.2	2.6%	1,121.5	5.4%	8.3%	1,531.0	4.6%	3.2%
3c	Low	High VALCOE	392.6	507.2	2.6%	638.0	2.5%	2.3%	725.2	1.3%	2.1%

Source: IBNI-IO SAG. Notes: All installed capacities represent net electrical capacities. Data Source for 2020 installed capacities: [16]. 2030 – 50 capacities assume 85% average capacity factors for all world nuclear power plants.

While the above Table 8 addresses only the projected nuclear and VRE shares (which are poised to become the dominant sources of generation by 2050), the diagram below (Figure 46), reflecting Scenario 1a, illustrates potential incremental process, whereby renewable capacities, which are typically quicker to deploy, would be scaled-up more immediately (through the 2030s) and nuclear capacities, which take more time to deploy, would be scaled-up in the 2030s and 2040.

FIGURE 46 – POTENTIAL EVOLUTION OF WORLD LOW-CARBON AND FOSSILS GENERATION SHARES UNDER SCENARIO 1A



Source: IBNI-IO SAG

IBNI will be a strong advocate of global nuclear capacity expansion and will provide all INBI Member States with the tools and resources to develop, expand and scale up nuclear programs in the cheapest, fastest and safest manner possible. Therefore, the Bank is expected to have a very strong influence on the global nuclear growth evolution from 2020 – 50. IBNI will be an active and strong proponent in challenging an expanding universe of nuclear nations to advance their programs and project as quickly as possible. The global nuclear industry and supply chains will rapidly respond to evidence of growing nuclear demand. Ultimately, the decisions that will enable a rapid global expansion of nuclear capacities, reminiscent of the global nuclear growth rates of the 1960s – 1990s, will be entirely dependent on the nations of the world. Nations need to make their own decisions in the near team as whether they will choose to scale-up nuclear generation or rely on renewables in the decades ahead. IBNI will be there to support and remove barriers for those nations that choose nuclear at any scale.

Irrespectively, as a results- and performance-based organization, IBNI should establish and periodically update long-term world targets and goals with respect to emission reductions, energy generation per capita, economic growth and development targets, world nuclear generation capacities and reductions in energy costs. Such targets and goals should be set at levels that are reasonably achievable, but on the aggressive side (the "bar should be set high"). These targets and goals will become one important organizational performance metric that IBNI's management and the IBNI Member State shareholders will be able to continually assess and measure the effectiveness of IBNI's programs in meeting the overriding organizational goals.

8.1 Proposed IBNI 2050 Global Emissions & Sustainability Targets and Goals

Assisting IBNI Member States in phasing-out fossil fuels generation and completely transitioning away from fossil fuel based economic systems as rapidly and efficiently as possible is a fundamental objective of the Bank. This global transitioning, while continuing to drive global economic development and prosperity, taken all together will represent a prodigious undertaking under any calculus. We also must remember that reducing GHG and all other emissions to zero by 2050 encompasses much more than just the power generation sector. As illustrated in Figure 1, the global power generation sector accounts for just 26% of total annual GHG emissions. Power generation, in combination with energy consumed in industry, for transport and within the built environment (the "energy sector") constitute about 65% of total annual GHG emissions (collectively about 34 Gt per annum)[89]. Total annual GHG emissions of about 52 Gt needs to be brought to 0.

It will be necessary for each nation to develop entirely new energy systems that are centered around energy generation supplied by nuclear and renewables. In addition to power generation, the vast majority of the world's industrial, transportation and built environments currently rely on vast inputs of fossil fuels (coal, oil and gas). Each of these systems and their associated vast infrastructures to supply them with fossil-based energies will need to be completely transformed to rely on energies supplied by nuclear and renewables. Accordingly, all of these systems will need to be either electrified or supplied with another energy carrier, such as hydrogen, electrofuels, heat and cooling provided by nuclear and renewables generation plants. Transitioning fossil fuels-based industries and economic systems to new clean energy ones, will create enormous challenges for policymakers in every nation. These changes will need to be conducted in the most responsible manner in effort to avoid any major unintentional economic repercussions.

[89] Sources: [7] & [8]

If we expect these very significant transitions to occur in such a relatively short time period, the key consideration will come down to the question *what does it cost?* Addressing this question is where nuclear and IBNI will play a critical role. For nations that choose to make nuclear a significant part of their new low carbon energy and economic systems (as shown above), IBNI will support each nation by helping make this transition in an economically sustainable manner. Undertaking such a massive transition, will require large near-term capital investments in each country's energy and related infrastructure[90]. Where nuclear, under the IBNI framework is part of this capital investment profile, many 'sustainable societal level returns' will result. Some of these sustainable 'societal level returns' will include:

- Access to *least-cost energy*[91] that is also abundant, reliable, secure, safe and clean;
- Mitigation of more severe detrimental human, economic and environmental consequences global climate change;
- Clean air, water and soils which sustain improved human health and environment;
- New economic models that create opportunities for growth of sustainable new industries, good jobs and human development;
- Preservation of land, aquatic and mineral resources available for sustainable agriculture, fishery, forestry, human and conservancy uses;

All of the above outcomes are integral within the IBNI S&C framework (See Section 5) which are inclusive of the SDGs[92] and broader ESG sets of principles.

While there are some factors, such as demographics (global population growth) that may not be directly impacted by the energy sector, nuclear energy and IBNI, other factors such as global economic development (GDP per capita) that will be highly correlated with the energy sector. Therefore, while IBNI cannot directly influence global population growth, its programs which are designed to provide all nations from developing countries to highly developed countries with access to the most affordable, reliable, clean and safe energy has a direct impact on economic development, improvement of living standards for all and poverty reduction. These elements can be measured by increasing energy consumption per capita. Energy efficiency and energy conservation (behavior changes) have and are expected to continue to lead to a "de-coupling" of energy consumption per unit of GDP. Combining the goals of sustainable global economic development, improvement of living standards for all, poverty reduction (increasing energy consumption per capita and

[90] However, as shown in Section 3.1, a proportionately higher nuclear share of the generation mix will serve to minimize the overall quantum of these near-term capital investments, as well as maximizing the societal level returns on such capital investments.

[91] After the low carbon transition, the unit cost (cost per kWh) of all forms of energy carriers consumed, including electricity, hydrogen, electrofuels, heat and cooling should be *cheaper* both in comparison to: a) prior fossils-based market models; and, b) relative to all other low carbon alternative market models (such as ~100% renewables). In the case that energy costs resulting from the low carbon transition model are significantly higher, it will be exceedingly challenging for low carbon (net zero) transitions to occur on time.

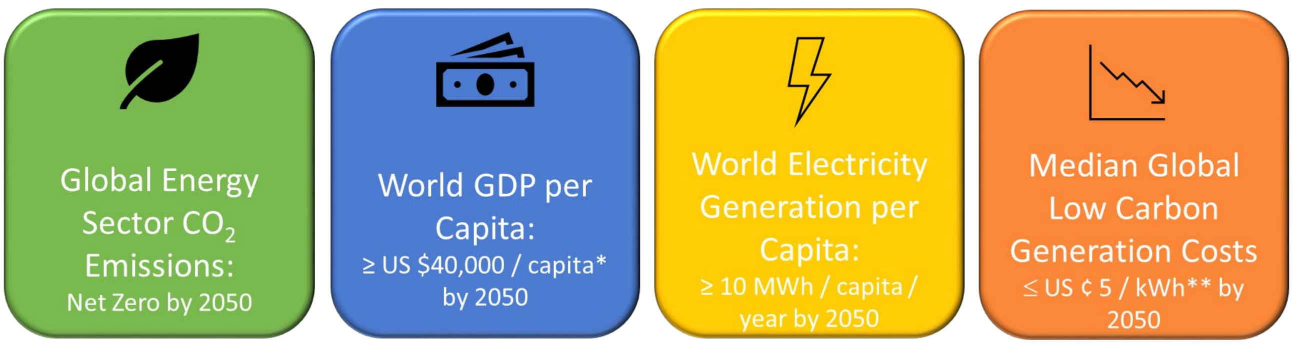
[92] Reference: [50]

increasing GDP per capita) and deflating the energy intensity of growth (decreasing energy consumption per unit of GDP) is expected to result in overall growth in energy demand per capita.

We must also remain mindful that approximately 13% of the world's population currently does not have access to electricity[93]. IBNI as an inclusive organization will also set specific goals and targets to ensure that special focus and assistance is provided to its developing country IBNI Member States that have low electrification rates, so that all people in the world who want access to affordable electricity, have access well prior to 2050.

In terms of some of the specific metrics for the sustainable development goals that IBNI should target, it is proposed that these specific measurable global sustainability goals should be the following:

FIGURE 47 - 2050 IBNI GLOBAL EMISSIONS AND SUSTAINABLE ECONOMIC DEVELOPMENT GOALS



*Source: IBNI-IO SAG Modeled Scenarios. * GDP/Capita reflective of 2019 "Purchasing Power Parity" as published by OECD. ** In 2020 values, inclusive of incremental systems costs related to type of energy generation mix. Includes targeted reductions in capital (overnight costs) for all low carbon technologies and cost of capital and other life-cycle generation costs (see Section 8.2).*

8.2 Proposed IBNI 2050 Global Nuclear Energy Targets and Goals

IBNI's above targets and goals related to global emissions reductions and sustainable development are inextricably linked to its goals and targets for expanding global nuclear capacities. From an IBNI perspective, the stimulation of a swift expansion of worldwide nuclear capacities (driven by near-term decisions by IBNI Member States), increasing nuclear shares of generation and the driving down capital costs of nuclear projects will be amongst the primary mechanisms for which the Bank will use to achieve the preceding emissions and sustainable development goals.

While there are some factors, such as demographics (global population growth or decline) that may not be directly impacted by the energy sector, other factors such as global economic development (GDP per capita) are viewed to be highly correlated with the energy sector. IBNI's programs will be designed to provide all its

[93] Source: [51]

Member State nations ranging from developing countries to highly developed countries with uniform access to the most affordable, reliable, clean and safe energy has a direct impact on each Member State's ability to sustain economic development, improvement of living standards for all and poverty reduction.

Expanding electrification, both in the developing world and intensive electrification globally, taken together with global advances in energy efficiency and energy conservation (behavior changes) will likely continue to contribute to a "de-coupling" of total final energy consumption per unit of GDP and per capita. While both world population and world GDP are projected to continue to grow, net energy demand per capita and per unit of GDP will likely continue to decrease. For example, OECD IEA/NEA has projected a total decrease in total world energy final consumption from 412 EJ/a (114.4 PWh/a) in 2020 to 344 EJ/a (95.6 PWh/a) in 2050 (an annualized -0.6% CAGR decrease). At the same time, both world population and GDP are projected to grow from 7.8 billion people and US $ 134.7 trillion in 2020 to 9.7 billion people and US $ 316.4 trillion in 2050 (annualized 0.7% CAGR growth in world population and 3.1% CAGR growth in GDP)[94].

The preceding forecasts indicate that final energy consumption per capita is projected to decrease from 14.8 MWh/capita in 2020 and 9.8 MWh/a in 2050 (an annualized -1.35% CAGR decrease) and final energy consumption per unit of GDP would decrease from 891.8 watts/US $ 1 of GDP in 2020 to 519.5 watts/US $1 of GDP in 2050 (an annualized -1.79% CAGR decrease).

Materialization of the above trends are positive, as the projections are indicative that world is projected to sustain robust and continued economic growth over the next 30 years, while generating that economic output more efficiently (e.g. with less energy and other resources per unit of output).

While overall world energy demand is expected to decrease over this time period, the transition to a global low carbon economy will entail a complete transition away from fossil fuels - not only in the power generation sector, but also for industry and transport sectors and in the built environment. Extensive electrification will serve as a practical replacement for much of the fossil fuels currently being consumed in industry, transport and buildings. Low carbon thermal generators such as nuclear, biomass, geothermal and CSP, which in some cases, can be located close to industrial and population centers may also be used to provide co-generated heat, cooling and desalinated water for industrial and/or residential consumption. In some circumstances, such as certain industrial and transport applications where direct electrification may be technically or commercially unfeasible, hydrogen and other electrofuels generated from low carbon sources may be utilized as well. All other residual GHG emissions from industry and transport, together with net GHG emissions from agriculture, forestry and land use (AFLU) and all other sources of GHG emissions will need to be either sequestered (through CCUS technologies) or offset by carbon sinks.

Figure 48 below illustrates a potential nuclear-oriented low-carbon economic system that IBNI would support.

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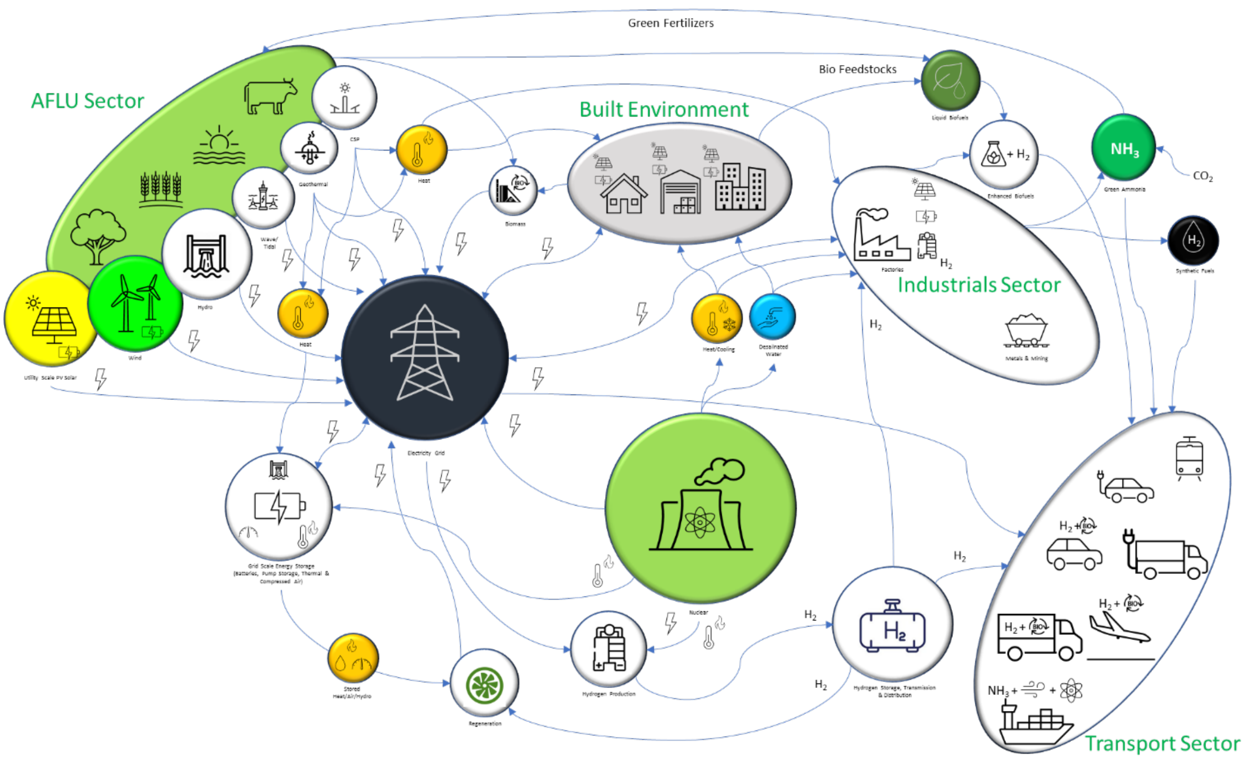
[94] Source: [6] – Table A.2, pg. 196 and Tables A.5, pg. 200. Note GDP is stated in terms of 2019 "Purchase Price Parity".

FIGURE 48 – ILLUSTRATIVE NUCLEAR-BASED FUTURE LOW CARBON ENERGY SYSTEMS ENDORSED BY IBNI



The future low carbon world will require the production of much more electricity, hydrogen, electrofuels, heat and cooling energy. Additionally, markets that choose to significantly scale up VRE generation will generally require increasing amounts of energy storage infrastructure (which may be stored in the form of hydrogen, electrofuels or using long-duration utility scale batteries, or in some cases pumped storage or as heat or compressed air[95]) if residual electricity demand cannot be otherwise provided by system reserves from dispatchable low-carbon generators (such as nuclear, hydros, geothermal and biomass) or from interconnections.

All of the foregoing suggests that despite the projected decreasing trend in total end-user energy demand, there will very likely be a significant increase in demand for low carbon electricity generation (which aldo includes electricity demand used to generate hydrogen and electrofuels) over the next 30 years. OECD IEA/NEA NZE 2050 has projected a more than doubling in global end-user electricity demand from 22.5 PWh/a in 2020 to 46.9 PW/a in 2050 (an annualized 2.5% CAGR growth rate). However, the same referenced NZE scenario shows a near tripling of global electricity generation from 26.8 PWh/a in 2020 to 71.2 PWh/a in 2050 (an annualized increase of 3.3% CAGR)[96]. It should be noted that the same referenced NZE scenario

[95] It should be noted that many of these emerging storage technologies are in various states of development and many are not yet commercially proven.
[96] Source: [6] – Table A.2, pg. 196 and Table A.3, pg. 198

assumes a 70% VRE and 8% nuclear energy mix by 2050. A critical observation is that by 2050, global electricity generation (at 71.2 PWh/a) is projected to be 1.5x the 2050 projected end-user electricity demand (46.9 PWh/a), whereas in 2020 (where global VRE share was 9.1%) this ratio was 1.2x.

In low carbon future generation scenarios, an increasing amount of electricity generation is expected to be needed for the production of hydrogen and electrofuels such as ammonia, synthetic liquid fuels and enhanced biofuels. Each of these fuels require energy conversion processes that are energy-intensive and result in energy losses through their conversion processes. All of these energy carriers can also be used for energy storage (stored or transported and then combusted or applied to hydrogen fuel cells to produce electricity). However, the "round-trip" process of re-generating electricity from these carriers results in further energy losses[97].

Given the preceding, what is the role of nuclear energy and for IBNI? IBNI will support Member States with nuclear generation tools and related solutions that will make each nation's low carbon future system most affordable, practical and sustainable. Specifically, IBNI-enabled nuclear energy solutions will offer Member States following tangible benefits:

- Scaling up nuclear generation and limited VRE penetration rates will be translated into the following:
    - Minimization of end-user energy costs associated with decarbonization program[98]
    - Substantial reductions in land, coastal areas and materials consumption[99]
    - Substantial reductions in required electricity grid and energy storage investment costs
    - Substantial reductions in required hydrogen and electrofuels production, transportation and storage costs[100]
- Nuclear power plants can also be used to co-generate heat and cooling energy and to produce desalinated water (where applicable)
    - "The UN predicts that 68% of the world's population will live in cities in 2050. Nuclear power occupies a very small footprint of land and can supply large urban areas and megacities with electricity and heating and cooling [and desalinated water and hydrogen]."[101]

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[97] Source: [20] – Pg. 56: *"The electricity-to-hydrogen conversion efficiencies are typically less than 70%, implying a round-trip efficiency of less than 50%."* From the perspective of round-trip efficiency, other commercially proven and emerging energy storage technologies may offer much greater "round-trip" efficiencies, including pumped storage, emerging advance battery storage (long-term, grid scale), heat storage, compressed air storage. These storage technologies may offer "round-trip" efficiencies ranging from 40% - 95%. Sources: [20] & [52].

[98] See Section 3.1.

[99] Source: [31] – Figure 22, Slide 18. On average, nuclear energy consumes almost 6 times less land than wind energy and almost 4 times less than solar.

[100] Nuclear energy is extremely energy dense in comparison to most renewables technologies, and in general can be located near major demand centers. This implies that large-scale hydrogen and electrofuels production facilities can be located near or adjacent to nuclear generation facilities and industrial consumers, improving cost efficiencies. Nuclear energy is also dispatchable technology, which results in less production of hydrogen used to fuel electricity production.

[101] Source: [44] – Pg. 53.

- Development of nuclear energy programs, nuclear industries and localized supply chains offer nations' with both a near-term and a long-term economic development benefit.
  - Construction and operation of nuclear power plants provides many direct near-term and long-term direct employment opportunities.
  - Indirectly, many other sectors of the economy will benefit over the long-term: employment, tax revenue, innovation, etc.

Taking into consideration the fundamental arguments for many of the nations of the world to take the near-term decisions to include a significant nuclear energy component in their low carbon futures, the follow are specific measurable global nuclear expansionary targets and goals that IBNI could establish. The shareholding structure will allow IBNI to provide up to approximately US $ 1 trillion in direct support for nuclear projects which is expected to catalyze global financial market investment and lending activities in the nuclear sector in total nuclear capital investments of potentially US $ 13 trillion or more over the next 30-years. Using existing and proven multilateral IFI models, all of this can be achieved with a collective shareholder initial capital investment of US $ 50 billion[102] or which US $ 25 billion (50%) would need to be paid-in, collectively amongst 50+ initial member shareholder countries.

[102] Based on IBNI-IO SAG's analysis of high world electricity demand growth and high world nuclear penetration growth rates until 2050, IBNI's total capital requirements would likely need to be periodically increased (in order to establish sufficient capitalization and liquidity ratios and therefore 'AAA' category credit ratings) up to approximately US $ 300 billion in about 15 years. Subsequent capital increases could most likely be done with reduced increases in the paid-in capital requirements (SAG has assumed the paid-in ration could be decreased to 25% after year 15, which corresponds to US $ 75 billion in paid-in capital). This is all based on many assumptions, including payment performance, recycling of assets. Many stress tests will need to be considered when the credit ratings are analyzed in discussions with the rating agencies. Rating agency views on the specific credit risks of IBNI will drive the actual conclusions and therefore these projected figures should be regarded as "preliminary and indicative" until further discussions with the rating agencies can occur.

Figure 49 - IBNI Global Nuclear Sector Performance Goals

*Source: IBNI-IO SAG analysis. * While approximately 2/3's of today's nuclear fleet are 30 years and older, which presents an immediate need to establish conditions necessary to extend the lives of these reactors, the reactors that are 20 years old today or older today may also need to be addressed over the next 3 decades (by 2050). ** Stated in terms of 2021 values. Includes IBNI induced cost decreases in overnight costs (expected based on scale up of global repetitive demand for NOAK designs, commercially available reactor technologies, reactivated supply chains, streamlined permitting and licensing procedures and numerous other factors) decreased costs of capital and life-cycle costs.*

8.3 Proposed IBNI 2050 Key Financial Metrics Targets and Goals

IBNI will incorporate both financial management and ESG principles "from the ground up" within its structure, which will ensure that it will enable it to achieve both the highest possible credit and highest ESG ratings. IBNI also will benefit significantly by being "at a much higher point on the learning curve" in comparison to the entry points of other prior IFIs.

It will be essential for IBNI to establish and maintain 'AAA' category ratings and achieve the highest possible ESG ratings. This will ensure that IBNI will have access to the lowest cost of capital and it will also establish the ubiquitous "risk free" benchmark for the entire nuclear sector. The benefit of IBNI in attaining the lowest possible cost of capital, which will be passed along to the benefit of its members, will be an essential part of all its programs and its core mission.

IBNI will aim to establish a global industry benchmark not unlike the model that has been already established by the International Development and Reconstruction Bank (IBRD) for the MDBs. Above all, IBNI will be well positioned to lead the nuclear sector on the ESG front and will be the leading force driving global capital investment and lending into the nuclear space. It is instructive to note, with respect to IBRD's role in leading sustainable financing, S&P wrote the following.

"IBRD plays a key role in powering the ESG market globally. It acts as a knowledge broker, outlining best-in-class frameworks and guidelines, compiling key sustainable policy indicators that it tracks globally, and offering ESG-related statistical platforms. Its creditworthiness also depends on delivering its mandate by improving environmental outcomes, notably through climate action, and supporting human and economic development. IBRD pioneered the global green bond market in 2008. It helped develop and expand the global sustainable bond market by connecting many of its issuances to raise awareness for the various 2030 U.N. Sustainable Development Goals (SDGs)…"[103]

It is expected that IBNI will be a frequent bond issuer across many capital markets globally and will be highly diversified in terms of currency and market access risk exposures.

The following table summarizes the existing peer major multilateral IFI/MDB community and their associated credit rating profiles.

TABLE 9 - SUMMARY OF COMPARATIVE CREDIT RATING PROFILES OF EXISTING PEER MAJOR MULTILATERAL IFIS

IFI	LT Ratings[a]	RAC Ratio (%)[b]	Liquidity Coverage Ratios (with Planned Disbursements)[c] 6-months	12-months	12-months + 50% UDL[d]	Funding Ratio (%)[e]	Enterprise Risk Profile[f]	Policy Importance[f]	Governance & Management[f]	Financial Risk Profile[f]	Capital Adequacy[f]	Funding & Liquidity[f]
AfDB	AAA/Aaa/AAA	18.9%	2.0x	1.5x	1.2x	72.3%	Very Strong	Very Strong	Adequate	Very Strong	Very Strong	Strong
ADB	AAA/Aaa/AAA	37.4%	1.7x	1.3x	0.9x	47.4%	Extremely Strong	Very Strong	Adequate	Extremely Strong	Extremely Strong	Strong
AIIB	AAA/Aaa/AAA	160.5%	15.1x	10.3x	6.9x	11.7%	Very Strong	Very Strong	Adequate	Extremely Strong	Extremely Strong	Strong
EBRD	AAA/Aaa/AAA	30.3%	1.4x	1.2x	1.2x	67.2%	Very Strong	Strong	Strong	Extremely Strong	Extremely Strong	Strong
EIB	AAA/Aaa/AAA	21.0%	1.3x	1.1x	1.0x	81.2%	Extremely Strong	Very Strong	Strong	Extremely Strong	Very Strong	Very Strong
IADB	AAA/Aaa/AAA	21.9%	2.3x	1.4x	1.2x	71.2%	Extremely Strong	Very Strong	Strong	Very Strong	Strong	Strong
IBRD	AAA/Aaa/AAA	24.3%	2.0x	1.1x	1.0x	82.0%	Extremely Strong	Very Strong	Strong	Extremely Strong	Extremely Strong	Strong

Sources: [48] & [49] and IFI and rating agency websites. Notes: (a) Long-term unsecured credit ratings from S&P/Moody's/Fitch, respectively. (b) Risk Adjusted Capital Ratios (RAC) from 2019 or 2020 (source S&P); (c) Liquidity coverage ratios (including derivatives payable) is the measure of the IFI's liquid assets relative to their planned distributions over the subsequent 6-month or 12-month period. (data from S&P. Representing 2019 or 2020). (d) Liquidity coverage ratio includes planned distributions for the subsequent 12-month period + 50% of the outstanding undistributed loans (UDL) (data from S&P. Representing 2019 or 2020). (e) Funding ratio represents the ratio of gross debt to adjusted total assets (data from S&P. Representing 2019 or 2020). (f) Source S&P. Representing 2019 or 2020 rating views.

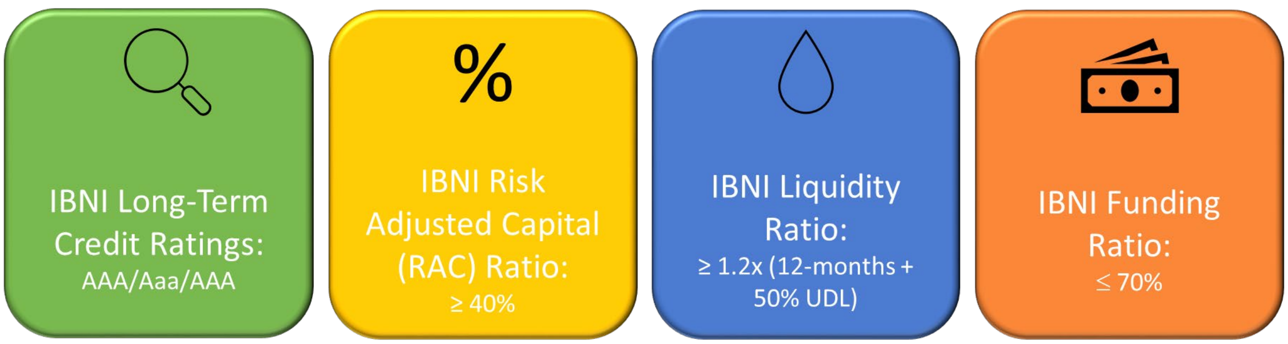
As set forth in Section 6, it is recommended that IBNI would be initially be established by a coalition of no fewer than 50 nations (IBNI Member State shareholder members) with a total capital amount of US $ 50 billion, of which 50% (US $ 25 billion) would be paid-in capital and 50% (US $ 25 billion) would be callable capital. Based on scenario analysis conducted by IBNI-IO SAG, this initial capitalization structure should be

[103] Source: [48]

sufficient to maintain the program under any reasonable demand scenario. Furthermore, the proposed shareholder composition will be both large diversified and include shareholder members who are also beneficiaries of the programs. The proposed shareholder and management structure is therefore in line with peer rating review that have received "very strong" and "extremely strong" credit views by S&P.

IBNI will aim to achieve a "best in class" financial and credit profile amongst its peer multilateral IFIs. The following is a summary of the measurable financial metrics that IBNI should strive to achieve and maintain.

Figure 50 - IBNI Financial Metrics Targets



Source: IBNI-IO SAG analysis.

9. IBNI Action Plan and Time Frame

Key Points

- There is a concrete and actionable plan in place for establishing IBNI within a defined time period.
- It is essential that IBNI be established as quickly as possible – the target date is early 2023.
- IBNI – Implementation Organization (IBNI-IO) is targeted for January 2022.
    - IBNI-IO will support the international, broad based coalition building exercise necessary for the establishment of IBNI.
    - IBNI-IO will serve as an advisory body to the coalition of nations participating in the establishment of IBNI.

The establishment of IBNI is an urgent matter and it deserves a concrete and actionable plan. IBNI will need to be established by a large coalition of nation states who join together as founders of IBNI under a common set of principle and the view that IBNI is necessary in order to achieve global net zero no later than 2050.

While the coalition of states will become the member shareholders (owners) in IBNI, the monumental task of bringing this coalition together under common principals and visions will entail assembling a much broader universe of global stakeholders from the public and private sectors. The universe will involve a coalition of supportive stakeholders from the NGO and philanthropic communities (particularly organizations supporting climate initiatives, just transition, sustainable development and clean energy), the global financial markets, the global nuclear industry, intergovernmental organizations (such as the United Nations, IAEA, OECD IEA/NEA, IFNEC, etc.) and individual governments.

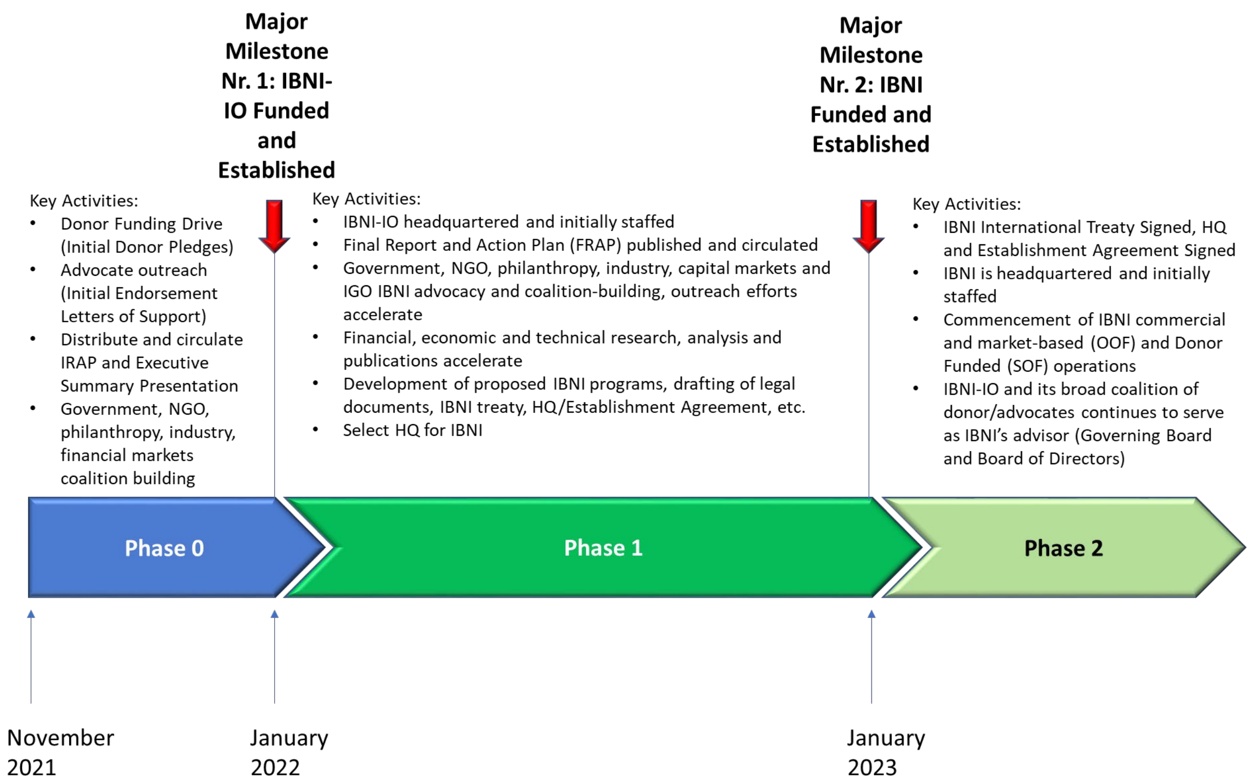
The world does not have a moment to spare in taking actions to achieve net zero by 2050, and therefore there is no time to spare with respect to the IBNI initiative. In view of this urgency the SAG has established an aggressive, but achievable Action Plan and Time Frame.

Essentially there are two steps. The first is to establish a not-for-profit advisory and implementation organization, called the “International Bank for Nuclear Infrastructure – Implementation Organization” or “IBNI-IO”. It is intended that IBNI-IO will be established at the beginning of 2022 and will be funded mainly by private sector donors. The details of IBNI-IO’s mission and objectives are described below in Section 9.1.

The second step will be for the coalition of nations to establish IBNI in early 2023. IBNI will then become operational and immediately focus on its core mission of supporting its shareholder members in developing, expanding and scaling up nuclear programs in the countries in effort to achieve their net zero commitments by 2050 in an economically sustainable manner.

The diagram below (in Figure 49) details the proposed phases required to establish IBNI within the targeted early-2023 timeframe.

FIGURE 51 - PROPOSED IBNI ESTABLISHMENT TIMELINE



Source: IBNI-IO SAG

Please bear in mind that the IBNI implantation time frame represents an aggressive agenda. In the interest of achieving global net zero by 2050, there is not a minute to spare. Initial donor funding and endorsements of IBNI-IO will be critical for achieving the establishment of IBNI by early 2023.

9.1 IBNI Implementation Organization (IBNI-IO) Action Plan

As mentioned above, the first critical step in advancing the IBNI agenda will be to establish the non-profit organization IBNI-IO. IBNI-IO will be established and maintained as a "non-governmental organization" (NGO), where its sole focus and mission will be to advise and guide a willing coalition of nations (drawn from member states of the IAEA) on the near-term best-practices and optimal establishment, start-up and efficient operations of IBNI as a new multilateral IFI. The IBNI-IO "Strategic Advisory Group" or IBNI-IO SAG is comprised of an international group of experts who have authored this report (the IRAP) and are currently undertaking the initiative of assembling group of donors and advocates from a broad international universe of public and private sector stakeholders, representing the NGO and philanthropic communities, the financial markets, the nuclear industry, intergovernmental organizations and individual governments.

SAG is currently requesting both letters of support and advocacy as well as donor pledges from the above targeted communities of potentially interested parties.

As mentioned above, it is intended that the non-profit IBNI-IO will be established, funded (by donors) and staffed by early 2022. The headquarters of IBNI-IO has not been ascertained at this time, but it is expected to coincide with the coalition of nations' decision as to the location where IBNI will be headquartered. If the decision as to the location where IBNI will be headquartered cannot be ascertained by the end of 2022, then a decision will be made as to where the interim headquarters of IBNI-IO will be located, respecting the consensus of the wishes of IBNI-IO donors. In any case, it is expected that IBNI-IO will maintain registered charitable entity establishments under the laws of the United States (such as a US Section 501(c)(3) organization) and similar not-for-profit entity designations in other countries so that donors from numerous world locations will be able to donate to IBNI-IO on a tax-deductible basis.

In addition to the initial task of "coalition building" and public advocacy, information and outreach campaigns, IBNI-IO's professional staff and resources will also assist the coalition of nations in developing drafting all constituting agreements (international treaty, HQ and establishment agreements, operational agreements, program and policy documents, etc.) utilizing global "best practices" for multilateral IFIs.

IBNI-IO SAG has developed the initial "mission statement" of IBNI-IO as follows:

- Build a strong international coalition of nations (IAEA member states), supported by a broad and deep multi-constituent global advocacy and support network for the establishment of the new International Bank for Nuclear Infrastructure (IBNI), which will support a significant and rapid global expansion of clean, reliable, safe and affordable nuclear energy in order to achieve the twin goals of 2050 global net zero and sustainable global economic development.
- Based on a rigorous and confirmatory fact-based campaign, demonstrate that the twin goals of 2050 global climate neutrality and global prosperity cannot be otherwise achieved without a significant global expansion of nuclear energy capacities facilitated by IBNI.
- Demonstrate that IBNI is necessary in order to achieve a significant expansion in global nuclear capacities, at a scale necessary, to achieve 2050 net zero. The financing of such a large scale and rapid investment in global nuclear infrastructure and technologies will not be achieved without IBNI.
- Demonstrate that the IBNI plan is feasible, achievable and affordable and the time to act is now. Establishing IBNI by early 2023 is within our reach!

After IBNI is established (targeted early-2023), IBNI-IO will remain and act as a non-voting advisory body to IBNI. IBNI-IO will represent the interests of its broad donor and advocacy base, including other NGO's, philanthropic foundations, nuclear industry, financial markets organizations and IGOs.

9.2 IBNI Action Plan

As mentioned above, it is envisaged that IBNI will be established as a multilateral IFI by early 2023 and commence its operations thereafter. Based on precedence, it is expected that IBNI will be established through international treaty, which will be ratified and signed by the founding member nations. The coalition of founding member states will need to mutually decide on a world headquarter location for IBNI. A long-term "headquarters and establishment agreement" would then be signed between IBNI and the host nation which will provide all terms and conditions with respect to the hosting arrangements.

SAG recommends that initial coalition of nations founding IBNI include no fewer than fifty (50)[104] nations The founding member states will need to contribute their individual paid-in share capital and their callable capital pledges on or around the time that IBNI is founded. It is envisaged that the total initial paid-in capital shareholding subscription will be US $25 billion with an additional total US $ 25 billion in callable capital subscriptions. The shareholders will mutually agree on methodologies for allocation of the share subscriptions amongst the member shareholders, rules for the future adding of additional members and withdrawal of members and procedures for reallocation and future increases and decrease of shareholder capital and paid-in/callable ratios.

The decision as to where IBNI will be headquartered is often based on competing offers from various potential host countries who are vying for the IFI's HQ decision. IBNI's HQ decision will have many dimensions and should be agreed as objectively as possible. In most cases countries who are competing for IBNI to be headquartered in their cities will provide strong "incentive packages" for the HQ decision in their country. These incentives typically involve such elements and tax benefits (for the organization and personnel), facilities provisions, streamlined expatriation policies, subsidies and other elements.

Incentive policies will be just one element for the founding nations to consider. Others elements will be the wishes of the largest initial contributing shareholder members, potential co-location with other IGO's (such as UN, IAEA, OECD IEA/NEA, etc.), access to major world financial and political centers. Decision may also be made as to whether all of IBNI's operations should be maintained in one location or perhaps there should be one or more regional/satellite offices. Most IFI's have at least regional operational offices and usually representational offices in all of their member countries. It is envisaged that IBNI would likely follow similar models.

As mentioned above in Section 9.1, given that IBNI-IO is expected to remain in an advisory capacity to IBNI, once the Bank is established, IBNI-IO would expect to co-locate its headquarters along-side of IBNI HQ

[104] Note, IAEA currently has 173 members. A broad and diverse membership base consisting of nations with a wide range of geographic, income and developmental status, having active participation in IBNI's programs will be viewed as a positive credit fundamental. Too few and too narrow a membership concentration is a negative credit fundamental.

location. However, IBNI-IO may initially select an interim location if the IBNI HQ decision cannot be made immediately (by early 2023).

Abbreviations and Acronyms

Abbreviation/Acronym	**Definition**
/a	per annum (per year)
ADB	Asian Development Bank
AfDB	African Development Bank
AFLU	Agriculture, forestry and land use
AIIB	Asian Infrastructure Investment Bank
AR	Advanced Reactor
b	1 billion (1×10^9)
BECC	Biological Energy Carbon Capture technologies
BoD	Board of Directors
BPI France	Banque publique d'investissement (French ECA)
BTU	British Thermal Unit
BWR	Boiling Water Reactor
CAGR	Compounded annual growth rate
CCGT	Combined Cycle Gas Turbine
CCUS	Carbon capture, utilization and storage
CEO	Chief Executive Officer
CGN	China General Nuclear Power Corporation (Chinese SOE)
CMAS	Capital Markets Advisory Services (IBNI OOF)
CO_2	Carbon Dioxide (a Greenhouse Gas)
CO_2-equiv.	Carbon Dioxide equivalents (Greenhouse Gases)
COP26	26th Conference of the Parties (COP26) of the UNFCCC
CYF	Current Year Funds
DG	Director General
DGR	Deep geological repository
DGS	Deep geological storage
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECA	Export Credit Agency
EDF	Électricité de France (French state-owned utility)
EGAI	Event of Government Action or Inaction
EHS	Environmental, Health and Safety
EIB	European Investment Bank
EJ	Exajoule equals 1 quintillion (1×10^{18}) joules
ENEC	Emirates Nuclear Energy Corporation (UAE state-owned Utility)
EP IV	Equator Principles 4th Update
ESG	Environmental, Social and Governance metrics
ESMS	Environmental & Social Management Systems
EU	European Union
EUR	Eurozone Currency Unit
Ex-Im	Export-Import Bank
FRAP	Final Report and Action Plan (IBNI)
G2G	Government-to-Government (agreement)
g	1 gram (equals 1000 milligrams)

Abbreviation/Acronym	Definition
GCFR	Gas Cooled Fast Reactor
GCR	Gas Cooled Reactor
GDP	Gross Domestic Product
GHG	Greenhouse Gas (all CO_2-equivalents)
GIIP	Good International Industry Practices
GJ	Gigajoule equals 1 billion (1 x 10^9) joules
GNP	Gross National Product
Gt	Gigatonne equals 1 billion (1 x 10^9) metric tonnes
GW_e	Gigawatt of electrical generation capacity (1 x 10^9) watts
GWh	Gigawatt hour equals 1 billion (1 x 10^9) watt hours
ha	1 hectare (1 x 10^4 square meters)
HTGR	High Temperature Gas Reactor
HQ	Headquarters
IBNI	International Bank for Nuclear Infrastructure
IBNI-IO	International Bank for Nuclear Infrastructure – Implementation Organization
IBNI-IO SAG or SAG	Strategic Advisory Group of IBNI-IO
IBNI OOF or OOF	the Ordinary Operations Fund (market-based activities) of IBNI
IBNI SOF or SOF	the Special Operations Fund (donor funded activities) of IBNI
IBRD	International Bank for Reconstruction and Development (member WBG)
ICMA	International Capital Markets Association
IDB or IADB	Inter-American Development Bank
IEA	International Energy Agency (organized under OECD)
IFC	International Finance Corporation (member WBG)
IFI	International Financing Institution
IGO	Intergovernmental organization
INIR	Integrated Nuclear Infrastructure Review program (IAEA)
IOU	Investor-owned utility
IPCC	Intergovernmental Panel on Climate Change (UN)
IPO	Initial Public Offering
IR	Ionizing Radiation
JRC	Joint Research Center (of the EC)
JV	Joint Venure
KEPCO	Korea Electric Power Corporation (S. Korean state-owned electric utility)
KEXIM	Korean Export-Import Bank (ECA)
KHNP	Korea Hydroelectric and Nuclear Power Corporation (subsidiary of KEPCO)
kJ	Kilojoule equals 1 thousand 1 (1 x 10^3) joules
kW_e	Kilowatt of electrical generation capacity (1 x 10^3) watts
kWh	Kilowatt hour equals 1 thousand (1 x 10^3) watt hours
LCFR	Lead Cooled Fast Reactor
LCO	Least-cost option
LCOE	Levelized cost of electricity
LTO	Long-term operations (related to the life extension of nuclear reactors)
LRF	Loss Reserve Fund
MDB	Multilateral Development Bank
mg	1 milligram
MIGA	Multilateral Investment Guarantee Agency (member WBG)
MJ	Megajoule equals 1 million (1 x 10^6) joules

Abbreviation/Acronym	Definition
mm	1 million (1 x 10^6)
mmBTU	1 million (1 x 10^6) BTUs
MW_e	Kilowatt of electrical generation capacity (1 x 10^6) watts
MWh	Megawatt hour equals 1 trillion (1 x 10^6) watt hours
NDB	National Development Bank
NEA	Nuclear Energy Agency (organized under OECD)
NO_X	Nitrous oxides
NPP	Nuclear power plant
NPT	1968 Treaty on Non-Proliferation of Nuclear Weapons
MSR	Molten Salt Reactor
NuclearCo	Nuclear generation or other special purpose company
NZAMI	Net Zero Asset Managers Initiative (UN convened)
NZAOA	Net Zero Asset Owners Alliance (UN convened)
NZBA	Net Zero Banking Alliance (UN convened)
NZCAFA	Net Zero Cooperation and Framework Agreement (proposed long-term contractual agreements established between IBNI and IBNI Member States receiving IBNI financing and support)
NZE or NZE 2050	Net Zero Emissions Scenario of the IEA's Net Zero by 2050 A Roadmap for the Global Energy Sector (2021)
NZIA	Net Zero Insurance Alliance (UN convened)
O_3	Ozone
OECD	Organization of Economic Cooperation and Development
PC	Pulverized Coal
PJ	Petajoule equals 1 quadrillion (1 x 10^{15}) joules
PM_{10}	Particulate matter (10 micrometers and smaller)
$PM_{2.5}$	Fine particulate matter (2.5 micrometers and smaller)
PPP	Public-Private Partnership
PV	Photovoltaic (solar generation technology)
PWh	Petawatt hour equals 1 quadrillion (1 x 10^{15}) watt hours
PWR	Pressurized water reactor
RAC	Risk Adjusted Capital
S&C or IBNI S&C	IBNI's Standards & Criteria
S&P	Standard and Poor's
SASB	Sustainability Accounting Standards Board
SEK	AB Svensk Exportkredit (Swedish ECA)
SC	Supercritical (steam parameters)
SCFR	Sodium Cooled Fast Reactor
SCWCR	Supercritical Water Cooled Reactor
SDG	Sustainable Development Goal
SIB	Social Impact Bond
SMR	Small modular reactor
SO_2	Sulfur dioxide
SO_x	Sulfur oxides
SOE	State-owned enterprise
SPAC	Special Purpose Acquisition Company
SPV	Special purpose vehicle
SSA	Sovereign, Supranational and Agency (bond markets)

Abbreviation/Acronym	Definition
t	1 tonne, metric (equals 1,000 kilograms)
TAS	Transaction Advisory Services (IBNI OOF)
TCFD	Task Force on Climate-Related Financial Disclosures
tr	1 trillion (1 x 10^{12})
TJ	Terajoule equals 1 trillion (1 x 10^{12}) joules
TVO	Teollisuuden Voima Oy (Finnish Cooperative Utility NPP Owner-Operator)
TWh	Terawatt hour equals 1 trillion (1 x 10^{12}) watt hours
UDL	Undistributed loan
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US or USA	United States of America
US $ or USD	United States Dollar
USC	Ultra-supercritical (steam parameters)
USDFC	United States Development Finance Corporation (ECA)
USDOE	United States Department of Energy
USEXIM	United States Export-Import Bank (ECA)
VALCOE	Value-adjusted levelized cost of electricity
VAT	Value Added Tax
VE	Venture Equity (Capital)
VHTR	Very High Temperature Reactor
VRE	Variable Renewable Energy (solar, wind, wave, tidal and other non-dispatchable renewable energy generation technologies)
WBG	World Bank Group
WEF	World Economic Forum
YOE	Year of Expenditure

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