



Paving the Way for SMR & Advanced Reactor Deployments to Support a Clean Growth Strategy for the Developing World

Reshaping Current Approaches

May 16, 2019

*By Paul Murphy, Edward Kee, and Kenneth Luongo**

Dual Imperatives

Access to electricity is directly correlated to quality of life.[i] The Developing World needs electricity to meet basic human needs, to support industrial development, and to keep up with the ever-greater electricity dependency of modern society. Moreover, population growth is greatest in the Developing World,[ii] requiring even more electricity. The Developing World also faces current and projected potable water scarcity[iii] (that can be mitigated by desalination, which requires large amounts of heat and/or electricity to support the process). That is one imperative.

The other imperative is that climate change is a clear and present danger to our planet. The carbon dioxide concentration in Earth's atmosphere has now climbed to the highest level in 3 million years.[iv] Electricity generation is a major contributor to carbon emissions and the resulting impacts of climate change. To limit global warming under any strategy, to include to within the 1.5 to 2 degrees Celsius scenario envisioned under the Paris Climate Agreement, actions need to be taken on multiple fronts, including shifting the electricity industry away from its current reliance on combustion-based generation.

In order for the Developing World to meet its surging electricity demand and other challenges, both current and projected, without increasing the reliance on combustion-based generation that will take the world even farther away from a sustainable energy portfolio, energy planning needs to be done within a Clean Growth Strategy that utilizes advanced technologies that can provide clean, reliable power. How can this be achieved?

The Value of SMRs and Advanced Reactors

Small Modular Reactors (SMRs) and Advanced Reactors (ARs)[v] are ideally suited to meet the energy needs of the Developing World under a Clean Growth Strategy, particularly because of grid constraints in most of these countries (i.e., a nuclear power plant that is of 1,000 MWe, or greater, is too large for the electricity systems in these countries), and taking note of the lower total project cost of an SMR (i.e., due to smaller size) compared to a large nuclear power plant. In addition, these technologies have potential use for non-grid applications (e.g., desalination, remote communities, district heating, etc.).

A major rethink of the way that nuclear power plants are developed is required to create an effective glide path for clean new energy resources. Otherwise, the world will miss its opportunity with SMRs, particularly for the Developing World, where most countries have no nuclear power programs. Why so?

The IAEA's Milestones Approach

When evaluating the adequacy of a national nuclear program, as well as a specific nuclear power project (NPP) within the program, the baseline framework used by export credit agencies from OECD countries, commercial banks, and other relevant parties, as well as the host countries themselves, is the International Atomic Energy Agency's (IAEA) **Milestones Approach**.^[vi]

The relevance of the Milestones Approach is threefold:

- First, it provides a list of activities under three phases of development, serving as a guideline for countries wishing to develop civilian nuclear power programs;
- Second, it helps to address concerns from both internal stakeholders and external observers that the country in question is responsibly developing a civilian nuclear power program; and
- Third, it is the benchmark that financial institutions will use to assess the program and the NPP as part of the credit approval process (which, given the critical role of financing in NPP development, becomes a "make or break" moment for almost all countries looking to deploy NPPs).

Notably, the Milestones Approach is focused on large nuclear power plants (and, thus, not well-suited for the deployment of SMRs). It is a very thorough approach, but it is time consuming (i.e., at least 10-15 years before commercial operation of the first nuclear power plant), expensive, and human resource intensive. The UAE is a recent example of a new civilian nuclear power country developing a program under the Milestones Approach (and applied by the export credit agencies that provided financing to the Barakah NPP). However, upon examination of what the UAE has done, it is abundantly clear that most other countries, especially those from the Developing World, cannot replicate the UAE's admirable approach.^[vii] Thus, the Milestones Approach creates an unfortunately high (and unrealistic) barrier to entry, which limits the ability of SMRs to be a meaningful solution for a Clean Growth

Strategy for the Developing World. Therefore, what is needed is a more practical, achievable approach for SMR deployments (without compromising safety, security, and safeguards, and addressing non-proliferation concerns).

Reshaping the Milestones Approach

Let's pause here and take a step back. If a newcomer country announces that it wants to pursue a civilian nuclear power program, the world watches -- with significant trepidation. However, at the moment, the IAEA's reactor database[viii] shows that, in Developing Countries alone, there are 87 operational research reactors, with 5 under construction, and 12 planned. So, one must wonder: *Why is it so hard to build a large reactor (and a robust civilian nuclear power program), but comparatively easy to deploy research reactors, and certainly without the scrutiny, high program costs, and existential angst faced by large reactors?*

Of course, there are a host of reasons why large reactors face deployment challenges that are very different than research reactors. Nevertheless, if we take the two extremes -- the large nuclear plant Milestones Approach and then the current approaches to deploying research reactors -- to bound our thinking, we can see the potential for a third approach. The smaller size of SMRs (and particularly single-digit MWe micro reactor designs) and the technological advancements associated with such designs (e.g., being "walk away safe") support the case that countries developing a new nuclear power program focused on SMRs should be able to follow a third approach that falls somewhere within the two extremes and that, arguably, could be much closer to the research reactor approach than the large nuclear power plant Milestones Approach.

So, where do we go from here? And, more importantly, why should we bother?

1. The world needs substantially more clean energy in this century, and that is acutely true in economically developing nations. Any major new energy plant has a lifetime measured in decades, and a coal or gas plant will produce substantial carbon emissions for that duration.
2. If we want the Developing World to have a Clean Growth Strategy, then SMRs must be made more accessible to the countries that want to deploy them. Renewable energy has a vital role to play in any climate change strategy, but nuclear energy -- clean, reliable, baseload energy -- is essential for development. For advanced, industrial societies with ever-increasing electricity dependence, carbon-free nuclear energy must play a key role in creating a sustainable future.
3. Therefore, a new methodology is required to support SMR deployments for civilian nuclear power programs in newcomer countries. The current approach is not feasible for virtually all developing countries, especially if substantial external financing for the nuclear power plant is needed.
4. Absent a new model for nuclear power newcomer countries, financial institutions and other stakeholders will expect these countries to follow the IAEA Milestones Approach. Such an approach will make it difficult, if not impossible, for the deployment of SMRs in these countries.

5. A new approach needs to be developed jointly by interested countries -- both the countries exporting nuclear power technology and the countries developing new nuclear power programs -- and supported by the global nuclear power industry and those groups that see nuclear as an essential response to climate change. With the support of key governments to provide the necessary impetus for such an endeavor, interested countries in the Developing World will be afforded with a more realizable pathway for SMR programs to come to fruition and, ultimately, get the international financing that is needed to support these projects.

What is needed is a call to action by those countries and stakeholders that see SMRs as a solution to the conundrum of development and climate change; that see SMRs as a fundamental element of a Clean Growth Strategy. What is needed is a *Coalition of the Willing* to develop a new approach to nuclear power, deploying SMRs in new nuclear power countries with a methodology that replaces the Milestones Approach, without compromising the essential pillars of safety, security, and safeguards/non-proliferation. This new approach is critical. Without it, the market for SMRs will be theoretical and countries in the Developing World that wish to utilize nuclear energy will struggle to achieve their goals, at a time when the Developing World needs to deliver real results to its population and when the global community is desperate for reliable, carbon-free energy.

This new approach is an opportunity to help the Developing World meet growing electricity needs with clean nuclear power that will also help contain global carbon emissions. So, who will step up to lead?

** About the Authors:*

- *Paul Murphy is the Founder and Managing Director of Murphy Energy & Infrastructure Consulting, LLC. He is also an Affiliate of Nuclear Economics Consulting Group.*
- *Edward Kee is the Founder and CEO of Nuclear Economics Consulting Group (<https://nuclear-economics.com/>).*
- *Kenneth Luongo is the Founder and President of the Partnership for Global Security (<https://partnershipforglobalsecurity.org/>) and the creator of the Global Nexus Initiative (<http://globalnexusinitiative.org/>).*

[i] <https://www.powermag.com/the-statistical-connection-between-electricity-and-human-development/?printmode=1>

[ii] <https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html>

[iii] <http://www.unwater.org/water-facts/scarcity/>; <https://www.un.org/en/sections/issues-depth/water/>; <https://globalchange.mit.edu/publication/16013>

[iv] https://www.nbcnews.com/mach/science/carbon-dioxide-hits-level-not-seen-3-million-years-here-ncna1005231?cid=sm_npd_nn_tw_ma

[v] For the remainder of this paper, for simplicity, reference will only be made to SMRs, but that should be read to include ARs that fall below the 300 MWe range.

[vi] See: <https://www.iaea.org/topics/infrastructure-development/milestones-approach>; Milestones in the Development of a National Infrastructure for Nuclear Power (IAEA Nuclear energy Series NG-G-3.1 Rev.1).

[vii] The application of the Milestones Approach to the Barakah NPP is all to the credit of the stakeholders

involved. The UAE deserves recognition for how it has developed its civilian nuclear program and the financial commitments it has made, both for the program and for the project. However, the UAE is uniquely situated financially and structurally to move forward with a program of this scale. It is unrealistic for this model to be replicated by other countries.

[viii] <https://nucleus.iaea.org/RRDB/RR/ReactorSearch.aspx>

Global America Business Institute | 1001 Connecticut Avenue NW, Suite 435,
Washington, DC 20036 | 202-499-7979 | ELL@thegabi.com | www.thegabi.com

STAY CONNECTED:

