

FESAC Long Range Planning Subcommittee Status

Troy Carter, on behalf of the LRP Subcommittee

FESAC Meeting Aug 24, 2020

Summary: Subcommittee making good progress, on schedule for draft report in October

- Carefully considered all CPP facilities, programs, recommendations; gathered additional information as warranted
- Extensive effort at putting costs to programs and facilities, using projects experts to provide cost estimates for major facilities (nearly complete)
- Framework for prioritization & constrained scenarios established, based on CPP report; working toward consensus answer on how to address constrained scenarios (our focus now and for the last few weeks)
- Gathered community input on how to accommodate DPS and FST priorities in a single strategic plan (focus groups, virtual workshop held Aug 20)
- Writing should be the focus of our work soon, aiming for concise report

2018 FESAC Charge

- Charge covers entire FES 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, modeled after the P5 (Particle Physics Projects Prioritization Panel) and the Nuclear Physics planning process
 - Letter indicates that APS DPP will lead the first phase (DPP Community Planning Process) of community-led activities (**done, thank you!**)
 - Phase 2, led by FESAC/FESAC Subcommittee, will take input from Phase 1 to develop the final long range plan (**we are here**)

FESAC Charge Language

- Identify specific research areas, across the entire portfolio, in which the U.S. should establish or enhance global leadership
- Maintain a healthy and flexible program, which incorporates the roles and contributions of universities, national laboratories, and industry, to deliver science results through next decade
- Maintain, upgrade, and/or pivot current small-, mid-, and large-scale facilities, including DIII-D and NSTX-U, and also initiate new experiments/facilities/projects
- Identify international collaborations and partnerships giving U.S. scientists access to devices with unique capabilities
- Provide support for private-public partnership ventures
- Position U.S. to obtain maximum benefits in ITER burning plasma science era
- Considering budgetary constraints, technical readiness and feasibility for any activity to proceed.

Budget Scenarios

- “Your report should provide recommendations on the priorities for an optimized FES program over the next ten years (FY 2022-2031) under the following three scenarios with the FY 2019 enacted budget for the FES program as the baseline:”
- Constant level of effort (with OMB inflators = 2.2% yearly growth)
- Modest growth (2% above OMB inflators = 4.2% yearly growth)
- Unconstrained, but prioritized

CPP process resulted in community-led, consensus report

A Community Plan for Fusion Energy and Discovery Plasma Sciences

Report of the 2019–2020 American Physical Society Division of
Plasma Physics Community Planning Process



Thank you to CPP Chairs,
PC Members,
Entire community

- Year-long community-led process. Whitepapers, webinars, town halls and 5 major workshops; Open process, with community review/vetting of draft reports
- Provides guidance for prioritization within Fusion Science and Technology (FST) (MFE, FM&T & IFE) and within Discovery Plasma Science (DPS) (GPS, HEDP); also considered four cross-cutting areas (Theory/Computation, Workforce, Diagnostics, Enabling Technology)

Why is consensus important? Look to P5 success

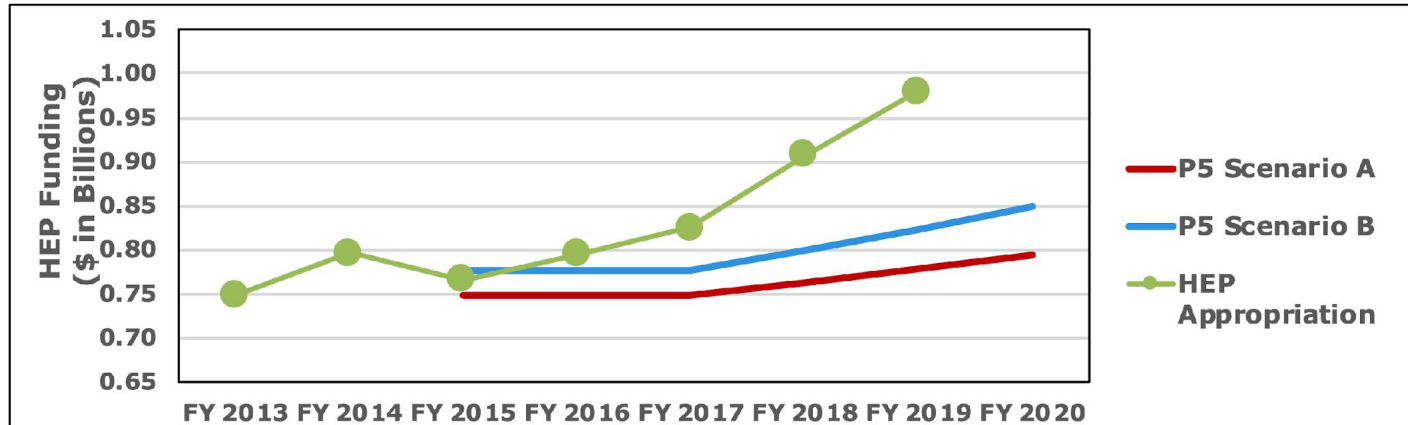
- The P5 planning process for DOE High Energy Physics is held up as an example for how strategic planning should be done within DOE
- Success tied to two things
 - Conveys compelling scientific opportunities and clear, prioritized plan to exploit these opportunities
 - Strong backing for the report from across the entire community
- **The HEP community was able to “speak with one voice” in support of the plan.** Large number of endorsing signatures to final report, more importantly voices across the community signaled support for the plan to DOE, NSF & Congress

Real impact on support for the field



Consensus has paid off in high energy physics (P5)

- FY 2019 Senate Energy and Water Development Appropriations Report:
 - “The Committee recommends \$1,010,000,000 for High Energy Physics. The Committee strongly supports the Department’s efforts to advance the recommendations of the Particle Physics Project Prioritization Panel Report [P5], which established clear priorities for the domestic particle physics program...”



W.M. Solomon / CPP MFE-FM&T opening / July 22, 2019

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Our goal: a strategic plan that can have the same impact via broad support from the FES-funded research community

The FES portfolio more intellectually diverse (and more diverse in stakeholders) than HEP

- Plasma/fusion science and engineering is broad, interdisciplinary with varied applications (e.g. fusion, semiconductor processing, plasma accelerators, ...) (see CPP report and Plasma 2020).
- APS DPP was chosen to lead CPP, however the FES-funded community spans many additional professional organizations
 - ANS Fusion Energy Division, IEEE Nuclear & Plasma Sciences Society, APS DAMOP (Gaseous Electronics Conference), APS DPF & DPB (beams/plasma accelerators), American Geophysical Union, ...
- Strong ties to industry: fusion (Fusion Industry Association), semiconductor processing, aerospace, medical applications, ...
- **Makes our task more challenging but also presents an opportunity: broad endorsement across these communities would send a powerful message**

CPP report is foundation for our work

- CPP report conveys compelling scientific & technology development opportunities, spanning fundamental science, to plasma-based technology, to urgent development of fusion power in the US
- This is the foundation of the final plan, our report will point to the CPP report
- CPP report expresses consensus prioritization guidance that is the result of significant work by the community
- **A top priority of the FESAC LRP Subcommittee is to maintain and build on that consensus so that the final plan is something that the entire FES-supported community can get behind**
- We're performing all of our work with this goal in mind

Need to go beyond the CPP to address the charge

- The CPP accomplished a great deal and provides a wealth of information, but we need more to fully address the FESAC charge
- **CPP did not attempt to address the budget scenarios, did not cost initiatives and programs**
 - Partnering (with other agencies, industry, internationally) important here, and represents additional information gathering need
- **CPP process resulted in consensus guidance for prioritization within subareas of the portfolio, but not across the entire FES portfolio**
 - Did not have sufficient time to have conversations between subareas so that each can understand the other's priorities and discuss how the plan can accommodate priorities across the whole portfolio

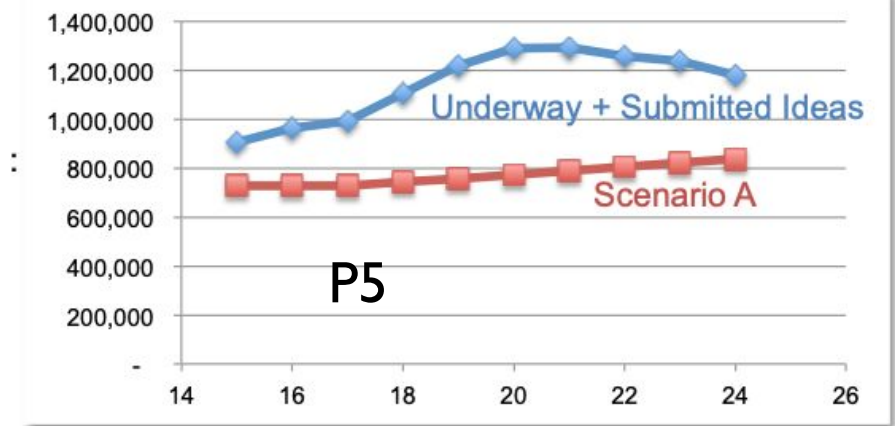
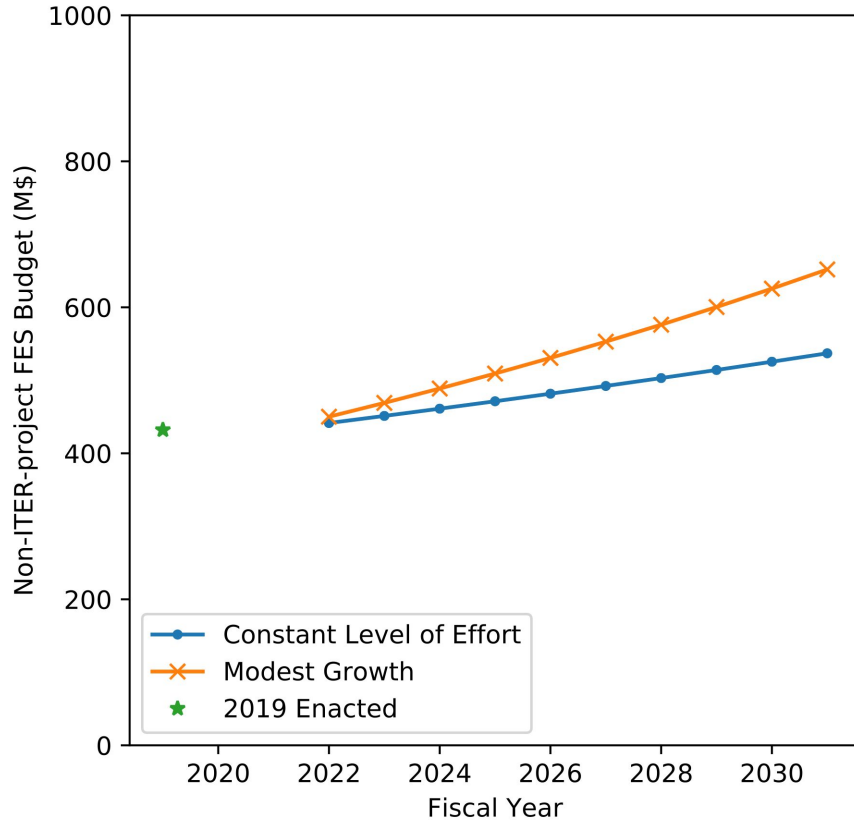
Subcommittee working incredibly hard, making good progress

- Committee has still not met in person, but has logged a huge number of hours on zoom. Many hours of Zoom (and Microsoft Teams) a week
- Whole subcommittee call, DPS Subgroup Call, FST subgroup call
 - Calls for other subgroups (SOs, PRs, prioritization teams, etc)
 - Leadership calls (FST, DPS, all)
 - Costing activity calls
 - Calls with external guests
 - Focus groups, Virtual workshop
- Plus lots of offline work!

Budget Scenarios: how we are interpreting the charge

- The FESAC charge asks us to “assume that the U.S. contributions to the ITER project will continue throughout this entire period”
- **In consultation with FES, we have decided to interpret the charge as asking us to focus on the non-ITER-project portion of the budget**
- Our starting point will be the 2019 enacted budget; we will remove the portion of the budget associated with the ITER project and the remainder will be projected forward under the budget scenarios (\$432M from 2019 enacted)
- Avoids the complication of trying to project the ITER project costs, makes the assumption that Congress will fund this appropriately without impacting the rest of the projected FES budget
- **We will account for ITER operation costs (projections already provided by FES) and costs for the ITER research program (we are projecting)**

From last FESAC meeting: Budget Scenarios



P5 generated cost for “blue sky” will try to provide at 2nd FESAC

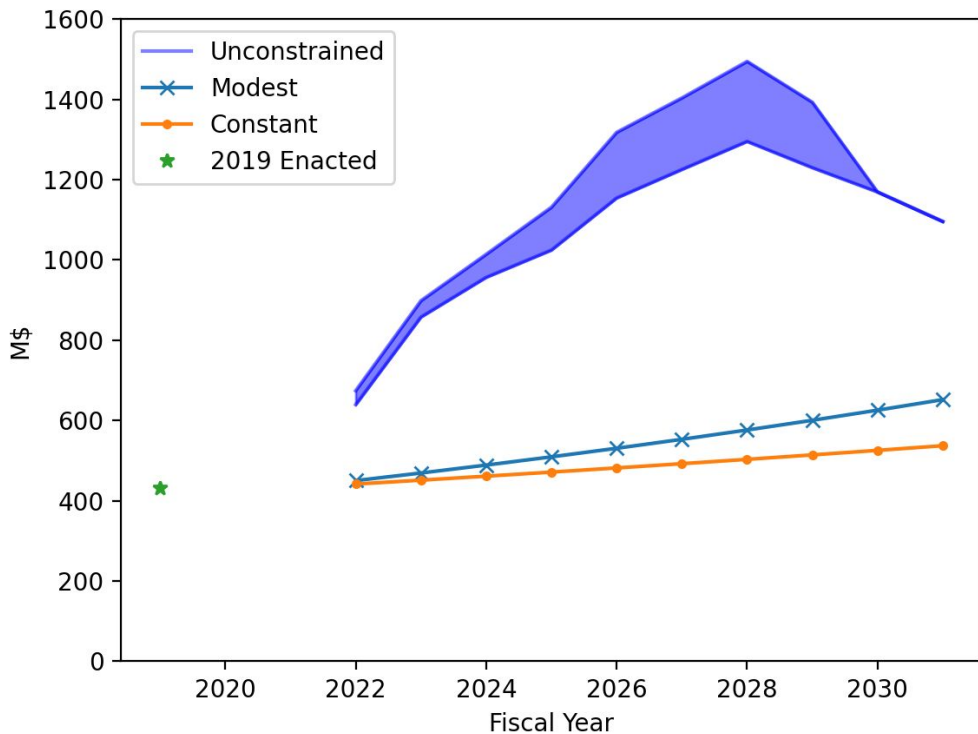
Approach to costing of programs/facilities

- For large facilities, utilized projects experts + cost estimators to estimate project costs (design, construction, operations) and timeline
 - Also gathered additional information (costs for existing facilities, foreign facilities)
- For FST programs, determined FTE needed to execute program, utilized existing program information & estimates of cost per FTE
 - Used multiplier to add costs for small experiments, equipment, etc
- For DPS programs, used FTE estimates and existing grant program information, estimated needed program sizes (considered award sizes, proposal success rates, growth associated with new programs)
 - Small experiments utilizing historical information on facility costs

Difficulties costing pre-conceptual facilities

- Only two of the facilities called out in the CPP report are in the Critical Decision (CD) process: MEC Upgrade (CD-0) and MPEX (CD-1)
- All others are in varying states of preconception, **makes costing and forming a strategic plan around these facilities very difficult**
- Projects experts acknowledge costings need to be taken with a grain of salt — better definition of scope, mission need and conceptual design & system study are needed to do an accurate cost projection. This is what the CD process is meant to enable
- **The subcommittee acknowledges the uncertainty associated with these costings and is attempting to build flexibility in the plan to accommodate**

Draft unconstrained budget estimate



- FST Unconstrained scenario fully embraces the urgency expressed in CPP report, launches design, construction of new facilities as soon as possible
- DPS Unconstrained scenario staggers facility construction
- Significant fraction of budget in facilities construction (exceeding DOE SC guidance, <20%)
- **Clearly have our work cut out for us in addressing the constrained scenarios**

Approach to prioritization and constrained scenarios

- Using all prioritization guidance from the CPP report: values, criteria, stated priority order of Strategic Objectives, and Appendix A information for FST
- Not seeking to produce a ranked list, instead considering a tiering system to provide flexibility in the plan (e.g. tiers might be “Essential”, “Integral”, “Aspirational”)
- Where possible, think about uniform percentage reduction of programs within Tiers as an approach to hit constrained scenario budget targets
- For Facilities, consider delays, possible reduction in scope, but hard to not fully fund construction (so percent reductions not a useful tool)

Addressing impact of constrained scenarios

- Strong sense of urgency conveyed by FST community for FPP by 2040's; urgency also expressed for advancing DPS science and technology for societal benefit
- Subcommittee is looking carefully at whether timeline can be kept (or not majorly delayed) under constrained scenarios; potentially would need to adopt much more risk on a path to FPP in FST
- Looking at ways to leverage investment from federal and private partners to get more bang for buck and make progress quicker across whole portfolio

Partnering to achieve FES goals

- Looking carefully at partnering with other federal agencies and private industry across the whole portfolio
- Within FST, identifying PPP opportunities from FIA interaction, CPP report statements, and SO/PR assessments within sub-panel
- Report will address cost share opportunities and other PPP models (beyond INFUSE and cost share) that might be utilized
- Have paid close attention to examples from DOE NE and international examples (e.g. I-DTT) (partnering to build major facilities)

Last piece of the puzzle: how to integrate DPS and FST into whole portfolio plan

- Subcommittee work so far largely focused within DPS, FST; prioritizing and considering constrained scenarios independently (keeping in mind the need to address cross cuts)
- Have to decide how to merge the two independent plans. Do we split the budget in a fixed way or do we perform prioritization across the whole portfolio? **Need for community input**
- Gathered input in two ways:
 - Focus groups (June/July)
 - Virtual workshop (Aug 20)

Several Focus Group Sessions were run in June & July

- Purpose: gather input on how to deal with program “balance” between DPS and FST, ask about additional synergies and cross-cuts, gather general feedback on LRP subcommittee process
- 90 participants, aggregated by early career, mid-senior career, graduate students, women, and underrepresented minorities.
- Did not attempt to solicit consensus on questions asked, however, there were several areas where multiple people were in agreement on a topic.
- Focus groups run by Laurie Moret, with help from Lauren Garrison (CPP Co-Chair)

Focus groups: Highlights

- Not much input on potential additional FST-DPS cross-cuts
- Some didn't like the word 'balance'; balance doesn't have to mean equal or same
- Very few people felt that they understood other parts of the field well enough to make informed decisions on budget "split"
- Recognition that the committee's job is difficult; On board with the end goal being a comprehensive report that was understandable and people could live with.
- Many desire change, understand that can be hard and that everyone may not be happy.
- Desire to repeat the process every 5 years.

Focus groups: Highlights, cont.

- Focus group participants interested in seeing:
 - Transparency, e.g., what the criteria used were, why decisions were made, feedback offered
 - A clear and compelling vision and mission – that is high level enough for everyone to see themselves
 - Reliance on the Phase I CPP report for project information, rankings, values, PACs, etc.
 - Inclusivity – solicit input from a broad audience
 - No surprises — show the community a draft if possible, have good connection to the Phase I report, update the community along the way
 - Sustaining workforce during program transitions important

Aug 20 Virtual Workshop

- Goals:
 - Provide opportunity for DPS and FST communities to interact, understand each others priorities and values
 - Gather input on how to “merge” the plans (how to go about splitting the constrained budgets between FST and DPS priorities), working toward a consensus way forward for the LRP Subcommittee to address the charge
- Most of the meeting spent in small breakout discussion groups (12 groups, with 2 discussion leaders drawn from the community (thanks!))
- LRP Subcommittee, FESAC, DOE participants as observers
- **Great community participation, 195 participants on Zoom**

Breakout discussion topics

First Breakout (mergin mission/vision, values):

1. Can we come to consensus on a mission and vision, both reflecting the outcome of the CPP, by merging the independent mission and vision statements from FST and DPS?
2. The CPP report expressed separate “values” for FST and DPS. Are there shared values, common to both communities that can be expressed?

Second breakout (merging DPS & FST into a whole portfolio plan)

1. Would using the existing split between DPS and FST in FES funding be an approach for answering the charge that the community can support (live with)?
2. If not, can we agree on a set of program-wide prioritization criteria to perform whole-portfolio prioritization (and not adhere to a percentage split)?
3. How can we be better prepared to consider this question during the next iteration of this process (in ~5 years)?

Workshop Outcomes

- Still processing copious notes provided by breakout discussion leaders (thank you!), but some takeaways:
 - Strong turnout representing the broad community.
 - Participants engaged in constructive, respectful conversations – directly addressing critical challenges
 - Individuals expressed a greater understanding of the trade-offs as scenarios beyond “blue sky” are considered.

Report: what it might look like

- Aiming for a concise, compelling report that clearly conveys priorities. Don't think we need to provide detailed budget information/precise funding allocations to specific initiatives
- Take the P5 report as an example. No budget numbers or costs for particular facilities. But makes a number of recommendations and expresses clear prioritization and impact of constrained scenarios

P5 Expression of priorities

Table 1 Summary of Scenarios

Project/Activity	Scenarios			Science Drivers					Technique (Frontier)
	Scenario A	Scenario B	Scenario C	Higgs	Neutrinos	Dark Matter	Cosm. Accel.	The Unknown	
Large Projects									
Muon program: Mu2e, Muon g-2	Y, <small>Mu2e small reprofile needed</small>	Y	Y					✓	I
HL-LHC	Y	Y	Y	✓		✓		✓	E
LBNF + PIP-II	Y, <small>LBNF components delayed relative to Scenario B.</small>	Y	Y, enhanced		✓			✓	I,C
ILC	R&D only	R&D, <small>possibly small hardware contributions. See text.</small>	Y	✓		✓		✓	E
NuSTORM	N	N	N		✓				I
<small>figure</small> RADAR	N	N	N		✓				I
Medium Projects									
LSST	Y	Y	Y		✓		✓		C
DM G2	Y	Y	Y			✓			C
Small Projects Portfolio	Y	Y	Y		✓	✓	✓	✓	All
Accelerator R&D and Test Facilities	Y, reduced	Y, <small>some reductions with redirection to PIP-II development</small>	Y, enhanced	✓	✓	✓		✓	E,I

Report: what it might look like, cont.

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- **Developing budget numbers and facilities costs is an important input for our process. But this information may not be released as part of the report.**

Report: when will it be done?

- Writing will be the main focus of our efforts very soon
- On track to meet original plan of having draft report in October
- P5 had used an NAS-like external review of their report, will do the same if possible
- Ultimate authority with FESAC (will have time to review and comment/suggest changes to draft)

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