

 National Spherical Torus eXperiment Upgrade

# NSTX-U / Magnetic Fusion Science Meeting

Dec. 14, 2020

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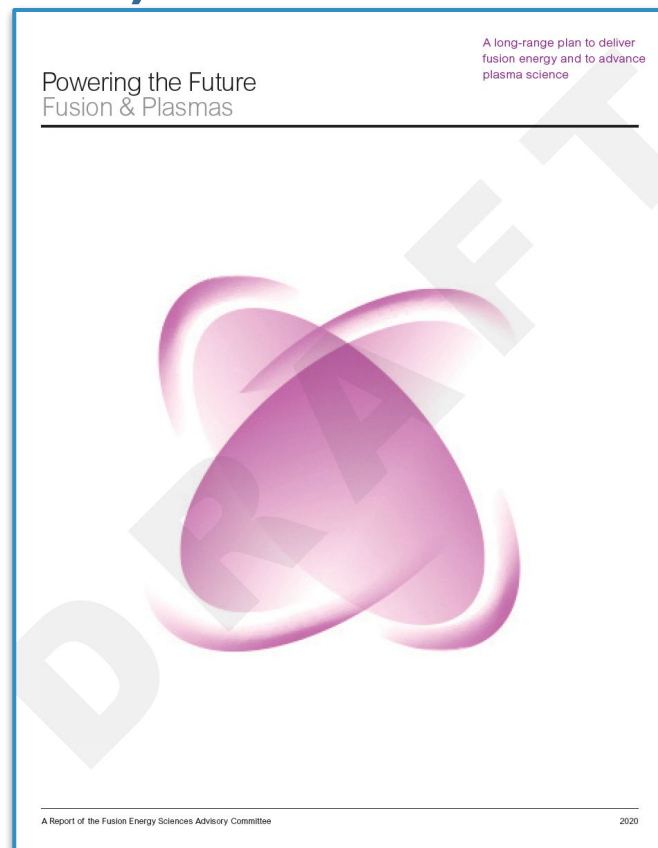
# Some upcoming events

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- Dec. 14-17, 2020 (virtual), High Temperature Plasma Diagnostics
- Dec. 16-17, 2020 (virtual), Fusion Power Associates
- Jan. 24-29, 2021 (virtual), Int. Conf. on Plasma Surface Interactions
- May 10-15, 2021 (Nice, France or virtual), IAEA-FEC
  - April 9, 2021: Conference “pre-prints” due
  - May 31, 2021: Nuclear Fusion manuscripts due
  - **Please be prepared to provide a couple paragraphs + figure for NSTX-U Research Overview paper and poster** (talk is rapporteured)
    - Should be work that’s new since FEC 2018 as published in Kaye et al. Nucl. Fusion 59, 112007 (2019): <https://doi.org/10.1088/1741-4326/ab023a>
- NSTX-U collaborators - we intend to schedule ~15 minute talks in the near future (~Jan/Feb 2021) for collaborators to briefly summarize their plans, schedules and needs

# Last week FESAC unanimously approved the FES Long Range Plan (LRP)

- “Powering the Future: Fusion and Plasmas” draft report available on [FESAC website](#)
  - Spans entire FES portfolio (Fusion Science & Technology, Plasma Science & Technology)
- Subcommittee presented plan to FESAC
- 3 day ~~interrogation~~ by discussion with FESAC
  - Questions and clarifications
  - Wordsmithing of Recommendation language
  - Additional minor edits requested, to be implemented for final report
- **All 27 recommendations, and the report as a whole, was approved unanimously by FESAC**  
→ **incredible success!**



# LRP recommendations clearly reflect community-driven CPP activities & final report

## **E.g., from Fusion Science & Technology Recommendations:**

- *Explicit vision of a US Fusion Pilot Plant in the 2040s* (Initiate FPP design effort)
- Expand Fusion Material & Technology programs and facilities (FPNS, MPEX, HHF)
- Establish ITER research team to fully engage in ITER
- Close tokamak FPP design gaps via NSTX-U, DIII-D, international facilities
- New EXCITE facility to close integrated tokamak exhaust and performance gap
- Strengthen innovative program elements for core confinement and PFCs (stellarators, LM PFC, IFE, alternates)

## **Some Overarching Recommendations**

- Expand current, and establish new, public-private partnership programs
- Establish plan to improve Diversity, Equity & Inclusivity; workforce development
- Support regular pre-conceptual design scoping & costing
- Provide resources for ongoing design & construction of new facilities
- Community-led long range planning should be repeated every five years (or sooner)

# LRP budget scenarios reflect CPP input

- LRP provides prioritization under three budget scenarios as requested by DOE/SC in the [FESAC charge](#)
- Clearly follows prioritization discussion that occurred as part of CPP workshops (Knoxville, Houston)
- “Constant level of effort” scenario (painful) respects CPP desire to expand FM&T efforts
  - With unfortunate consequences that nobody likes or wants, but FESAC was charged to address
- “Unconstrained” scenario supports vision of a FPP in the 2040’s with a not-unrealistic budget expansion (~3-4x non-ITER \$)

Chapter 2 Powering the Future: Fusion and Plasmas Table 1

Portfolio Elements	Scenarios			Technology and Science Drivers					
	Consistent Level	Modest Growth	Unconstrained	Scale a Burning Plasma	Engineer for Extreme Conditions	Horizon Fusion Power	Strengthen the Foundations	Create Transformative Technologies	Advance the Plasma Universe
<b>Research, Operations, and Small Scale Construction</b>									
FM&T Programs	Yes, enhance	Yes, enhance	Yes, enhance	*	*	*		*	
US Tokamak Operations and Research	Yes, but reduce	Yes, but reduce	Yes						
Stellarator and Alternates Operations and Research	Yes, but flat	Yes	Yes, enhance	*	*		*		
IFE program	Yes, but limited	Yes, but limited	Yes	*	*				
FPP Design Effort	Yes, but limited	Yes	Yes	*	*				
GPS Program	Yes, but reduce modestly	Yes	Yes, enhance modestly				*	*	
HEDP Program	Yes, but reduce modestly	Yes	Yes, enhance		*	*	*	*	*
Plasma-Based Technology Program	Yes, but limited	Yes	Yes, enhance		*	*	*	*	*
Theory and Computation	Yes	Yes	Yes, enhance	*	*	*	*	*	*
<b>New Construction of Midscale+ Facilities</b>									
MPEX	Yes	Yes	Yes				*	*	
FPNS	Yes, but highly delayed	Yes, but delayed	Yes		*		*	*	
MEC Upgrade	No, but develop further	No, but develop further	Yes		*	*	*	*	*
EXCITE	No	Yes, but highly delayed	Yes	*	*				
Mid-Scale Stellarator	No	No	Yes	*	*				
BCTF	No	No	Yes	*	*	*	*	*	
Solar Wind Facility	No	No	Yes	*	*				*
HIF-Component	No	No	Yes		*				*
Multi-PW Laser	No	No	Yes		*		*	*	*
High Rep. Rate Laser	No	No	Yes, with partnerships		*		*	*	*
Midscale Z-Pinch	No	No	Yes, with partnerships		*		*	*	*
VNS	No	No	Concept Study		*		*	*	*
<b>Collaborations and Networks</b>									
ITER research team	Yes	Yes	Yes, full	*	*	*			
Private fusion collaborations	Yes, enhance	Yes, enhance	Yes, enhance	*	*	*		*	
International fusion collab.	Yes	Yes	Yes, enhance	*	*	*		*	
LaserNetUS	Yes	Yes, enhance	Yes, upgrade	*	*	*	*	*	*
ZNet, MagNetUS, LTPNet	No	Yes, but limited	Yes		*	*	*	*	*

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

# It is critical for the FES community to convey our unified support and excitement for the plan!

- Sending a unified, consistent message (NAS BP 2018, CPP 2020, FES-LRP 2020) to congress, OMB, DOE, and the public is critical to enable continued support (and hopefully new activities and growth) even as administrations change
- What's not to be excited about - Let's continue gathering momentum!

Dec 19, 2014

IN DEPTH | ENERGY RESEARCH

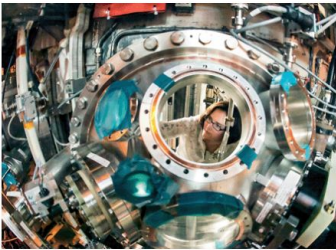
## U.S. fusion effort melts down

Adrian Cho  
+ See all authors and affiliations

Science 19 Dec 2014;  
Vol. 346, Issue 6216, pp. 1436-1437  
DOI: 10.1126/science.346.6216.1436

Article   Figures & Data   Info & Metrics   eLetters   PDF

Dysfunctional, broken, in complete disarray: That's how numerous insiders describe the United States' research effort in fusion, which aims to generate energy using the same process that powers the sun. A rift has opened between officials in the Department of Energy's (DOE's) Fusion Energy Sciences (FES) program and the research community it supports. Many scientists say program officials operate opaquely, but the community itself has a reputation for being unmanageable.



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Dec 11, 2020

IN DEPTH | FUSION

## Scientists rally around plan for fusion power plant

Adrian Cho  
+ See all authors and affiliations

Science 11 Dec 2020;  
Vol. 370, Issue 6522, pp. 1258  
DOI: 10.1126/science.370.6522.1258

Article   Figures & Data   Info & Metrics   eLetters   PDF

U.S. fusion scientists, notorious for squabbling over which projects to fund with their field's limited budget, have coalesced around an audacious goal. A 10-year plan presented last week to the federal Fusion Energy Sciences Advisory Committee is the first since the community tried to formulate such a road map in 2014 and failed spectacularly. It calls for the Department of Energy (DOE), the main sponsor of U.S. fusion research, to prepare to build a prototype power plant in the 2040s that would produce carbon-free electricity by harnessing the nuclear process that powers the Sun.

The plan formalizes a goal set out 2 years ago by the National Academies of Sciences, Engineering, and Medicine (*Science*, 21 December 2018, p. 1343) and embraced in a March report