

Powering the Future Fusion & Plasmas

A long-range plan to deliver
fusion energy and to advance
plasma science

A report of the DOE Fusion Energy Sciences Advisory Committee

FESAC Meeting, August 30, 2021

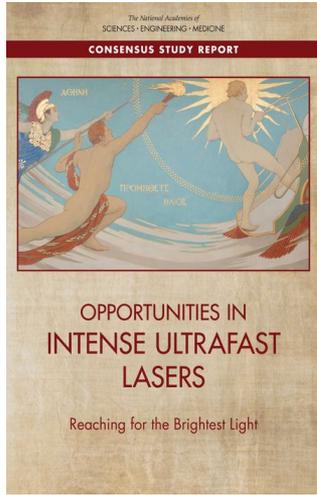


2018 Fusion Energy Sciences Advisory Committee Charge

- Charge covers entire DOE Fusion Energy Sciences portfolio: “...**should identify and prioritize the research required to advance both the scientific foundation needed to develop a fusion energy source, as well as the broader FES mission to steward plasma science.**”
- Two part process, community driven phase (APS DPP Community Planning Process) and FESAC-led phase
- “Optimized FES program over the next ten years” (FY22-FY31). Consider three budget scenarios: **constant level of effort, modest growth** (2% above inflation), and **unconstrained** but prioritized
- “...assume that the US Contributions to ITER project will continue throughout this entire period”: focus on the non-ITER-project portion of the budget.



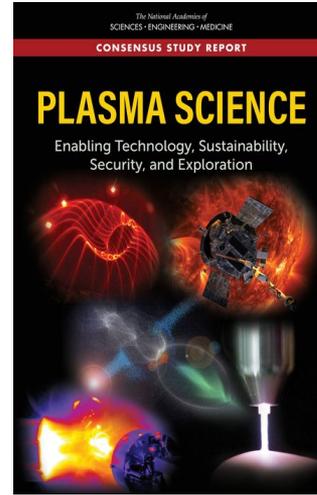
Context: Four important NASEM reports



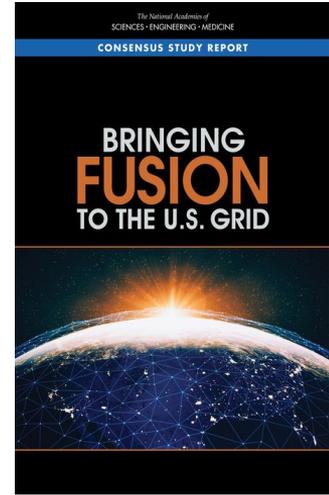
2018



2019



2020



2021

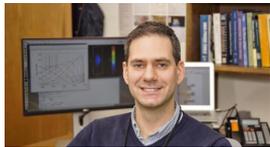
- Convey exciting opportunities in plasma science and technology and urgent need to accelerate the development of fusion energy, with the goal of a fusion pilot plant on a timescale to mitigate climate change



Successful Phase 1, thanks to CPP leadership and the community



Scott Baalrud



Nathan Ferraro



Lauren Garrison



Nathan Howard



Carolyn Kuranz



John Sarff



Wayne Solomon



Earl Scime

- APS DPP Community Planning Process (CPP): Year-long community-led process. Whitepapers, webinars, town halls and 5 major workshops; Open process, with community review/vetting of draft report
- Process not only enumerated the many scientific and technical opportunities, but did the hard work of establishing guidance for prioritization of these activities
- Consensus CPP report expresses community's excitement to move forward urgently to develop fusion power and advance plasma science and was the scientific and technical basis for the FESAC report

Thank you!



FESAC Long Range Planning Subcommittee



Scott Baalrud



Riccardo Betti



Troy Carter



Tyler Ellis



John Foster



Cameron Geddes



Arianna Gleason



Chris Holland



Paul Humrickhouse



Chuck Kessel



Ane Lasz



Tammy Ma



Rajesh Maingi



David Schaffner



Oliver Schmitz



Uri Shumlak



Lance Snead



Wayne Solomon



Erik Trask



Francois Waelbroeck



Anne White

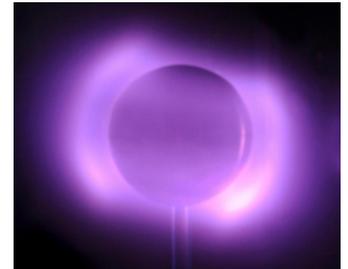


Don Rej (ex officio)



Thank you!

- To Laurie Moret, for her guidance throughout the two-year process
- To Sam Barish, for his advice and assistance as FES liaison
- To Sandbox Studio (Michael Branigan & Ana Kova) for illustration and graphic design and to Jim Dawson & Martha Hanna for editing.





Subcommittee Process

- Subcommittee work began February 2020, ramped up with delivery of the “Phase 1” Community Planning Process report in March
- Entire process conducted virtually (many subcommittee members have never met before in person). Uncountable number hours spent on Zoom (countable number on MS Teams)
- Many guest speakers: from other federal agencies, on related reports, on public–private partnership models
- Community engagement through focus groups, virtual workshop
- Scenarios developed using extensive budget analysis: utilizing data from FES, range of inputs on facilities costs including costing experts with extensive DOE project experience ([Jeff Hoy](#), [Carl Strawbridge](#))
- Worked by consensus process to produce the final report



Final report published, web version available

- Draft report released publicly December 4, 2020
- Report approved by unanimous vote during FESAC meeting December 7-10, 2020
 - ◆ That approval required changes to draft to improve, clarify report
- FESAC changes implemented, report had professional editing and copy editing
- **Final report released Feb 15**
- **Web version of the report published in May**
- Report (web version + PDF) posted at <http://usfusionandplasmas.org>

Web version & Hardcopies available



A Report of the Fusion Energy Sciences Advisory Committee



Powering the Future Fusion & Plasmas

Fusion is the merging of nuclei to release the energy that powers stars; plasmas are ionized gases, the fourth state of matter that makes up stars. The two are inextricably linked. Their shared history exemplifies how basic scientific research translates from a deeper understanding of the universe to technologies that benefit society.

[→ Learn More](#)

Fusion Technology & Science Drivers

The Fusion Science and Technology area should focus on establishing the scientific and technical basis for a fusion pilot plant by the 2040s.

Plasma Technology & Science Drivers

The Plasma Science and Technology area should focus on new opportunities to advance fundamental understanding and, translate these advances into applications that benefit





Report rollout presentations/briefings

- **Presentations to plasma/fusion institutions and community groups:** FPA, HEDSA, ANS FED, PPPL, ORNL, DIII-D/GA, Wisconsin, Michigan, VLT, US BPO, LLNL, MIT, UT Austin, U Wash.
- **Presentations to foreign plasma/fusion institutions:** I-DTT, Japan MEXT, DIFFER*
- **Chevron:** presentation to energy transition team
- **Energy Sciences Coalition**
- **Congressional Staffers**
 - ◆ Fusion Day Congressional Briefing
 - ◆ Authorization committees staffers: House Science, Space & Technology Committee; Senate Energy & Natural Resources
 - ◆ Appropriation committees staffers: House Energy and Water; Senate Energy and Water Development
- **Office of Management & Budget**



Feedback from Congressional Staffers

- All were very happy to see a research community **consensus** report that was **unanimously approved** by FESAC and includes **clear prioritization**. We were thanked for this by all staffers that we met with - **the community was successful in delivering a report that met the charge**
- Heard excitement about & interest in the new directions called for in the report
- Question that we heard in every meeting: “Do we need to draft legislation to ensure that DOE will follow the report?”
 - ◆ Asked for follow-up after President’s budget to discuss alignment



FY22 Appropriations process; President's budget

- President's budget request for FES does call out FESAC report and makes changes relative to FY21 that are consistent with prioritization
 - ◆ 20% increase in FM&T (+\$10M), starts (nascent) FPP design effort, increase (slight) to INFUSE, puts resources into new DEI/Workforce program (DOE SC RENEW), starts ITER research team
- However, disappointing total number, \$675M, only \$3M over FY21
 - ◆ Positives: far better than FY21 President's Budget request for FES; Because of shifts in construction spending, represents a \$14M increase over the FESAC plan starting point
 - ◆ But not consistent with an aggressive fusion energy development effort targeting an FPP by the 2040's

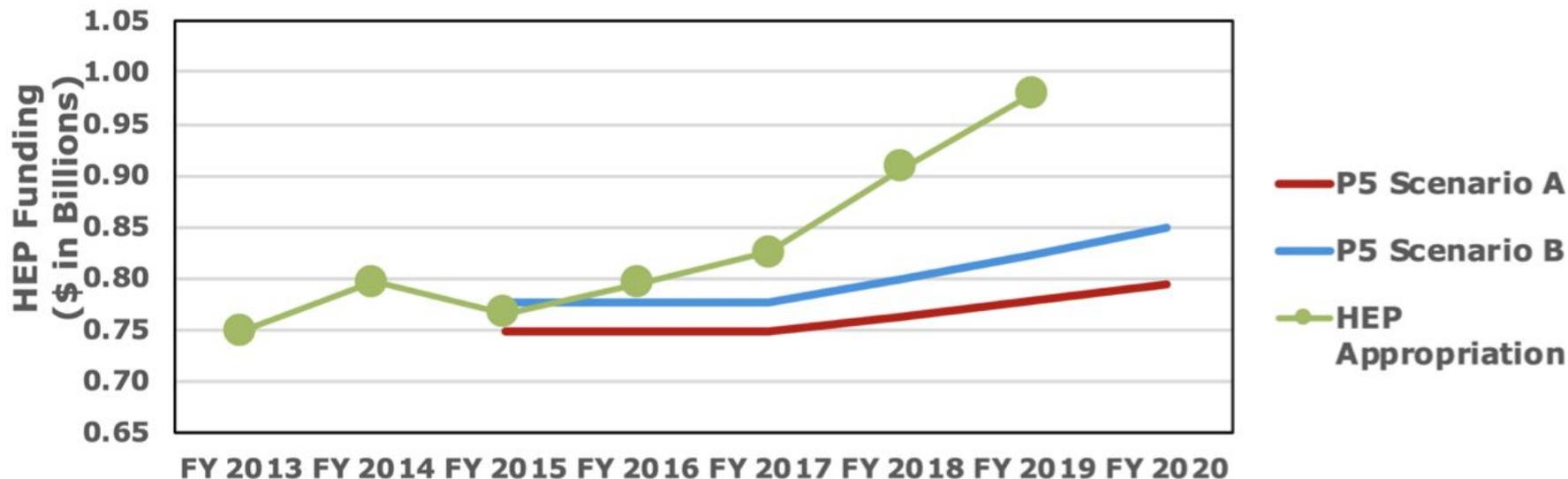


FY22 Appropriations process; President's budget

- Administration gave limited overall increase to DOE Office of Science, did not give headroom for significant increases to FES
- FESAC LRP report landed at an awkward time, during the transition in administrations
 - ◆ FY22 President's budget generated before confirmation of DOE SC Director, Undersecretary for Science & Energy
- House and Senate E&W budgets not too dissimilar from President's budget. Limited chances for changes to SC FY22 budget remain (in reconciliation) but full FY22 process is not over yet

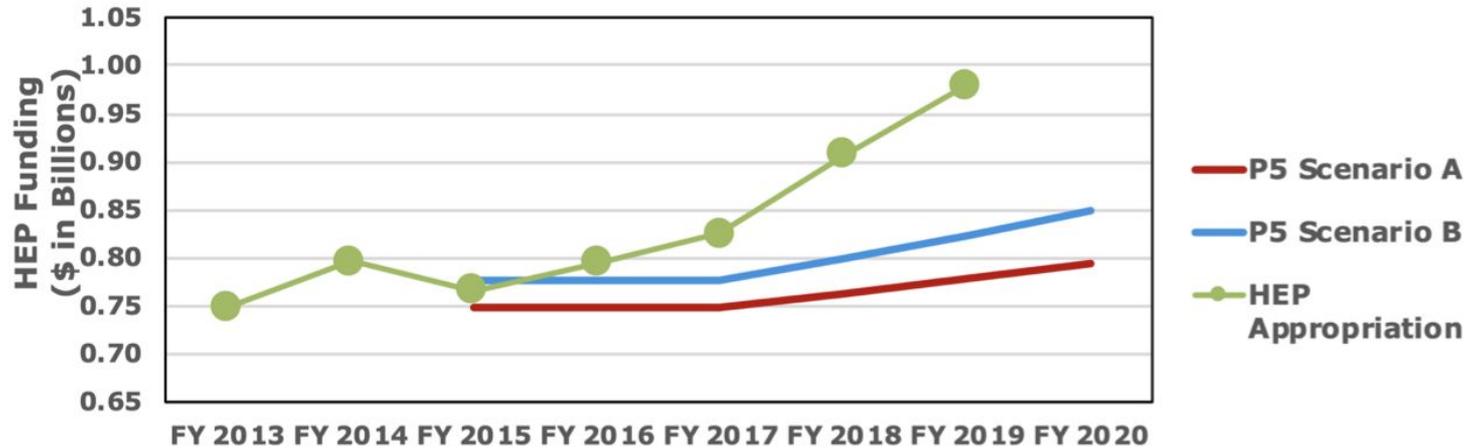


P5 bump was not overnight, must continue to speak with one voice





P5 bump was not overnight, must continue to speak with one voice



- Fusion & Plasma research community worked incredibly hard to produce a report that **met the charge, with consensus and real prioritization**
- This report has been met with appreciation and support from within the federal government and we need to continue to work together to advocate for the plan



DOE Science for the Future Act

(C) by adding at the end the following:

“(2) the Director shall incorporate the findings and recommendations of the report of the Fusion Energy Sciences Advisory Committee entitled ‘Powering the Future: Fusion and Plasmas’ and the report of the National Academies entitled “Bringing Fusion to the U.S. Grid” into the planning process of the Department, including the development of future budget requests to Congress.”;

- 2) \$1,002,900,000 for fiscal year 2022;
- 3) \$1,095,707,000 for fiscal year 2023;
- 4) \$1,129,368,490 for fiscal year 2024;
- 5) \$1,149,042,284 for fiscal year 2025; and
- 6) \$1,243,097,244 for fiscal year 2026.”.

New reauthorization for DOE SC (passed House in June) calls out report & priorities and increases authorization levels for FES.



Support from Rep. Eddie Bernice Johnson

EDDIE BERNICE JOHNSON, Texas
CHAIRWOMAN

FRANK D. LUCAS, Oklahoma
RANKING MEMBER

Congress of the United States House of Representatives

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

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June 30, 2021

The Honorable Rosa DeLauro
Chairwoman
Committee on Appropriations
H-307, The Capitol
U.S. House of Representatives
Washington, DC 20515

Dear Chairwoman DeLauro,

As the Chairwoman of the House Science, Space, and Technology Committee, I am writing to encourage your continued support for our nation's research and development enterprise at the Department of Energy (DOE). Investments in clean energy innovation, from fundamental research to commercial application programs, serve to strengthen U.S. scientific and economic leadership, support the next generation of scientists and technology leaders, and seed the industries that will accelerate a just transition to a clean energy economy.

Letter to Chairwoman of House Appropriations Committee Rosa DeLauro

 Support from Rep. Eddie Bernice Johnson

Lastly, I am quite concerned that the recommendations in a comprehensive, community-driven long range plan that was recently produced by the Fusion Energy Sciences Advisory Committee (FESAC) and those in a recent National Academies report entitled *Bringing Fusion to the U.S. Grid* were not reflected in the President's budget request in a meaningful way. For many years, this Committee and others of jurisdiction have recommended that the Department and the fusion research community produce a strategic plan that identifies clear priorities under several realistic budget scenarios, similar to the successful planning processes for the high energy physics community and other research programs. The Department was also required to produce such a report following passage of the Department of Energy Research and Innovation Act in 2018. So I was very pleased to see DOE and the fusion research community take this challenge on and make the tough decisions to produce a robust and achievable roadmap that would ensure U.S. leadership in this critical field over the next decade. It is therefore disappointing, and frankly perplexing, that this report from FESAC in particular appears to have had no significant impact on the subsequent budget request for fusion research from the Department. Also of note, in



ENERGY | OPINION

It's Time for Congress to Support Fusion Energy

Fusion devices for clean, safe, and affordable electricity and industrial heat are making advances and need a push

By U.S. Representative Don Beyer on June 4, 2021

Sci. Am. Op Ed by VA Rep Don Beyer (chair of House Fusion Caucus)



New House Fusion Caucus

A burgeoning U.S. fusion industry is making progress toward introducing energy-producing devices that will provide clean, safe, and affordable electricity and industrial heat. Several American companies are already working on the goal of commercializing fusion technology and providing power to the grid, with recently reported successes contributing to an optimistic outlook. The Department of Energy's Fusion Energy Sciences Advisory Committee recently recommended starting up a U.S. experimental pilot plant by the 2040s. A preliminary design for such a plant should be completed by 2025, according to a strategic plan published earlier this year by the National Academies of Science, Engineering, and Medicine.

Sci. Am. Op Ed by VA Rep Don Beyer (chair of House Fusion Caucus)



Next Steps?

- Fusion & Plasma research community worked incredibly hard to produce a report that **met the charge, with consensus and real prioritization**
 - ◆ This report has been met with appreciation and support from within the federal government and we need to continue to work together to advocate for the plan

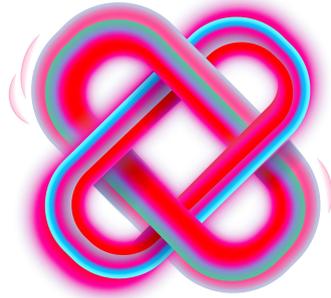


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 - ◆ This report has been met with appreciation and support from within the federal government and we need to continue to work together to advocate for the plan
- Beyond advocacy and speaking with one voice, I think there are additional needed steps:
 - ◆ CPP and FESAC LRP did not fully define needed initiatives/programs: need the community to work to define these (e.g. FPP Design activity, ITER research team, Plasma Technology Program, needed new facilities). ReNeW like activities will help here
 - ◆ What can FESAC do? Ongoing role in providing advice on implementation? Process to develop new models for PPP?



Thank you!



<http://usfusionandplasmas.org>



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