Energy under the Trump Administration

Trump’s Potential Impact on the Future of U.S. Nuclear Power:

State of the Industry and Advanced Nuclear R&D

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Introduction

Although President Trump's budget proposal to allocate $120 million to reviving Yucca Mountain indicates the administration's strong support for nuclear,[i] it remains uncertain what net impact the President's energy policies will have on nuclear power in the U.S. On the surface, President Trump's energy priorities would appear to be with the oil and gas industry; given President Trump's decrees to move forward with the completion of the Keystone XL and Dakota Access pipelines, it appears certain that he will follow through with his campaign promise to develop pipeline networks and other infrastructure to enable the expansion of domestic energy production. Although facilitating the development of domestic fossil fuel resources may not directly affect U.S. nuclear power, they may nevertheless influence the trajectory of the nuclear industry and advanced nuclear R&D programs.

Our Energy Future

In 1956 and 1957, two back-to-back visionary discourses offered by Admiral Hyman G. Rickover[ii] and M. King Hubbert[iii] outlined the need for continued access to affordable energy to sustain our way of living and the freedoms we enjoy, while suggesting that the turn of the century could see energy transitions from conventional to unconventional liquid fossil fuels, implying that these resources may become part of a 21st century all-of-the-above energy portfolio. They also stressed the importance of preparing in advance for an ultimate transition away from fossil fuels. While it can be considered self-evident that a transition to sustainable energy resources is inevitable, the pace at which this will occur, and what it may look like are matters of open discussion. Furthermore, while there are genuine concerns over the contributions of energy usage to climate change, these are arguably secondary to the need to create and manage a seamless transition to sustainable energy to avoid major national, global, economic and societal disruptions that would occur if the world were to experience global energy shortages during the 21st century.

Herein presents itself an incredible opportunity for nuclear energy in the form of heat and power coupled to fossil fuel development. In an article describing future investment strategies between nuclear power, renewable energy, coal, and electric vehicles,[iv] Michael Munro astutely points out that investments in the oil industry can be hedged by investments in uranium. The price of uranium will grow with the electric vehicle market as nuclear energy grows to produce more electricity on the grid. Taking this analysis a step further, it can be argued that investments in nuclear energy generating stations themselves, and not just uranium, can serve as a hedge for investments in both the oil and electric vehicle industries. This is because nuclear power plants can be structured to supply heat and power to both. The production of liquid fossil fuels, from extraction to refining, requires substantial energy in the form of heat and power, which is especially the case for high-energy extraction industries such as kerogen-based oil shale and bitumen, the United States' and Canada's largest unconventional petroleum resources, respectively. If nuclear power plants are designed and licensed to dynamically produce and supply heat and power, they will be uniquely situated to balance service to both the fossil fuel and the electric vehicle industries over a 60 to 80-year plant lifetime as our transportation fleet gradually transitions from fossil fuel to electricity and alternative power sources. In this manner, they can umbrella and support the two coexisting industries during a transition period that may not necessarily be rapid or even one-directional (e.g. as electric and alternative vehicles become more competitive and capture part of the market from liquid fossil fuels in the transportation sector, the demand for liquid fuels--and therefore its price--will drop, allowing it to return and secure portions of the market which it lost).[v]

Nuclear and Keystone XL

On January 24, 2017, President Trump issued a directive[vi] that revived the Keystone XL Pipeline project, an issue of high political controversy during the Obama administration. One of the primary criticisms of the pipeline was that it would transport oil produced in Canadian tar sands to refineries in the U.S. As with oil production from oil shale, oil recovery from tar sands tends to be highly energy and carbon intensive, as relatively large volumes of natural gas are needed to produce a unit of oil--approximately 36 cubic meters per barrel.[vii] As a result, oil sands production has comparatively high carbon intensity, with estimates ranging from 12-22% higher than conventional processes.[viii]

To address the related issues of high energy input requirements and atmospheric emissions associated with mining oil sands, Canadian industry had for many years considered the use of nuclear-generated heat in lieu of natural gas combustion to produce the steam needed to extract oil from tar sands deposits. A number of different reactor technologies have been proposed to serve this purpose, ranging from large CANDU-type reactors to advanced designs with unconventional coolants.

With respect to advanced nuclear energy, many cutting-edge concepts in development possess features that would be advantageous for tar sands oil production. For instance, many advanced nuclear developers are designing their reactors to be small, portable, and modular. A number of these designs are transportable by truck or rail, meaning that they can be deployed close to mining sites, eliminating efficiency losses from the transmission of heat or steam over longer distances. Furthermore, the relatively small sizes and power ratings of these reactors permit ease of scalability, allowing operators to deploy as many or as few units as needed according to the desired volume of production. Perhaps most importantly, advanced nuclear designs generally boast enhanced passive safety characteristics relative to traditional light water reactor technologies, thereby allowing for co-location with mining crews and equipment while also affording unparalleled levels of safety.

Indeed, a variety of advanced reactor types have been proposed for less fuel intensive and emissions-free oil production in the Canadian tar sands. Toshiba has reportedly been in discussions with oil sands operators regarding its 4S ("super-safe, small and simple") sodium-cooled mini-reactor, which could be operational by around 2020.[ix] Canadian advanced nuclear developers Northern Nuclear Industries and Terrestrial Energy have proposed lead-cooled pebble-bed reactors and molten fluoride/chloride salt reactors, respectively, for use in the country's tar sands; both of these concepts are scalable, passively safe, and operate at high temperatures--characteristics that are desirable for the extraction of oil from tar sands.[x] With ample opportunities for deployment (remote off-grid locations in the north, in addition to the Athabasca oil sands) and a favorable regulatory environment (the Canadian Nuclear Safety Commission conducts pre-licensing design reviews,[xi] allowing vendors to proceed in a stepwise fashion and reduce uncertainties), Canada may be relatively close to commercializing some of these innovative designs.

U.S. Fossil Fuel Production: Impact on Nuclear Power and Advanced Nuclear

If President Trump's energy policies result in a significant expansion of U.S. fossil fuel production, nuclear energy may be tapped to facilitate this production. To be selected as a source of heat and power, nuclear energy must be able to position itself as a valuable and competitive alternative to natural gas. Nuclear has significant reliability, security of supply, and environmental advantages over natural gas, and can act as a useful hedge against uncertainties (e.g. U.S. natural gas exports may stabilize or even increase costs) in natural gas prices. Furthermore, since nuclear power plants typically have lower conversion efficiencies than an NGCC plant, nuclear more closely approaches the economics of natural gas on a levelized cost of heat basis than it does versus natural gas on a levelized cost of electricity basis. In such an environment, the domestic nuclear industry may find greater opportunity in focusing its attention towards non-electricity applications as a critical means to ensuring its continued viability.

In addition to supplying heat for the development of the United States' massive oil shale resources, nuclear heat can also be utilized for coal gasification and syngas production, creating another source of domestic gas. There are also processes that involve the application of nuclear heat to convert natural gas and coal-derived syngas into liquid fuels, essentially converting coal and natural gas into valuable petroleum substitutes or liquid fuels for the transportation sector.[xii] Back in 2012, Rod Adams argued that combining coal and nuclear to produce oil would result in higher value added for both industries.[xiii] Such a suggestion is arguably more germane today, as President Trump has stated his support for both nuclear and coal, but such applications will require support to get off the ground. Given the administration's dual objectives of "putting coal country back to work"[xiv] and supporting nuclear power, such propositions warrant serious re-examination and consideration.

Given the U.S. energy landscape and present trends, the nuclear industry may be compelled to further invest in capabilities that allow for dynamic alternation between heat and power, as suggested earlier. As the aforementioned Canadian oil sands case illustrates, many cutting-edge designs presently in development are intended to be as adept at providing process heat as they are generating electricity. With respect to process heat applications for industry and fossil fuel production, advanced reactors are ideally suited to provide this energy because many of these designs produce high temperatures and operate in geographically isolated areas with air cooling if necessary. Advanced engineering and modularization of LWRs, HTRs, SFRs, and MSRs can reduce costs, while sales of industrial heat may be able to compete with a tighter margin on a levelized-cost-of-heat basis with natural gas. Spare capacity can also be dedicated to high temperature electrolysis to support a growing hydrogen economy.

One potential concern regarding current efforts to commercialize advanced nuclear in the U.S. is the wide range of reactor types under research and development. Although diversity is not a negative in and of itself, the multiplicity of designs in consideration could create a dissipating effect for advanced reactor development efforts in the U.S. overall, as well as an additional layer of complexity for a domestic regulatory regime that has been structured primarily to evaluate and license light water reactor technologies. Higher valuation on characteristics such as the provision of cost-competitive process heat, flexible switching between heat and electricity generation, and commercial readiness may create important criteria in the down-selection process towards a few viable reactor designs.

Policy and Legislative Recommendations

Clever legislation can greatly facilitate and maintain the stability and continuity of such an industrial paradigm and transition to sustainable energy. A revival of projects such as the Next Generation Nuclear Plant (NGNP), and appropriation of required funds, may be one possible mechanism for spurring activity and enhancing capacity within the NRC to address advanced reactor licensing and bring forth the world's first modern commercial non-LWR advanced reactor. This preparation would pave the way for investment in licensing applications of other advanced reactors. Passage of legislation such as Securing America's Future Energy's (SAFE) Energy Security Trust Fund (ESTF) could also be a strong enabler. Supported by General James T. Conway of SAFE, this legislation proposes to open oil resources currently under moratorium for development, with a portion of the royalties devoted to a fund dedicated to advanced energy R&D. The ESTF can provide resources necessary at the national lab, university, and public-private partnership levels to develop the control systems and related infrastructure that are necessary to make nuclear non-electrical applications a reality. Research dollars can also investigate how to use hybrid nuclear industrial systems to balance and integrate renewables into the grid.[xv]

In a future where fossil fuel production is designed to receive heat and power from nuclear energy, grant funding from the ESTF will most likely return to the host states from which it was derived and go towards research institutions and projects located within these states. In contrast to other legislative proposals which raise energy costs to stimulate a transition to sustainable energy, this legislation can be viewed as a synergistic transfer that catalyzes a transition based on economic principles. It also lays a foundational electrical infrastructure that is immediately available for access as fossil fuel supplies diminish in the future. Due to the resulting established interdependence between the nuclear, renewable, and fossil energy production industries, such an arrangement holds the potential to endure across decades of unique administrations, safely securing the United States' future energy supply, security, and leadership, enabling breakthrough technological developments and averting undesirable energy shortages.

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