How oil & gas majors could turn the tide against global warming

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I. Introduction

In the early stages of the nuclear power industry, some oil & gas majors (OGMs) entered the uranium industry, but their interest in nuclear power projects is rare, with Total's bid for the Barakah project in 2009 one of the few recent examples. Are these instances historical footnotes, or might there be a role for OGMs in the nuclear power industry today, even considering the current pandemic and overall market conditions

This report is a discussion of the role that OGMs might play in the nuclear power industry.

The bulk of this report was written in the first two months of 2020, when the global and local impact of the COVID-19 pandemic was just beginning to emerge. Given the pandemic's impact on oil markets, the authors intentionally refrained from finalizing the article. However, with recent news concerning Equinor's investment in Commonwealth Fusion Systems, the concepts raised below have become timely once again.

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II. Oil and Gas Majors in nuclear power

When the United Arab Emirates selected KEPCO and its APR1400 reactor for the Barakah Nuclear Power Project (NPP; Dec 2009), one of the other finalists was a consortium of AREVA, Bechtel, GDF Suez (now Engie), EDF, and, most interestingly, Total – an oil and gas major (OGM). A decade later, that same OGM, Total, is the target of a ground-breaking lawsuit[1] for allegedly failing to adequately fight climate change.

Recent OGM activities in support of nuclear power projects are rare, with Total's interest in the Barakah NPP project one of the few examples. However, in the early stages of the nuclear power industry, some OGMs entered the uranium industry.[2] Are these instances to be historical footnotes, or might there be a role for OGMs in the nuclear power industry today? Specifically, might technology development in the Small Modular Reactor (SMR) and Advance Reactor (AR, and together with SMRs, SM&ARs) space be a unique opportunity at a critical moment in time for OGMs? OGMs are awakening to the strategic, reputational, and workforce retention challenges they face if they do not address public perceptions and fiscal/regulatory actions

[1] https://www.voanews.com/europe/energy-giant-total-taken-french-court-climate-inaction.

[2] https://www.nytimes.com/1981/05/08/business/exxon-and-gulf-end-uranium-suit.html.

related to fossil fuel-only activities. While the suit against Total is by environmental groups and local authorities, it is representative of initiatives by activist shareholders against other OGMs. Activist shareholders are demanding that OGMs take significant steps to address climate change due to the impact of fossil fuels on the environment.

A. OGM Climate Change Issues

Whether due to these challenges or of their own accord, it is notable that certain OGMs have made major announcements and/or strategic corporate changes to address carbon intensity. For example, Equinor[3] has chosen to address carbon intensity, BP[4] has incorporated a "net-zero" policy plan, and ExxonMobil[5] has worked to develop alternative fuels.

Using a technology-driven reconfiguration of asset portfolios that reflects a commitment to achieve carbon emissions reductions and sustainability, the aforementioned OGMs are endeavoring to increase clean energy elements while reducing fossil fuel operations as a percentage of the OGMs' overall portfolios. By listening to their shareholders and to the public debate, changes are being made.

As the first unit at Barakah enters commercial operation, an interesting question for further examination arises:

> *Would investment by OGMs in emerging nuclear power technologies provide a more meaningful pathway for OGMs to counter-balance their core businesses (oil & gas) and substantively address activist shareholder concerns that demand the OGMs do more to address climate change?*

B. Climate Change is an Important Issue

Climate change ***is*** a clear and present danger to our planet.[6] The carbon dioxide concentration in Earth's atmosphere has now climbed to the highest level in 3 million years.[7] Electricity generation is a major contributor to carbon emissions and the resulting impacts of climate change. To limit global warming under any strategy (e.g., 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 and towards clean generation.

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3 https://www.equinor.com/en/news/2020-02-06-climate-roadmap.html.

4 https://www.carbonbrief.org/daily-brief/new-bp-boss-bernard-looney-pledges-net-zero-emissions-by-2050.

5 https://corporate.exxonmobil.com/en/Research-and-innovation/Advanced-biofuels/Advanced-biofuels-and-algae-research.

6 For extensive research on climate change, please refer to the United Nations' Intergovernmental Panel on Climate Change at https://www.ipcc.ch/.

7 https://www.earthprotect.com/blogs/entry/3292-carbon-dioxide-hits-a-level-not-seen-for-3-million-years-here-s-what-that-means-for-climate-change-%E2%80%94-and-humanity.

In addition, given the greater demand placed on electrification and electric grid infrastructure to meet evolving consumption and development patterns – whether it be to address human development (i.e., energy poverty and quality of life) and population growth, or to promote new applications and transformations (e.g., desalination, the hydrogen economy, etc.) – significant investment in technology and then the further application of such technology to viable deployment models are required.

C. Role of Nuclear Power in Resolving Climate Change

Nuclear power is an essential part of any feasible clean growth strategy and is required for any plan to achieve a zero-carbon electricity sector.

The role that nuclear power plays has been clearly identified by the International Energy Agency (IEA) [8] and in a recent Massachusetts Institute of Technology (MIT)[9] study (*see Fig. 1*).

In its report, Nuclear Power in a Clean Energy System (May 2019), the IEA notes:

> *"A range of technologies, including nuclear power, will be needed for clean energy transitions around the world. … [T]o achieves a trajectory consistent with sustainability targets – including international climate goals – the expansion of clean electricity would need to be three times faster than at present. It would require 85% of global electricity to come from clean sources by 2040, compared with just 36% today. Along with massive investments in efficiency and renewables, the trajectory would need an 80% increase in global nuclear power by 2040."*

Moreover, the mix of electricity generation platforms matters, underscoring the need for nuclear power. A recent MIT study notes:

> *Across the wide range of technology assumptions and power system characteristics considered in our core scenarios, we find that the availability of firm low-carbon resources consistently reduces the system cost of decarbonizing power generation relative to scenarios in which these resources are excluded from the eligible resource mix. … The availability of firm-low carbon resources is an important factor in containing the cost of power sector decarbonization and thus the overall cost of climate mitigation efforts.*

A key takeaway is that a mix of electricity generation platforms matters, of which nuclear power can play a powerful role. With the role of nuclear power clearly identified as essential in the

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8 https://www.iea.org/publications/nuclear/. See also, World Nuclear Association, *The Silent Giant: The need for nuclear in a clean energy system* (September 2019), which notes that, under the United Nations' Intergovernmental Panel on Climate Change's "middle-of-the-road" scenario, in which social, economic, and technological trends follow current patterns, nuclear energy's contribution would need to increase by five times globally by 2050 (to maintain a 1.5ºC target limit for global warming).

9 *The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation,* Sepulveda et al., Joule 2, 1-18 (October 17, 2018). This point is also made in MIT's, *The Future of Nuclear Energy in a Carbon-Constrained World (2018),* noting "As the world seeks deep reductions in electricity sector carbon emissions, the cost of incremental power from renewables increases dramatically."

effort to address climate change,[10] the underlying challenge for increasing nuclear power is how to secure investment in support of these mid-century goals.

D. Nuclear Power Industry Financing Issues

Two key financing problems exist for nuclear power.

1. Massive Upfront Project Investment

Significant scholarship has been devoted to the idea that financing an NPP, especially the massive upfront costs, is one of the greatest challenges of NPP deployment. The amount of investment required in nuclear power plants to help with a clean growth strategy or a zero-carbon electricity sector is often perceived to be prohibitive. The 80% increase noted in the 2019 IEA report amounts to about 220 GW, assuming that existing nuclear power does not fade. Placing more than 200 GW of new nuclear capacity into operation will require hundreds of new large nuclear power projects, as well as an even greater number of smaller nuclear reactors.

Even if governments provide some support for new nuclear projects (e.g., revenue enhancements, reductions in development cost and completion risk), the amount of investment is enormous, even in a non-pandemic or post-pandemic environment, where government budgets and corporate balance sheets are under immense stress (and further exacerbated by the current economic downturn).

For perspective, OGMs earned more than $80 billion in earnings[11] in 2018, more than twice the equity required for new nuclear investments in a year. Put in the context of the nuclear industry, the amount of investment required for 200 GW of new nuclear will be at least 1 trillion USD (i.e., with a capital cost of $5,000/kW), with the potential to be much higher. Regulated nuclear might have up to 50% of the capital cost provided by debt, but nuclear plants within deregulated electricity markets may only get 20% to 25% of capital from debt, depending on the project's economics. This means that $500 to $750 billion in equity (or about $37.5 billion per year) will be required for this 200 GW of new nuclear power projects over twenty years.

2. Front-End Funding for new SM&AR Designs

With the emerging wave of SM&ARs that are under development, one of the biggest hurdles to the development and deployment of SM&ARs is the front-end funding required to bring these technologies to market. As an example, NuScale Power (formed in 2007) has spent approximately $800 million as of the end of 2018,[12] likely to exceed $1 billion by the time it receives its design certification from the U.S. Nuclear Regulatory Commission. While NuScale Power is backed by Fluor, a global engineering and construction company, most SM&AR

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[10] Albeit disappointingly omitted from the European Union's multi-billion euro plan to relaunch economic activity: https://www.world-nuclear-news.org/Articles/European-recovery-plan-omits-nuclear.

[11] http://energyfuse.org/oil-majors-boost-profits-in-2018-risks-loom/.

[12] November 27, 2018 presentation by Allyson Callaway (NuScale Power), *NuScale Micro-Reactor Technology*, available online.

developers are not large, multi-disciplinary companies with significant financial resources/balance sheets and the requisite global reach for international deployments, except for those that are state-sponsored in certain countries, where national budgets support orchestrated technology development as part of national considerations and international strategies.

As such, SM&AR start-ups lack the financial wherewithal and project development experience to bring their technologies to market (to include the development of specialized factories to fabricate the reactors in order to achieve the "economies of multiples" benefits of factory-based assembly) and to achieve international deployments at the levels that will be needed to support, what will inherently be, a volume business. Notably, both the United States and the United Kingdom have engaged in cooperative funding approaches, with NuScale Power receiving funding from the U.S. Department of Energy[13] and Rolls-Royce receiving funding from UK Research and Innovation, a whole-of-government incubator that supports public-private partnerships.[14] Even though the Rolls-Royce SMR effort is a collaborative effort among a number of companies, government support for the technology and the associated funding is vital to this endeavor.[15]

Bringing SM&ARs to market is not simply a question of the quantum of money needed; these technologies are beset with a unique set of investor challenges. NPP investments have long technological development, licensing, and project development and construction periods. This time horizon is not practical for a classic equity investor, nor for very liquid financing sources such as private equity groups who are less tolerant of taking front-end risks and are also looking to shorter investment recovery time horizons – conditions that do not line up properly to fund NPP development, including SM&AR technology development. Instead, what is needed is an investor that is willing to play the "long game" and is not averse to providing seed capital for new technologies, particularly in areas outside of their traditional areas of technological expertise.

E. Who can play the long game?

The nuclear power industry needs participants that can play the long game. Governments are one obvious choice, and the U.S. and U.K. Governments are rolling out various support options for developing SM&ARs.[16] Certain industrials could be another (see Fluor above). But consider:

- What group is under a withering attack by climate change activists?
- What group could make a huge difference in a sector with amounts of money that represent "pocket change" for this group?

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13 https://www.nuscalepower.com/about-us/doe-partnership.

14 https://world-nuclear-news.org/Articles/UK-confirms-funding-for-Rolls-Royce-SMR.

15 https://www.world-nuclear-news.org/NN-UK-SMR-consortium-calls-for-government-support-1209174.html.

16 https://www.world-nuclear-news.org/Articles/US-DOE-launches-advanced-reactor-demonstration-pro.

- What group can play the long game, as it looks to transition from a traditional sector that has been fundamental to modern, industrial society, but must now figure out a way to support that same society which is now looking to refashion energy and electricity in a fundamental way to combat possibly the greatest challenge to human development and well-being over the long term?
- What group operates on a global basis and has experience developing complex projects, involving innovative technologies, and doing so often in challenging geographic environments?

F. Oil and Gas Majors

OGMs would not only be well-suited to take up this charge from an investment and operations standpoint, but doing so would also be mutually beneficial to counter their perceived (and sometimes actual) climate change insouciance.

If the OGMs are serious about climate change and the diversification of their portfolios that is required to transform themselves into true *Energy Companies* that have a significant business component focused on looking to offset their fossil fuel activities, investment in SM&ARs can have a game-changing effect on the development of such technologies. The transformational impact of such a concerted decision would influence the energy industry writ large and would help to make nuclear power more accessible to, among others, the developing world, and create innovative applications that could have further transformational effects, to include hydrogen production applications and desalination. Energy transformation and decarbonization take time. For better or for worse, fossil fuel activities will still be a core component of modern living for the foreseeable future, which underscores the importance of – and immediacy of – the portfolio balancing activities of OGMs as a key contributing pathway to a sustainable future.

Instead of small gestures and R&D efforts to appease environmental activists – but which might never achieve the touted goals – OGMs have an opportunity (on an individual basis or collectively) to take meaningful steps by supporting the development of SM&ARs. These R&D efforts will not only improve OGMs' reputational posture, but will ***actually*** facilitate the achievement of goals being championed by environmental groups. Interested OGMs could also consider pooling their efforts to financially support development of one or two of the more advanced SM&AR technologies to even greater effect.

Admittedly, OGM stakeholders focus on profitable operations and investments that will ensure continued profitability. OGMs could view a move into nuclear technology as too risky and long term a play, seeing other options as more palatable. Considering the impact of the pandemic on oil prices and the curtailment of new investment by OGMs, a move into nuclear technology would be a major move at a time when OGMs are under siege. Yet, it is in times of economic and corporate crisis that strategies do need to be rethought and portfolios do need to be reassessed, which is already occurring in the midst of this pandemic.[17]

[17] https://oilprice.com/Energy/Crude-Oil/BP-Boss-We-May-Have-Already-Hit-Peak-Oil-Demand.html.

Perhaps, though, the OGMs might need an additional push. If national governments clearly articulate the place for nuclear power as part of a clean growth strategy, and then take the requisite steps to establish clear pathways for the technology and its economic viability (e.g., a regulated asset base approach), a convergence of interests can be created which could mobilize corporate capital that would, in turn, catapult the development and deployment of SM&ARs.

OGMs have the potential to being ground-breaking leaders in bringing disruptive innovation to clean energy generation. The hope is that more strategic partnerships, like that among Eni, MIT, and Commonwealth Fusion Systems, involving a €50 million initial investment by Eni[18] (and now supported by further investment from, among others, Equinor) will occur.

This report is meant to introduce the idea, and it is by no means an attack on OGMs, nor is it meant to address fully all considerations that OGMs would face before making such investments. Instead, the hope is to open a meaningful dialogue among OGMs, SM&AR developers, the nuclear industry, and interested governments and international organizations.

[18] https://www.eni.com/en-IT/operations/sustainable-energy-study.html; https://www.reuters.com/article/nuclearpower-fusion-eni/rpt-italys-eni-defies-sceptics-may-up-stake-in-nuclear-fusion-project-idUSL8N1RT15C.

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