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Financing Fusion Energy[1]

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PRACTITIONERS DIGEST

Fusion energy is a reaction in which energy is released by the *fusing* of atoms into new elements. This process, which powers stars and our sun, possesses the qualities of an ideal energy source: high-power density, high dispatchability (i.e., no intermittency), virtually limitless fuel availability, a low environmental impact with high sustainability, and no risk of a runaway reaction, since it relies on its fuel remaining hot, not a chain reaction. With greenhouse gas levels rising, the effects of global warming already tangible in the form of extreme weather events, and the world's oil supply expected to be depleted by the end of the century, the creation of a sustainable, unlimited energy source is of paramount importance. While solar and wind power technologies have improved in efficiency and cost, there are structural limitations preventing these renewable sources from supplanting the largely fossil fuel-dominated energy economy. Therefore, fusion energy is perhaps the only truly sustainable energy source for supporting human life over the next several millennia. And on December 5, 2022, the theoretical possibility of fusion became a reality when the National Ignition Facility at UC Berkeley's Lawrence Livermore Laboratory achieved the first fusion reaction in which net energy was produced.[8]

The two main challenges in realizing this carbon-neutral future are the feasibility of fusion to produce net power at scale, and the uncertain timeline of near-term deployment of power plant demonstrations. While fusion research has historically been funded and executed by governments or government-sponsored projects, there has been a recent surge in private ventures aiming to embrace a different approach than the bureaucratic behemoth

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[8] https://www.nytimes.com/2022/12/13/science/nuclear-fusion-energy-breakthrough.html (accessed 13 December 2022).

of ITER (which means “the way” in Latin), the world’s largest fusion program, backed by the European Union, China, India, Japan, Russia, South Korea, and the United States. While the likes of Jeff Bezos, Bill Gates, and Peter Thiel have supported some of these ventures, the private fusion industry is still woefully underfunded compared to the progress of the research, as the cumulative capital raised is only around 4% of ITER’s budget.

In this article, we synthesize the perspectives of present and potential future stakeholders in a fusion energy economy, including (but not limited to) academic research groups, government labs, startups, and energy-sector specific and general investors, to assess trends and views on private fusion financing, and then provide recommendations on how to leverage financial engineering methodologies to incentivize greater capitalization. During its compilation, we have interviewed academics at leading research institutions; investors who have previously funded fusion projects; investors who have passed on fusion initiatives; members of energy advisor groups, investment banks, and sovereign wealth funds; founders of fusion startups; and members of the Department of Energy's Advanced Research Project Agency-Energy (DOE ARPA-E), the US government’s research engine for energy technological exploration.

Drawing on insights from these stakeholders, we propose a megafund securitization approach to financing fusion, in which many high-risk projects are amalgamated into a single financial entity, thus improving the risk–return balance of a portfolio of fusion projects to a point that funding might be sourced through a series of optimized debt securities in addition to an equity tranche. We further de-risk the megafund by leveraging first loss capital guarantees from philanthropic sources (ultra-high net worth [UHNW] individuals or private foundations) and governments to fund coupon payments to senior and mezzanine bondholders in its early years. This work represents the first application of the megafund concept outside of the biotech domain. This financial structure exploits the unique properties of the fusion sector, among them the ability of fusion companies to perform many types of divestitures (such as spinning off an independent company or executing equity carve-outs), the increasing industry demand for auxiliary technologies such as control systems, 3D printing, and rapid automated material testing, and the capacity for partnerships with academic institutions. This structure has the potential for immediate implementation, as long as the total assets under management (AUM) are consistent with the quantity of investable assets present in the fusion industry, but it will scale in relevance as the fusion industry proliferates in size and demonstrates commercial performance capabilities.

Fusion is the ultimate “green” investment, yielding a clean source of energy that can sustain human life for longer than any other energy source available to us. Although achieving commercially viable fusion reactors will require tens of billions of dollars of

financing, this expense is trivial when compared to the cost of not pursuing this last best hope of humanity.

