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NUCLEAR POWER IN A NEW ERA: FOUR ESSENTIAL POLICY PILLARS FOR ITS FUTURE

Kenneth Luongo



PARTNERSHIP *for*
GLOBAL SECURITY

LEADING THE WORLD TO A SAFER FUTURE

KENNETH N. LUONGO

Nuclear Power in a New Era: Four Essential Policy Pillars for its Future

“There is a strong case to be made for the societal value of nuclear power in the 21st century that is compelling and globally important.”

We are at a critical point in determining the future of nuclear power in the U.S. and abroad, and losing this moment of opportunity will be a serious mistake.

There is a strong case to be made for the societal value of nuclear power in the 21st century that is compelling and globally important. However, it is urgent and necessary to update the policy and economic context in which nuclear power can contribute to addressing this century’s growing list of challenges.

There is an integrated “four pillars” argument for nuclear power that needs to be made in a cogent and cohesive manner. The four pillars are:



- Supporting Decarbonization
- Strengthening Geopolitical Competitiveness
- Prioritizing Innovation and Technology
- Leading on Global Security and Governance

Developing this comprehensive policy context is something that government, philanthropies, the private sector, and nongovernmental organizations can and must collaborate on. But there are significant gaps in the existing institutional capacity to adequately address and fully unify these key issues.

This work cannot effectively be done by only one or two of these stakeholders. They all need to work in concert and need real resources to achieve success. That is going to require that we break some of the old rules, redefine comfort zones, eliminate obsolete demarcation lines, forge new partnerships, rethink funding models, and build new institutions.

There are clearly other important issues that are not listed in the four pillars. There is the need for clean energy standards at the state level rather than renewable energy standards. Power market imbalances that do not value zero carbon energy need to be addressed. We also must prepare the global playing field for small and advanced reactors, particularly in the developing world. And a much more effective and robust communications strategy is required to support this process.

If successful, the development and integration of these four pillars can create the cultural shift that is necessary to support nuclear power as a solution to 21st century problems, not a contributor to them.

This paper is based on remarks given on October 24, 2018, at the Atlantic Council Task Force on the Future of Nuclear Power, led by honorary co-chairs Senator Mike Crapo (R-ID) and Senator Sheldon Whitehouse (D-RI).

Supporting Decarbonization

According to a report in *Axios*², there is

\$500 trillion

OF WEALTH ON PLANET EARTH

\$230 trillion

IN LAND AND PROPERTY

\$200 trillion

IN DEBT

\$70 trillion

IN EQUITY

The rationale for nuclear power's role in decarbonization is clear in the reports from the Intergovernmental Panel on Climate Change (IPCC), in the decisions in the U.S. at the state level to maintain nuclear plant operations as a means of meeting carbon reduction goals, and more recently in the determination of key corporations¹ and non-governmental organizations that maintaining nuclear power's zero carbon contribution is essential to meeting climate objectives.

Let's take a step back and consider the macro stakes that we are facing if we fail at curbing carbon.

This is the starting point: According to a report in *Axios*, there is \$500 trillion of wealth on planet earth – \$230 trillion in land and property, \$200 trillion in debt and \$70 trillion in equity.² Credit Suisse's 2018 Global Wealth Report states that aggregate global wealth rose by \$14 trillion in the last 12 months and there has been an unbroken run of growth in total wealth and wealth per adult since 2008.³

The IPCC puts the global damage cost of a 1.5°C increase at \$54 trillion. A rise to 2.0°C is estimated at \$69 trillion. And a temperature increase of 3.7°C essentially wipes out all wealth on earth at \$551 trillion.⁴

The recent U.S. climate assessment from 13 federal agencies underscores the economic risk quite starkly, claiming that climate change could wipe out ten percent of the US economy by the end of the century.⁵ In 2017 extreme weather events in the U.S. caused over \$300 billion of damage.⁶ According to Allstate Insurance, a once in 500-year storm hit 26 times in the last decade.⁷

These are sobering statistics. So, when someone says, "well, the temperature has fluctuated in the past and it will again" we need to think about what that really means.

The earth's climate has been stable for about 7,000 years. By 2050 we are looking at a global population of close to 10 billion and rising energy demand in the developing world that must be met with clean technologies.

By comparison, at the end of the last ice age in 10,000 BC – a major climate event – the world population is estimated to have been between 1-10 million. I doubt that they calculated their global wealth back then. But we now have hundreds of trillions of dollars in wealth and billions of people who are going to be negatively impacted by the level of global temperature rise.

“The market needs to value carbon-free energy, not just the cheapest energy or renewable energy.”

That makes the “well, climate changes” argument a bit disingenuous. There is much more at stake than in previous eras of climate change.

It is equally disingenuous for the environmental community that professes to care about solving climate change to repeat the mantra that “renewables will save us.” Renewables will go a long way to helping us, but at the moment it is difficult to see how a large industrialized nation will be run off of them alone.

The world is 81% dependent on fossil fuels, a percentage that hasn’t changed in 30 years.⁸ The most recent analysis from the Global Carbon Project states that greenhouse gasses rose by 1.6% in 2017 and are expected to grow further, by another 2.7% in 2018. Even the exponential growth of renewables has not been able to overcome the world’s dependence on oil and gas.⁹

So far, only California has decided to rely 100% on zero-carbon energy in the future. It will be a major test case in the U.S., as the state is the equivalent of the 5th largest economy in the world, trailing just China, Japan and Germany. But California is running a significant risk of economic and social disruption if it turns to an all-renewables approach to meet that zero-carbon goal and fails.

The most recent IPCC report on climate change adds new urgency and energy to the discussion of nuclear power’s carbon reduction role, even as it raises questions about the social acceptance of an expansion of the technology. The report noted that “institutional” and “societal preference” limitations associated with nuclear power curtailed its ability to reach its full potential as a clean energy source. This is a societal value disconnect that can and must be overcome. We can’t afford to leave major carbon reduction contributions on the sidelines.

Germany and Japan are two examples where institutional and societal preferences have led to decisions to phase out nuclear power. This has led to increases in carbon emissions.

Germany is on track to spend \$580 billion to overhaul its energy system by 2025 but is likely to fall short of its greenhouse gas emissions target in 2020.¹⁰ The head of the government commission monitoring the energy transition said, “There was too much confidence that renewables would do the trick.”

In Japan, even though renewables have increased from 8.8% to 15%, the share of fossil fuels and carbon emissions are increasing. Nuclear power had accounted for 29% of Japan’s electricity generation from 48 nuclear plants, until that was reduced to just a few operating plants after Fukushima.

There does seem to be a growing recognition among global experts that nuclear energy can’t be sidelined as the world grapples with carbon emissions overload.

The MIT Energy Initiative on the Future of Nuclear Power lends urgency to the argument for nuclear in the clean energy mix. Its bottom-line finding was that nuclear power must be “meaningfully” incorporated into the array of low carbon energy technologies in order to meet the challenge of climate change, though it faces price and policy obstacles.¹¹

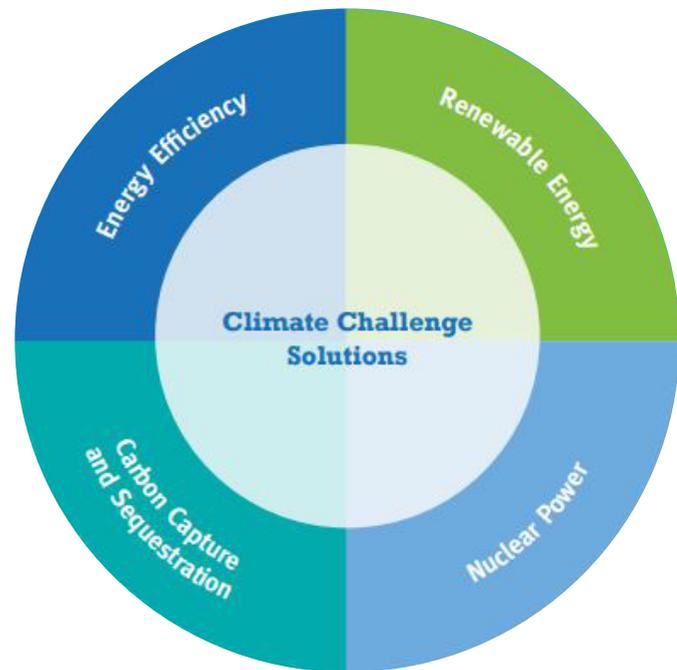
The Union of Concerned Scientists, no friend of nuclear power for decades, has endorsed maintaining the existing reactor fleet as necessary for achieving carbon reductions.¹²

RECOMMENDATIONS

- The market needs to value carbon-free energy, not just the cheapest energy or renewable energy. Clean energy standards instead of renewables standards are an important change in policy at the state level and should be reflected in national policy.
 - The global economic stakes of failure to limit the global temperature increase need to be made more real and vivid for the policymaking community. We have 10 billion people and \$500 trillion dollars of wealth at risk. That is a sobering and compelling rationale for action.
 - The MacArthur-Exelon breakthrough has to be built upon. It is an unprecedented opening for breaking through the old funding silos, rewriting the “renewables only” climate canon, and creating a “break-the-mold” coalition. This philanthropy-private sector partnership needs to be joined by governments and further expanded to other participants.
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The MacArthur Foundation’s President and Exelon’s CEO recently co-authored an op-ed entitled, “Time for Environmentalists and the Energy Industry to Work Together.” The authors agreed that “the use of safe and secure nuclear power that does not increase the risk of nuclear weapons proliferation” was one of four key steps to address climate change.¹³

MacArthur is one of the largest climate change and nuclear security philanthropies in the country. It has been a leader in supporting the groundbreaking nuclear-climate-security focused Global Nexus Initiative (GNI).¹⁴ It has taken real courage for them to publicly support nuclear power as a significant climate response. Other organizations and colleague philanthropies have been unwilling to take this step. If followed up, a collaboration between the philanthropic community and the private sector can help to change the culture, restructure collaborations, and open new funding options.



Strengthening Geopolitical Competitiveness

“A framework should be developed for a new alliance of nuclear power allies.”

The geopolitics of nuclear power is an issue that is rising in political importance but one that is still an underdeveloped consideration in the policy rationale for nuclear power. There is a lot at stake because the nuclear relationship is a century-long partnership, and its establishment attracts other business opportunities and offers political leverage.

The state-backed nuclear companies of Russia and China are completely integrated into the geopolitical ambitions and strategies of those countries. By contrast, we are asking U.S. and other western private sector companies to compete against this with their own resources. It is a severely tilted playing field.

Russia's Rosatom has established a presence in 44 countries and is building nuclear plants in a half dozen. Its build-own-operate incentives are very attractive to newcomer nuclear nations and very difficult for private sector companies to match – and they don't.

China is poised to become the Amazon.com of nuclear commerce in the 21st century, fueled by its own significant nuclear building program, which will make it the largest nuclear fleet operator by mid-century. It also has significant geopolitical ambitions as evidenced by its One Belt, One Road Initiative and a goal of dominating global advanced technology through its Made in China 2025 program.

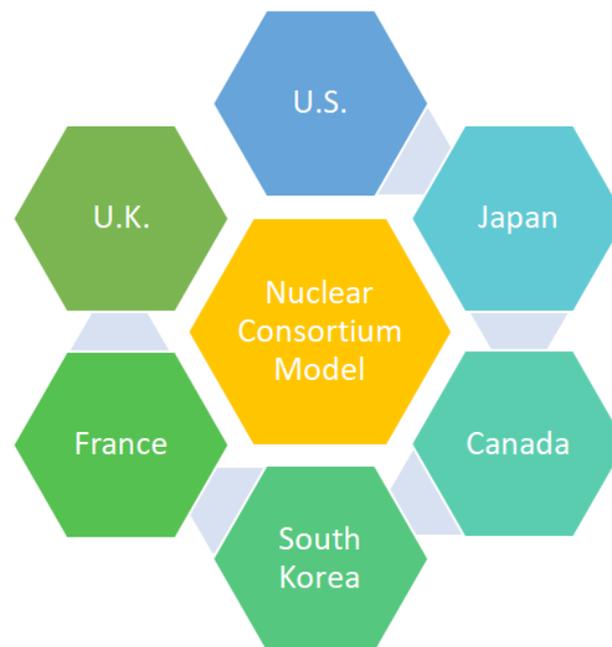
These are serious geopolitical challenges to the U.S. and its allies. The new U.S. International Development Finance Corporation (IDFC) is an important step forward in competing with the geopolitical influence of Russia and China in the developing world. It should have a special fund devoted to clean energy, including nuclear power as a signal to the international investment community that the U.S. considers nuclear energy a technology with a future.

We also need to think very hard about creating a new alliance of nuclear power partners particularly the U.S., Canada, Japan, South Korea, France, the U.K., and perhaps India. There is a mix of talents and capabilities that make this grouping a potentially potent alternative to nuclear supply from Russia and China.

The question to consider is whether we can afford to compete with our friends and compete with Russia and China at the same time and actually win. A consortium model may offer a much better and more realistic option.

RECOMMENDATIONS

- The U.S. and its allies have to think about how to collaborate rather than compete against one another in the global nuclear market and respond to the geopolitical challenge from Russia and China in a more unified and effective manner.
- A framework should be developed for a new alliance of nuclear power allies. This will be a difficult, complex process but a necessary one. One way to think about it is that some nations are better at the hardware of nuclear power – hot production and supply lines – and others are better at the software – design, governance, operations, regulation, and education. But this combination of attributes will be very attractive to nations seeking nuclear power.
- The U.S., in collaboration with its allies, should consider launching an international initiative that would modernize the Atoms for Peace concept and eliminate some of its existing downsides. It could: be a coalition of the willing/allies model; provide money for education and training at home and abroad to prepare the market and support operations; support the expansion of the IAEA's work with new-comer nuclear nations; include as a principle opposition to the use of fissile materials in civilian commerce; offer expanded outreach to the investment community to draw together private and public funding; develop a better model for small modular reactors (SMRs) and advanced reactor deployments including the development and international harmonization of new regulatory measures; and focus on the full range of positive contributions that nuclear power can make in the 21st century.
- The U.S. IDFC should have a special fund supporting clean energy with a focus on nuclear power.



Prioritizing Innovation and Technology

“What is especially needed is a strong signal to the investment community.”

RECOMMENDATIONS

- The U.S., in particular, needs to provide the policy signals to the investment community that there is still life in nuclear power outside the existing fleet in order to attract more private sector funding. The goal is to make clear that SMRs and advanced reactors are important and relevant to the future. Congress and the executive branch have to offer significantly more funding to support the full suite of requirements for the next generation of reactors.
- We need to down select some advanced technologies and drive them, their market, and the governance regime for them forward more aggressively. At present there are numerous advanced reactor designs and companies, but no breakthrough path forward. Government should not be the final arbiter, the market should be, but without clear incentives to the investment community, maintaining a scattershot approach for too long will dissipate momentum and focus.
- One criterion for the down selection should be the requirement of safeguards and security by design in the reactor. This is essential for their marketability and will avoid after-the-fact determinations about how to prevent proliferation or protect these reactors from terrorist and other security threats.

The race for next-generation reactors and markets and the integration of advanced technologies into these plants is the new frontier. In this area, the U.S. administration and Congress have taken the initiative, but there does not seem to be a consistent policy or strong market signal.

The signing into law of the Nuclear Energy Innovation Capabilities Act¹⁵ is a positive development, and there is other legislation being considered that would further support advanced reactor technology in the U.S. What is missing is an integrated “whole of government” approach that would fully support the financing, development, and deployment of advanced reactors. This is a framework that is best developed by the executive branch to ensure that all stakeholders and issues are included, but at the moment Congress is playing the leading role.

Legislation is important, but can often be limited by congressional committee jurisdiction. Bills being developed and introduced need to be supplemented with other policies and federal financing. There is a long uphill policy climb on regulation, safety, security, non-proliferation, and market identification for these new reactors. These issues need to be urgently addressed at the executive level, preferably in collaboration with our allies. What is especially needed is a clear, strong signal to the investment community that advanced nuclear technology is important and robust and that governments are willing to partner with them.

Western nations also are facing significant competition in advanced nuclear from Russia and China. Russia is very focused on fast neutron spectrum reactors and China is supporting a range of technologies with a concentration on high temperature gas reactors. The recent decision to limit U.S. advanced nuclear technology exports to China because of national security concerns may raise significant new barriers to the competitiveness of U.S. advanced reactor technology.¹⁶

Leading on Global Security and Governance

“Advanced reactor designers and the IAEA need to engage much more intensively, constructively and early in the design phase to ensure that this new class of reactors does not become a nuclear weapons proliferation or global security threat.”

This is an area where the U.S. and its allies have a very significant advantage. They are strong supporters of nuclear safeguards to prevent proliferation, nuclear security to prevent nuclear terrorism, and nuclear safety regulation. We can't allow a race to the bottom on governance and security.

Historically, the nations that are the dominant nuclear suppliers have written the global governance rules. When we look beyond light-water reactors (LWRs) to advanced reactors, this issue becomes particularly important. We cannot afford to be deploying miniature bomb factories. We also need to be very aware of the impact of known and emerging disruptive technologies, like cyber and artificial intelligence, on civil nuclear operations.

My organization, the Partnership for Global Security, has partnered with the Nuclear Energy Institute on the Global Nexus Initiative (GNI). It examines the intersection of nuclear power, climate change, and global security, and develops policy recommendations in this space. GNI is currently evaluating the security and safeguards of advanced reactors.

The GNI report will be released in early 2019, but its work to date offers insight into the safeguarding of next-generation reactors. All three major types of advanced reactors offer safeguards challenges when compared to the process for LWRs. Molten salt and pebble bed reactors are the most problematic, but fast reactors also pose challenges. This is not to say that safeguards can't be applied or that these reactor designs are irreversibly proliferation prone, but the designers will have to be more aware of this issue, and the IAEA will have to be more creative to find the correct balance.

RECOMMENDATIONS

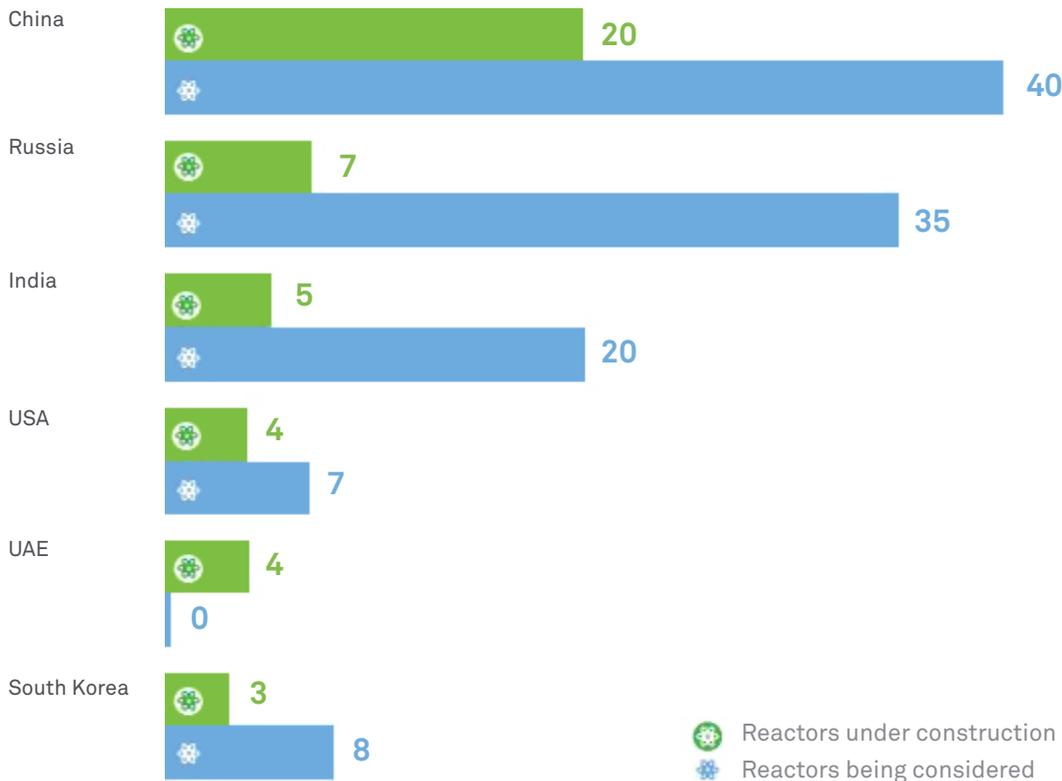
- We cannot allow a race to the bottom on nuclear governance and security by allowing Russia and China to dominate the next generation of reactor technology and its export. This should be a national security priority.
- The U.S. should initiate a dialogue with its major nuclear power allies on providing uniform and high-level protection of all nuclear infrastructure from cyber threats.
- Similarly, these countries should also be discussing how technologies like artificial intelligence are likely going to support and potentially disrupt civil nuclear operations.
- Advanced reactor designers and the IAEA need to engage much more intensively, constructively and early in the design phase to ensure that this new class of reactors does not become a nuclear weapons proliferation or global security threat.

INSTITUTIONAL REQUIREMENTS

The cohesive integration of these four key policy pillars does not exist in any institution or in any well-organized, actionable form. There are different organizations, companies and parts of governments that are making one or several of these points, but not everyone is making them all. They need to be integrated into a holistic strategy, preferably in one multi-participant institutional structure that can much better coordinate among government agencies, NGOs, the private sector, and international organizations.

This approach needs to be supported with significantly more financial resources and there needs to be a much stronger communications capability. This is what is needed to change cultural perceptions about nuclear power and maintain a leadership role in global nuclear commerce and governance in this century. The window of opportunity is open, but narrowly. We cannot fail to take these actions now.

Countries with the Most Civil Nuclear Power Reactors under Construction



Notes



Kenneth N. Luongo is a recognized innovator, entrepreneur, and leader in global nuclear and transnational security policy. He is the founder and president of the Partnership for Global Security and the creator of the Global Nexus Initiative. He served as the Senior Advisor to the Secretary of Energy for Nonproliferation Policy and simultaneously at the Department of Energy as the Director of the Office of Arms Control and Nonproliferation, Director of the Russia and Newly Independent States Nuclear Material Security Task Force and Director of the North Korea Task Force.

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- 2 "The Cost of Climate Change," *Axios*. October 14, 2018. <https://www.countable.us/articles/12375-cost-climate-change>
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- 5 U.S. Global Change Research Program, Fourth National Climate Assessment, November 2018,
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- 8 <https://www.eia.gov/todayinenergy/detail.php?id=31892>
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- 16 "U.S. Nuclear Suppliers Seen at Risk of Losing Business under Export Limits to China," *Morning Consult*, Nov. 8, 2018.



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1400 Eye Street, NW, Suite 440
Washington, DC 20005
T 202.332.1412
partnershipforglobalsecurity.org

