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Ethics of Nuclear Energy Investment in the Twenty-First Century: A Literature Review

Brett Hudson

I. INTRODUCTION

Nuclear energy is experiencing a renaissance with the looming climate crisis as the backdrop. Demand in existing sectors is growing while transportation, manufacturing, and utilities such as indoor heating become increasingly electrified. The need for electrical power is greater than ever, but it is becoming increasingly clear that current renewable sources are not sufficient to replace to simultaneously replace existing power plants and meet rising demand. Nuclear power has accordingly taken center stage once more as a viable alternative to fossil fuel plants. It is a proven source of reliable, safe, and clean power, but nuclear power is not without ethical concerns. Public sentiment proves to be ambivalent at best and outright hostile at worst, which reflects in most public policy relating to nuclear today. The academic discourse on the subject reveals the complexity of implementing nuclear at scale, especially in the shadow of the disastrous accidents at Chernobyl and Fukushima.

II. NUCLEAR ENERGY AND ENVIRONMENTAL RESPONSIBILITY

At the crux of nuclear energy debate is the current climate crisis. The effects of climate change need not be reiterated here, but the question of how to combat climate change proves to be as divisive a topic as the topic of climate change itself, even amongst those who deem it a credible threat. Among these debates stands the question of whether renewed investment in nuclear is ethically advisable. Friederich et al. [1] argues that nuclear energy as a power source is not only an effective option for reducing reliance on fossil fuels but is an ethical imperative. This is not a universally accepted idea, however. Wealer et al. [2] object to this notion in their paper, insisting that the mining detritus and waste products from nuclear energy present an unacceptable risk to the environment without whilst also being economically unattractive.

Carbon emissions are a key consideration in the debate. Among clean sources of energy such as wind, geothermal, and hydroelectric, nuclear stands as a reliable exceptionally low-emissions source. MacDonald et al. [3] posit an achievable 80% reduction in electrical power generation emissions in the US by 2050 (relative to 1990 figures) with the significant expansion of renewables. This is an encouraging figure, but it reveals a potential pitfall. The trouble is mitigating the final 20%, which Shaner et al. [4] correctly point out is stymied by environmental conditions and consumer demand. Seasonal strains, unpredictable weather, and fluctuating energy demand renders many renewables unreliable and largely impractical as a primary power source without additional investment in significant energy storage—enough for several weeks' worth of national energy demand, the authors argue. Even in a nation as large as the US where renewables may be spread out to diminish the impact of weather, adequate harvest is not always achievable the cost of building energy storage disincentivizes broader investment, perpetuating the use of more consistent fossil fuel plants for baseload (baseline) power generation. Friederich et al. [1] explain that this risk of decarbonization failure is significantly lower with the use of "firm" baseload such as hydroelectric, geothermal, and nuclear than it is without, pointing out that nuclear has the most geographic flexibility of the three. This allows the expansion of renewables without risking expansion of fossil fuel plants.

All of this is to say nothing of other sources of carbon emissions, such as aviation, long-distance road transport and global shipping, and industrial production of cement, iron, and steel which cumulatively account for 12% of global emissions alone, according to Davis et al [5]. This is compared to load-following electricity (that is to say, electricity that is produced according to demand), which accounts for 12% of global emissions, while non-load following (electrical production done at a constant rate regardless of demand) accounts for another 26% [5]. This 12% gap in energy consumption poses a major challenge, as the cost of converting to renewable sources of energy is much higher or requires a mode shift, if alternatives even exist. Moving long-distance shipping onto electric trains, using cleaner burning synthetic fuels, and using electric arc furnaces to produce steel are examples of cleaner solutions to these problems, but they all require immense amounts of base-load electricity generation that is far beyond the capability of current renewable infrastructure to achieve. This is where nuclear energy comes into its own. Not only is it able to provide consistent levels of base-load electrical power, but the heat energy from nuclear reactors can be harnessed directly for industrial uses or even utilities such as heated water [6].

[To be continued]

III. WASTE DISPOSAL AND FUTURE GENERATIONS

IV. SAFETY VERSUS ECONOMIC INTERESTS

V. PUBLIC CONSENT AND DECISION MAKING

VI. EQUITY AND ACCESS

VII. AUTHOR'S NOTE AND DRAFT OUTLINE

This document is an incomplete draft. Additional material and full list of references to come.

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