Prepared Statement of

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Hearing on Fusion Energy Science in the United States
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Chairman Weber, Ranking Member Grayson, and Members of the Committee, thank you for the opportunity to testify on fusion energy science in the United States. I thank the Committee for its longstanding support of fusion energy and plasma physics research in this country. In this hearing, I have been asked to describe the status of DOE support for the development of innovative fusion energy concepts, and to provide recommendations on potential ways to improve the DOE's ability to foster such concepts.[1] I am pleased that the Committee is considering these topics. The primary points of my testimony are as follows:

- Fusion energy has the potential to provide safe, clean, abundant baseload power for the world and deserves stable, strong support.
- There is a wide range of scientifically credible innovative fusion energy concepts (to be defined more precisely below) that warrant further study and exploration.
- Such concepts have a potential to significantly lower the cost and shorten the timeline of fusion energy development, even though many of the concepts are presently at a low technological readiness level.
- Lowering the cost of fusion energy development could have several benefits, the most important of which is enabling a healthy public-private partnership for development, as is done in many other technological fields.
- There are presently no opportunities for new federal support of innovative fusion energy concept development toward a fusion power reactor.
- Recent DOE support of innovative fusion energy concept development appears to have been terminated without formal scientific review.
- Congress and DOE should re-assess innovative fusion energy concept development, and strongly consider implementing a new innovative fusion energy concept development program with appropriate program and project metrics to support timely development toward economically competitive fusion power.
- If such a program is implemented, meaningful progress can be made for a modest fraction of the overall fusion energy budget.

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[1] This testimony represents my views and not necessarily that of Los Alamos National Laboratory.

Introduction

Fusion energy holds the tremendous promise of providing safe, clean, and abundant energy for the world with no long-lived radioactive waste and minimal nuclear proliferation dangers. Over sixty-plus years of worldwide controlled fusion research, the United States has supported the development of dozens of widely varying fusion approaches (Fig. 1), of which the magnetically confined tokamak, e.g., ITER, and laser-driven inertial confinement fusion (ICF), e.g., the National Ignition Facility (NIF), have become the two most scientifically mature approaches. The many other approaches have collectively come to be known as "innovative concepts" (where the U.S. has been a clear world leader) within the fusion energy research community, even though innovation itself abounds and is needed throughout fusion research. Indeed, the accumulated scientific and engineering knowledge developed by our fusion research programs make it possible for us to undertake the array of fusion research being conducted today and into the future. These include our domestic fusion research programs, our partnership in ITER, the pursuit of ignition on NIF, the recently launched ARPA-E (Advanced Research Projects Agency–Energy) ALPHA (Accelerating Low-cost Plasma Heating and Assembly) program,[2] and privately funded ventures (e.g., Tri-Alpha Energy, Helion, and the Canadian company General Fusion). It is notable that these efforts represent many fundamentally different fusion approaches. The history of support for fusion research by Congress, DOE (and its predecessors), and other federal agencies (e.g., NASA, Navy, etc.) are what enable all these and perhaps new possibilities.

With ITER and NIF, we are entering a new era of generating laboratory burning plasmas, in which the energetic helium ions produced by deuterium-tritium fusion reactions begin to self-heat the fusion fuel,[3] and where significant fusion energy gains over the input energy are expected to be achieved (as on ITER). The study of burning plasma physics approaching or reaching ignition is the next scientific frontier of the mainline fusion programs, and is therefore the primary present focus of both the DOE Office of Fusion Energy Sciences (FES), supporting fusion energy development via magnetic confinement fusion, and National Nuclear Security Administration (NNSA), supporting Stockpile Stewardship via ICF. *However, the pursuit of ITER and NIF alone does not assure the realization of economically competitive fusion power before the latter half of this century.* This requires many other serious pursuits at increased support, including tritium breeding,[4] development of plasma facing systems that can survive the heat and neutron flux, and *also the development of fusion plasma configurations requiring less engineering complexity and lower capital cost.* Development of innovative fusion energy concepts together with the generation and study of burning plasmas by the most expedient way possible constitute our surest bet to enable economically competitive fusion power production within a reasonable time.

For the purpose of this testimony, let us define "innovative fusion energy concept" as any

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[2] `http://arpa-e.energy.gov/?q=arpa-e-programs/alpha`.

[3] As was recently demonstrated on NIF; O. A. Hurricane et al., "Fuel gain exceeding unity in an inertially confined fusion implosion," Nature **506**, 343 (2014).

[4] Deuterium, which is abundant in seawater, and tritium, which is not available in sufficient quantities and is bred from lithium, are the fuel of a likely first-generation fusion power reactor. However, some concepts aim to use "advanced fuels," such as hydrogen and boron, that do not require tritium breeding nor neutron-compatible plasma-facing systems, but at the expense of requiring higher plasma temperatures than a deuterium-tritium reactor.

concept that *has a pathway toward economically competitive power production* and *could potentially result in a demonstration fusion reactor* (e.g., continuous thermal power output) for total development costs of less than a few billion dollars and in less than twenty years. This would allow fusion to penetrate the midcentury power-generation market. Fusion energy concepts likely costing more than a few billion dollars but still significantly less than ITER, e.g., spherical tokamak (ST),[5] compact stellarator,[6] reversed-field pinch (RFP),[7] tokamak using high-temperature superconducting magnets,[8] or many inertial-fusion-energy (IFE) concepts,[9] could also potentially accelerate the timeline and lower the costs to a demonstration reactor. However, the primary focus of this testimony is on early stage innovative fusion energy concept development.[10]

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[5] F. Najmabadi et al., "Spherical torus concept as power plants–the ARIES-ST study," Fus. Eng. Des. **65**, 143 (2003).

[6] F. Najmabadi et al., "The ARIES-CS Compact Stellarator Fusion Power Plant," Fus. Sci. Tech. **54**, 655 (2008).

[7] F. Najmabadi et al., "Introduction and synopsis of the TITAN reversed-field-pinch fusion-reactor study," Fus. Eng. Des. **23**, 69 (1993).

[8] For example, B. N. Sorbom et al., "ARC: A compact, high-field, fusion nuclear science facility and demonstration power plant with demountable magnets," Fus. Eng. Des. **100**, 378 (2015)

[9] *An Assessment of the Prospects for Inertial Fusion Energy*, Committee on the Prospects for Inertial Confinement Fusion Energy Systems, NRC (National Academies Press, Washington, D.C., 2013).

[10] A practical definition of "early stage" could be before a concept has demonstrated sufficient plasma stability and/or confinement to demonstrate a plasma temperature of ten million degrees, or 1 keV, in a manner that is scalable to fusion breakeven.

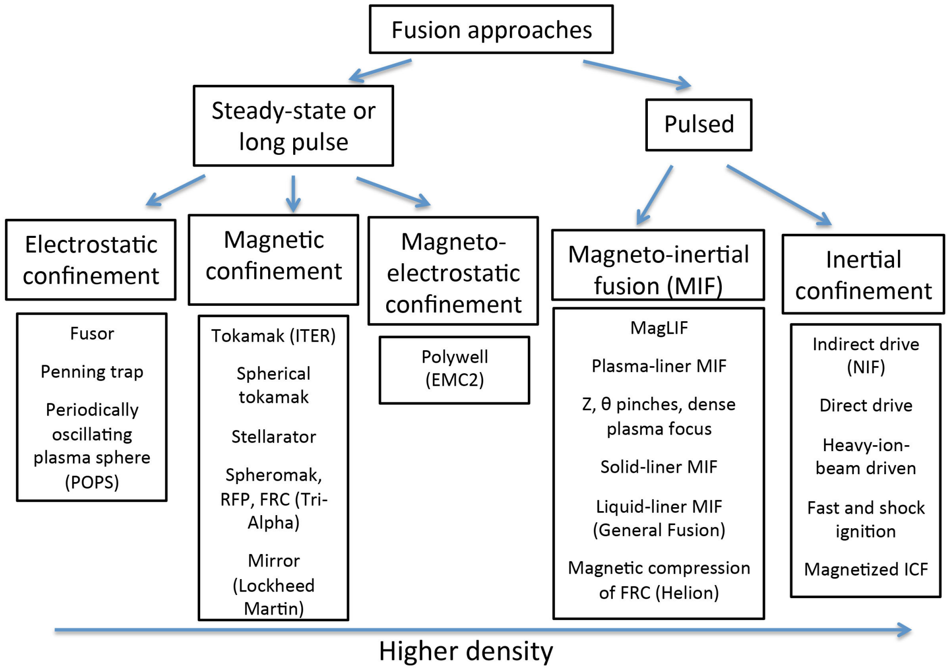

Figure 1: Simple, non-exhaustive categorization of some fusion approaches. The approaches other than tokamak and indirect-drive ICF are collectively referred to as "innovative" or "alternative" fusion concepts by many in the fusion research community.

Fusion energy research in FES is presently organized into four areas.[11] Three of the areas support burning plasma science: foundations (predictive understanding of burning plasmas), long pulse (research on present worldwide long-pulse devices and materials), and high power (ITER). The fourth is discovery plasma science, of which FES is the primary steward in this country. Discovery plasma science underlies all of fusion energy development and impacts many other applications and scientific disciplines as well. The present FES portfolio warrants continuing strong support, but early stage innovative fusion energy concept development is not presently supported within the FES portfolio.

Arguments for Early Stage Innovative Fusion Energy Concept Development

Most early stage innovative fusion energy concepts, even though they are much less mature than a tokamak or laser-driven ICF, would be better suited for an economical fusion power reactor if their performance can be improved. The reason is that most innovative concepts are smaller and have less engineering complexity through the use of more efficient plasma confinement, assembly, or compression technologies. This results in smaller required facility energy and external magnets than tokamaks and less power than ICF to exceed breakeven. As a result, breakeven-class facilities for these innovative fusion energy concepts are significantly lower cost (potentially 100 times less expensive than ITER[12]), easier and faster to build, and lend themselves to faster research progress if there is the support to pursue them. Research opportunities and needs across a range (but not all) of innovative fusion energy concepts were documented in recent reports by expert panels.[13]

Scientifically credible innovative fusion energy concepts span a diverse range in ion density (10^{14}–10^{26} ions/cm^3), magnetic field strength (0 to $>$ 1000 Tesla), geometry (linear/cylindrical, spherical, toroidal, cusp, etc.), pulse duration (sub-nanosecond to steady state), confinement method (electrostatic, magnetic, inertial, or combinations thereof), and technologies for fuel assembly, heating, and/or sustainment (e.g., electromagnetic waves, neutral beams, lasers, ion beams, various pulsed-power techniques such as plasma jets, etc.). Much of this "phase space" of fusion possibilities has not been explored to anywhere near the depths afforded to the mainline approaches of the tokamak and laser-driven ICF. Many innovative concepts have enjoyed continued recent advances despite having no DOE support, e.g., field-reversed configurations (FRC) at Tri-Alpha Energy, mirror-based gas dynamic traps in Russia, magnetized target fusion (MTF) at General Fusion, and polywell at Energy Matter Conversion Corporation (EMC2), showing that there are opportunities in innovative fusion energy concept development.

Another significant potential benefit of innovative fusion energy concept development is the opportunity it provides to enable a healthy public-private partnership by significantly

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[11] Office of Fusion Energy Sciences, A Ten-Year Perspective (2015-2025), Dec. 2015; `http://science.energy.gov/~/media/fes/pdf/program-documents/FES_A_Ten-Year_Perspective_2015-2025.pdf`.

[12] I. R. Lindemuth and R. E. Siemon, "The fundamental parameter space of controlled thermonuclear fusion," Amer. J. Phys. **77**, 407 (2009).

[13] Reports of the 2009 Research Needs Workshops (ReNeW) on Magnetic Fusion Energy Sciences and High Energy Density Laboratory Physics, U. S. Dept. of Energy (2010), `http://science.energy.gov/fes/community-resources/workshop-reports`; Report of the FESAC Toroidal Alternates Panel, U. S. Dept. of Energy (2008), `http://science.energy.gov/~/media/fes/fesac/pdf/2008/Toroidal_alternates_panel_report.pdf`.

lowering the cost of fusion energy development.[14] Presently, the cost-times-risk product at each step of our present fusion energy development path far exceeds what the private sector can accept. Instead, if costs are hundreds of millions of dollars or less (compared to billions or more for the mainline fusion approaches) for achieving each major technical milestone on the path to reactor-relevant energy gain, the private sector has already shown that it is willing to undertake this, e.g., in their funding of Tri-Alpha Energy and General Fusion. However, it is presently difficult to garner private support for a larger range of innovative fusion energy concepts due to the tremendous early stage risks (including those faced by Tri-Alpha Energy and General Fusion). If early stage risk could be systematically minimized by federally supported research across a portfolio of innovative fusion energy concepts, to the point where the combination of cost, risk, and potential reward become attractive to private investors, it is plausible to envision many more private fusion ventures. Private investments could then considerably outpace federal dollars in scaling up concepts that have already passed the riskiest early stage milestones.[15,16] Lower-cost fusion concepts could also enable more non-energy spinoff applications of fusion.[17]

The long time scales associated with our present fusion energy development strategy presents a dilemma to many of our best and brightest science and engineering students. While many of them wish to devote their careers to solving our profound energy challenges, they also want to feel that societal impact is within reach during their lifetimes. Stable, robust support for innovative fusion energy concept development provides such a possibility. Although the challenges are significant, innovative fusion energy concept development could help maintain a strong fusion energy workforce, while also increasing the chances for fusion energy to impact the midcentury power-generation market.

If any of the numerous scientifically credible innovative fusion energy concepts are successful, fusion energy could possibly be developed for a few billion dollars[18] in less than twenty years. Even while we justifiably pursue the most mature paths to burning plasmas and/or ignition (i.e., ITER and NIF), we also have a responsibility to the taxpayer to overturn the idea that fusion energy development must cost tens of billions of dollars and is always thirty years away. Innovative fusion energy concept development provides this possibility.

Status of DOE Support for Innovative Fusion Energy Concept Development

The DOE, its predecessors, and at times other federal agencies have long supported the development of innovative fusion energy concepts. The past support underpins all present-day innovative fusion energy concept development. Recently, innovative fusion energy con-

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[14] S. Woodruff et al., "Path to Market for Compact Modular Fusion Power Cores," J. Fusion Energy **31**, 305 (2012).

[15] An example of such a public-private partnership is the $800M NASA investment under COTS (Commercial Orbital Transportation Services) that resulted in two new U.S. medium-class launch vehicles and two automated cargo spacecraft developed by the companies SpaceX and Orbital Sciences Corporation.

[16] For fusion, similar to the nuclear fission industry, assistance from the federal government in licensing, regulation, and loan guarantees are still needed for constructing a capital-intensive fusion power plant.

[17] An example is SHINE Medical Technologies, which will produce radioactive isotopes for medical applications; `http://shinemed.com`.

[18] For example, D. A. Sutherland et al., "The dynomak: An advanced spheromak reactor concept with imposed-dynamo current drive and next-generation nuclear power technologies," Fus. Eng. Des. **89**, 412 (2014).

cepts (including both early stage, such as spheromak and FRC, and more mature concepts, such as spherical tokamak and reversed-field pinch) were referred to collectively as "alternative fusion concepts," which also included magneto-inertial fusion (MIF, aka MTF) and IFE. An alternative fusion concept program was explicitly included in the *Strategic Plan for the Restructured U.S. Fusion Energy Sciences Program* in 1996,[19] to which the present-day FES traces its roots. Recommendations for the alternative concepts program were provided in a detailed 1996 report to FESAC chaired by F. Najmabadi.[20]

However, DOE support for the development of early stage innovative fusion energy concepts has eroded over the past decade, coincident with longstanding and increasing budget pressures on fusion energy research in this country. Until as recently as FY2010, FES supported early stage innovative fusion energy concept development (both magnetic and inertial) at approximately $42M per year.[21] In FY2011, support for the development of magnetic alternate concepts as fusion energy concepts in their own right was terminated with much of the budget transitioned to supporting computational model validation and/or burning plasma science.[22] In FY2012, support for innovative MIF and IFE approaches within the Joint FES/NNSA Program in High Energy Density Laboratory Plasmas (HEDLP) was terminated and transitioned to supporting discovery HEDLP science.[23] In FY2016, spheromak and FRC research was moved to the NSF/DOE Partnership in Basic Plasma Science and Engineering, where "proposals directly related to fusion energy studies are not eligible."[24] Remaining small or intermediate-scale experiments based on ST (PPPL, Wisconsin–Madison), stellarator (Wisconsin–Madison, Auburn), and RFP (Wisconsin–Madison) continue to be supported by FES, but largely with the objectives of supporting model validation, burning plasma science, or discovery plasma science, and not for innovative fusion energy concept development. Many others including the spheromak (Lawrence Livermore National Laboratory), FRC (Univ. of Washington), dipole (Columbia/MIT), centrifugal mirror (Univ.

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[19] `http://science.energy.gov/~/media/fes/fesac/pdf/1990-99/1996_aug.pdf`, pp. 5–6.

[20] `http://science.energy.gov/~/media/fes/fesac/pdf/1990-99/1996_jul.pdf`.

[21] About $18M/year in their "Experimental Plasma Research" budget line supporting mostly toroidal magnetic alternates, and about $24M/year in their "High Energy Density Laboratory Plasmas" budget line supporting innovative approaches to inertial fusion, including laser-driven (e.g., shock or fast ignition), pulsed-power driven (e.g., magneto-inertial fusion), or ion-beam driven.

[22] Proposal solicitation DE-FG01-04ER04-18 on "Research in Innovative Approaches to Fusion Energy Scences" for FY2005 funding states that the "OFES Innovative Confinement Concepts (ICC) Program has the long-term performance measure of demonstrating enhanced fundamental understanding of magnetic confinement and improved basis for future burning plasma experiments through research on magnetic confinement configuration optimization. The program is focused on resolving key scientific issues and determining the confinement characteristics of a range of attractive confinement configurations." In contrast, proposal solicitation DE-FOA-0000286 for FY11 funding states that "the ICC program explores improved pathways to practical fusion power by addressing critical problems that hinder the tokamak concept, such as plasma disruption, heat load on internal components, and operational and maintenance complexity."

[23] Proposal solicitation DE-PS02-08ER08-16 in HEDLP for FY2009 funding states that a key objective is to "advance HED science that enables fusion energy" including "novel approaches to inertial fusion energy sciences" such as "fast ignition, shock ignition, magneto-inertial fusion and heavy ion fusion." In contrast, proposal solicitation DE-FOA-0000755 in HEDLP for FY13 funding focused on HEDLP as the "study of ionized matter at extremely high density and temperature" with no mention or invitation of energy-relevant studies. Many innovative energy-relevant HEDLP projects awarded under the earlier solicitation were terminated in FY2012 with no opportunity for continued funding in innovative fusion energy concept development.

[24] NSF/DOE Partnership in Basic Plasma Science and Engineering, Program Solicitation NSF 15-601, p. 4; `www.nsf.gov/pubs/2015/nsf15601/nsf15601.pdf`.

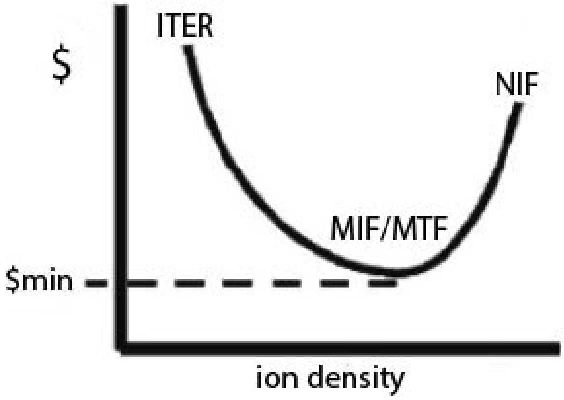

Figure 2: Illustration of cost of an ignition-class facility versus ion density. The minimum (several hundred million dollars or less) occurs for magneto-inertial-fusion (MIF), aka magnetized target fusion (MTF), concepts with ion density (10^{18}–10^{23} ions/cm^3) in the range between those of ITER and NIF. See footnote 12. Figure adapted from P. J. Turchi, IEEE Trans. Plasma Sci. **36**, 52 (2008).

of Maryland), and inertial electrostatic confinement (Los Alamos National Laboratory and others) no longer receive DOE support. These program decisions appear to have been made without formal scientific reviews.

Today, the only early stage innovative fusion energy concept development supported by the DOE is within the previously mentioned ARPA-E ALPHA program ($30M total over three years, initiated in 2015), the goal of which is to create new, lower-cost development paths toward economical fusion power. ALPHA focuses on pulsed, intermediate-density (10^{18}–10^{23} ions/cm^3) MIF/MTF approaches because the intermediate-density parameter space represents a low-cost minimum for a thermonuclear-fusion, ignition-class facility (several hundred million dollars or less), as depicted in Fig. 2, due to an optimum combination of required stored energy and heating power to achieve ignition. The ALPHA program is structured fundamentally differently than other DOE fusion research programs.[25] It is an aggressive, milestone-driven program specifically focused on systematically removing early stage scientific and technical risks, with appropriate program and project metrics. Consistent with ARPA-E's charter and mission, the support is for a defined period (in this case, three years) with the objective of transitioning its most successful projects as soon as possible to support and development by private investments and/or other federal agencies. This type of federally supported program, but sustained for a duration needed until the best concept(s) are well-suited for private development, would benefit a broader range of early stage innovative fusion energy concepts, most of which *have no avenue for new federal support*.

Private investments have overtaken DOE support for the development of early stage innovative fusion energy concepts, but not because those concepts are ready for commercialization. Entry of private investors into early stage, highly risky fusion energy development may be the result of a confluence of three factors: (1) growing sense of urgency of the need for large amounts of clean, baseload power by midcentury, (2) growing impatience by many people, both within and outside the fusion research community, at the rate of progress in

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[25] ARPA-E ALPHA Funding Opportunity Announcement DE-FOA-0001184 (2015).

fusion energy development, and (3) the opportunity to re-examine previously explored concepts (often with a substantial new twist) with the benefit of a very advanced understanding of fusion science and engineering, as well as truly impressive computational and measurement capabilities. Over the past decade or so, there has been at least $300M of private investments in innovative fusion energy concept development, with Tri-Alpha Energy and General Fusion receiving the large majority of that investment, even though, as mentioned earlier, these are relatively isolated cases of private investments in fusion with risk-reward ratios much larger than most private investors are willing to accept. With private funding, Tri-Alpha Energy and General Fusion have reported major advances in FRCs[26] and spheromaks,[27] respectively, building on the extensive knowledge and capabilities developed under previous DOE support. However, there is still a challenging, uncertain road ahead for both.

The NNSA does not support IFE research but does support three approaches aimed at obtaining high yield or ignition: (i) indirect- and (ii) direct-drive laser-driven ICF, and (iii) magnetically driven implosions (including an MIF concept call MagLIF[28]), to support Stockpile Stewardship. High yield and ignition are important scientific milestones for ICF and fusion generally, regardless of whether ICF is being studied for the energy application. IFE development, which would leverage NNSA fusion facilities and staff, can accelerate potential ICF pathways (including MagLIF) toward fusion energy. Opportunities include the study of more efficient, reactor-relevant drivers and a broader range of target designs (e.g., fast or shock ignition and magnetized ICF). However, due to development costs, many ICF approaches may not fit within the earlier definition of "innovative fusion energy concept."

Recommendations

1. Provide an avenue for merit-based federal support for scientifically credible, innovative fusion energy concept development. *This does not presently exist outside the limited-term ARPA-E ALPHA program.* Any new program to support innovative fusion energy concept development should pay attention to both the plasma physics challenges as well as criteria for a practical fusion power reactor.[29]

2. Such support should be milestone-driven with metrics-based criteria for project advancement and termination, such as in the ARPA-E ALPHA program or in the originally intended vision of the alternative concepts program of FES.[30]

3. To be effective, the size of an innovative concept development program should be well-matched to the achievement of milestones in a timely manner. Funding requirements

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[26] M. W. Binderbauer et al., "A high performance field-reversed configuration," Phys. Plasmas **22**, 056110 (2015).

[27] Talk by M. Laberge, Exploratory Plasma Research Workshop, Feb. 23–26, 2016, Auburn, AL; `http://www.iccworkshops.org/epr2016/uploads/419/epr_2016_upload-1.pdf`.

[28] Along with the earlier-mentioned result on unity fuel gain on NIF, MagLIF has also provided a significant recent advance in the science of MIF: M. R. Gomez et al., "Experimental Demonstration of Fusion-Relevant Conditions in Magnetized Liner Inertial Fusion," Phys. Rev. Lett. **113**, 155003 (2014).

[29] J. Kaslow et al., "Criteria for practical fusion power systems: Report from the EPRI fusion panel," J. Fusion Energy **13**, 181 (1994).

[30] In assessing stages of innovative fusion energy concept development in the past, FES used the nomenclature of "concept exploration" (CE), "proof of principle" (POP), and "performance extension" (PE), as outlined in the *Report of the Integrated Program Planning Activity for DOE's FES Program*, 2000; `http://fire.pppl.gov/IPPAfinalrev.pdf`. See also footnote 14.

for a particular concept depend on the inherent cost of the concept and the concept's stage of development, and could range from \$5M to \$100M or more over three years (notional figures) for each concept to pursue its next logical milestone.

4. Ensure that a federal funding bridge from DOE Office of Science all the way to handoff to venture capital exists for early stage innovative fusion energy concept development (see Fig. 3). However, the incompatibility between an energy-development program and the Office of Science must be considered, even for early stage development.

5. If progress warrants, issue a follow-on phase 2 to ARPA-E's ALPHA program to support its most successful projects, which would improve the chances of transitioning at least one of its projects to development by private investment or other federal agencies.

6. Ensure that fusion energy, especially innovative fusion energy concept development, is included within the scope of and benefits from Mission Innovation,[31] as implemented.

7. Support the development (and use) of tools (e.g., computational codes, diagnostic capabilities, domestic and international facilities) and engineering solutions (e.g., plasma facing and tritium-breeding systems) needed by many fusion energy concepts, e.g., an expanded version of the FES Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs.[32]

8. Enable nearer-term public-private partnerships (e.g., code development and sharing, personnel exchanges, use of DOE nuclear facilities) with private fusion companies.[33]

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[31] `http://mission-innovation.net`.

[32] `http://science.energy.gov/sbir`.

[33] As outlined in General Fusion CEO Nathan Gilliland's testimony to this Committee on May 13, 2015.

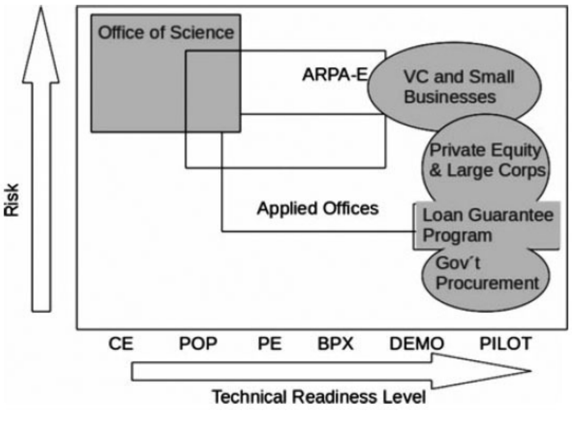

Figure 3: Possible roles of various entities in a lower-cost fusion energy development path. Lowering the cost of fusion energy development is necessary to enable this type of funding model. Figure is from Woodruff et al., 2012 (see footnote 14), adapted from the testimony of A. Majumdar to the House Committee on Science and Technology on Jan. 27, 2010.

Biography for Scott C. Hsu

Dr. Scott C. Hsu is a fusion research scientist in the Physics Division–Plasma Physics Group at Los Alamos National Laboratory (LANL) in Los Alamos, NM. He earned a Ph.D. in Astrophysical Sciences (Program in Plasma Physics) in 2000 from Princeton University, where he made experimental measurements of ion heating during magnetic reconnection, which is an ubiquitous process in both laboratory fusion and astrophysical plasmas responsible for converting energy from magnetic field energy to plasma kinetic energy. Subsequently, he was awarded a DOE Fusion Energy Postdoctoral Fellowship to pursue research at the California Institute of Technology on an alternate magnetic fusion concept called the spheromak. There, he also became a pioneer in connecting the physics of astrophysical jets to those studied in laboratory plasma experiments. In 2002, he went to LANL as a Frederick Reines Distinguished Postdoctoral Fellow to work on magnetized target fusion (aka magneto-inertial fusion or MIF), which is a higher-density and pulsed alternate fusion approach, and also basic laboratory plasma physics and plasma astrophysics. More recently at LANL, Scott has also branched out into research in high-energy-density (HED) physics and inertial confinement fusion (ICF). Presently, Scott is lead principal investigator for a multi-institutional plasma-jet-driven MIF research project, including primary partner HyperV Technologies Corp., sponsored by the DOE Advanced Research Projects Agency–Energy (ARPA-E) under its ALPHA (Accelerating Low-Cost Plasma Heating and Assembly) program. He also conducts experiments and HED research on the OMEGA laser facility at the Laboratory for Laser Energetics at the University of Rochester. Scott is the author or co-author of 60 refereed research publications in plasma and fusion science. In 2002, Scott was a co-recipient of the American Physical Society (APS) Award for Excellence in Plasma Physics Research, and in 2009, he served as a subpanel member in the DOE's Basic Research Needs Workshops for both Magnetic Fusion Energy Sciences and High Energy Density Laboratory Physics. He was formerly an executive committee member of the APS Topical Group in Plasma Astrophysics (2004–2007), and is presently a member of the Exploratory Plasma Research (EPR) executive committee (since 2012).