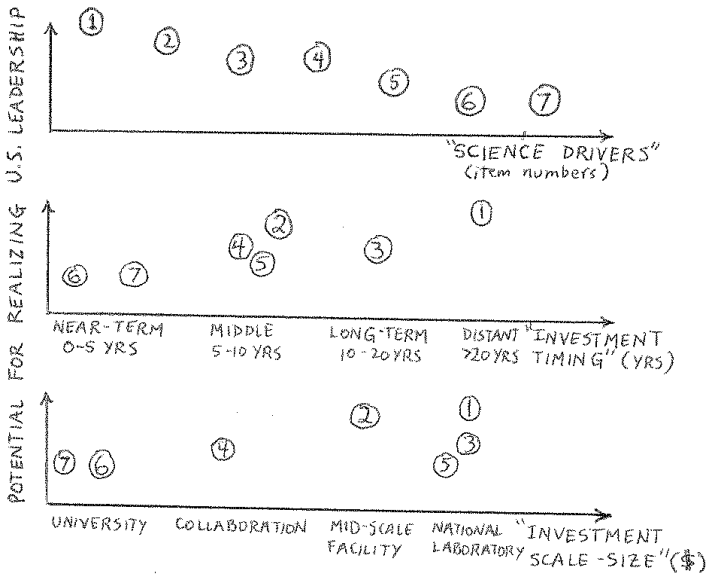
A Perspective on White-Paper Content

The four budget scenarios being considered in the charge have highly constrained growth and the question that arises is which subset of existing priorities within FES-program sub-elements should be reduced or eliminated to make room for some new priorities and initiatives. Answering this question benefits from understanding the correlation between the required timing for optimal investment into a specific priority or science driver, the potential return on investment for realizing U.S. leadership, and the required facility scale-size for resolving the scientific, engineering, or technical issue. A specific priority or science driver might be addressed by multiple options that are dispersed throughout the four-parameter space (time scale, size scale, potential for increased leadership, spectrum of priorities or science drivers) and the panel would like the "initiatives" white paper to characterize each initiative in this way if possible. Certainly, all of the community-submitted priorities and initiatives will be imagined as being dispersed across this parameter space. Rather than dictating a writing style, this guidance serves merely to convey how the panel might be thinking about how to incorporate your initiative into the recommendations. Below, a notional example of one program sub-element's seven priorities and initiatives. The numbers one through seven could correspond to the options for advancing the U.S. stellarator research, or to the options for advancing integrated multi-scale and multi-physics modeling, or to the options for advancing toward a fusion nuclear science facility, etc.



The FESAC Strategic Planning (SP) Panel invites all members of the fusion-research and plasma-science communities to submit a white paper expressing a particular scientific topic's **status and priorities**, as updated from the *2007 Greenwald's FESAC panel report on Priorities, Gaps, and Opportunities*, and a separate white paper expressing that topic's associated **initiatives**, i.e., new and exciting topic sub-elements of a given program element.

The **second paper** speaks to **changes in continuing FES program investments** and potential **new FES program investments**, both required to ensure that the U.S. is in a position to exert long-term leadership roles within and among each of the four program elements of DOE-FES. The **first paper** speaks to prioritizing what we are doing now that is required to ensure U.S. leadership in at least some areas of each program element and assumes that, by itself, the status quo will not address the gaps necessary to fill in order to sustain U.S. leadership over the decade and into the next decade in at least some areas of each program. The panel is to prioritize between the program elements, providing views on new facilities, new research initiatives, and facility closures.

Note that the newly structured FES program is comprised of 4 program elements.

Burning Plasma Science: Foundations
Burning Plasma Science: Long Pulse
Burning Plasma Science: High Power
Discovery Plasma/Fusion Science

The SP charge involves 3 of them, de-emphasizing the 4th "*High Power*" to the point of barely being mentioned and thus not being a part of the charge because ITER (project and research) is an assumed element of the strategic plan. The justification is that High-Power research must be done on ITER (and DEMO) and thus will not be part of the charge for recommendations relevant to the panel's input into a 10-year strategic plan. However, the success of ITER for research depends on *Burning Plasma Science: Foundations* and *Burning Plasma Science: Long Pulse*. Research on strongly-driven systems and on self-driven systems is part of *Burning Plasma Science: Foundations*, as is Theory, Modeling, and Simulation. Research on materials and fusion nuclear science is part of *Burning Plasma Science: Long Pulse*, as is research on superconducting toroidal confinement facilities.

For papers pertinent to *Burning Plasma Science: Foundations*, *Burning Plasma Science: Long Pulse*, and *Discovery Science* both white papers (Priorities, Initiatives) should put the author's comments into the context of the **mission** and **goals** of DOE-FES. Quantify and qualify the impact on mission and goals of having and not having each sub-element associated with the white paper's topic in terms of stand-alone and collective scientific advancement.

For white-paper categories "*Prediction and Control*" and "*Long Pulse* and Materials", **please place the white-paper subject into the context of a prior report or study and discuss the white-paper content in terms of the metrics used in the**

referenced report or study. The following documents are the primary references to be used for providing context and at least one should be referenced explicitly, although other documents are suitable as secondary references. For example, both white papers should put the author's comments into the context of the **Gaps** as analyzed in Chapter 4 of the FESAC panel report on Priorities, Gaps, and Opportunities and into the context of the more relevant of the first two **Challenges** on page 9 of E. Synakowski's 9 April presentation "*The charge for advice on strategic planning*".

1. DOE/SC-0102, FESAC Report on Priorities, Gaps and Opportunities: Towards a Long-Range Strategic Plan for Magnetic Fusion Energy, October 2007
2. Magnetic Fusion Energy Sciences Research Needs Workshop Report (2009)
3. DOE/SC-0149, FESAC Report on Opportunities for Fusion Materials Science and Technology: Research Now and During the ITER Era, February 2012
4. FESAC Report on Magnetic Fusion Energy Program Priorities (2013)
5. FESAC Report on Prioritization of Scientific User Facilities during 2014-2024 (2013)
6. Opportunities and Modes of International Collaboration During the ITER Era (212)
7. Fusion Electricity: A roadmap to the realisation of fusion energy (EU, Nov 2012)
8. China CFETR Plan (2013)

For white-paper category "*Discovery Science*", **please place the white-paper subject into the context of a prior report or study and discuss the white-paper content in terms of the metrics used in the referenced report or study.** The following documents are the primary references to be used for providing context, although other documents are suitable. *Discovery* does not need to refer to the FESAC panel report on Priorities, Gaps, and Opportunities.

9. Plasma Science: Advancing Knowledge in the National Interest (2007)
10. High-Energy-Density Laboratory Plasmas Basic Needs Workshop Report (2009)
11. Low Temperature Plasma Science Workshop Report (2008)

The panel requests that all white papers suggest a prioritization of each identifiable sub-element in the white paper, in other words, rank your priorities within the existing program and rank your new and exciting initiatives. The panel will likely break each presented topic into sub-elements and assign a ranked priority relative to that sub-element's portfolio of priorities and initiatives. The more the white paper could do this for the panel, the better for the panel's deliberations.

So that the two separate white papers can be distinguished conveniently, the filename and document title should have the forms FESAC-SPpaperPriorities-*authorname* and FESAC-SPpaperInitiatives-*authorname*.

Documents should be submitted using the email address **SPwhitepapers@burningplasma.org** so that the message is received simultaneously by Mark Koepke (SP Panel) and by Mark London (USBPO).

All white papers received will be posted or linked, for public viewing, on the following web site, where previously published reference documents and public information about the SP Panel can be found.
https://www.burningplasma.org/activities/?article=2014%20FESAC%20Strategic%20Planning%20Panel

White-paper deadline: Papers will be accepted until 1 September. Earlier submission benefits the panel in both the reading of gathered input and the writing process.

The panel recommends 1 June for submitting white papers for June presentations, but 1 August would also work well. The panel recommends 1 June for submitting white papers for July presentations, but 1 August would also work well. The 1 June recommendation is made so that the panel may have the benefit of as much context as possible before the initiatives presentations, but the panel has prior reports and studies for much of that context. **The 1 August recommendation is made so that the panel may have the benefit of as much updated status and priority text as possible before the August teleconferences on priority assessment and budget scenarios and before the report drafting takes place throughout August. No one should wait until the last day of white paper acceptance (1 September), as the reviewing of all documents will start immediately upon submission.** The panel review of white papers is not like the grant-application evaluations associated with the review process for a solicitation issued by way of a funding-opportunity announcement (FOA) that take place after a common submission deadline.

Guidance (continued) appropriate for the first 10-page white paper:

Review and update the 2007 status, progress, and priority of a research topic and the topical sub-elements, as originally documented in the 2007 FESAC Panel Report, by describing the current and future priorities, gaps, and opportunities.

Additional guidance appropriate for the second 10-page white paper:

Describe a proposed scientific program to address priorities, gaps, and opportunities. Explain where the proposed program fits in DOE-FES's new program elements, as described in E. Synakowski's FESAC talk "FES Update and the FY2105 Budget Proposal", and why it should be included in the 10-year strategic plan.

Review the relevant gaps and mission elements in the 2007 FESAC Panel Report's Chapter 4 and look at the Major Gaps listed in Section 4d. Explain how the program now being proposed relates to the mission elements described in the 2007 FESAC Panel Report. Is the program aligned with the 2007 FESAC Panel Report, or has new understanding prompted a re-thinking of what needs to be done?

Additional guidance appropriate for facilities
(this parallels questions that could be asked of any research program):

What compelling and unique science can be carried out at the facility in the next ten years assuming (a) flat funding and (b) cost-of-living funding increases?

What is the minimum level of support (research and operations) needed to maintain a viable program at the facility?

What workforce is needed to sustain a viable program at the facility?

What research would you expect to pursue at your facility in 2024 and what would be the 5-year goals of this research? What is needed to support this? What science would the field not be able to pursue without your facility?

What is role of other federal agencies and international partnerships in the research being performed at your facility? To what degree does such a partnership represent synergy that would be lost or gained based on the future of your facility? If the US effort in this area were significantly curtailed, to what degree would efforts in other countries fill the gap? In that case, to what degree could US scientists be able to advance research in this area by working outside of the country?

Quantify and qualify the facility contributions to the educational mission of training the future workforce in fusion research, plasma science, enabling technology research and development, and associated applied areas.

As described on the DOE-SC-FES home page http://science.energy.gov/fes/ …

Four strategic **goals** of DOE Fusion Energy Sciences (DOE-FES)

1. Advance the fundamental science of magnetically confined plasmas to develop the predictive capability needed for a sustainable fusion energy source;

2. Support the development of the scientific understanding required to design and deploy the materials needed to support a burning plasma environment;

3. Pursue scientific opportunities and grand challenges in high energy density plasma science to explore the feasibility of the inertial confinement approach as a fusion energy source, to better understand our universe, and to enhance national security and economic competitiveness, and;

4. Increase the fundamental understanding of basic plasma science, including both burning plasma and low temperature plasma science and engineering, to enhance economic competiveness and to create opportunities for a broader range of science-based applications.

The DOE-FES **mission**, as stated on its Mission webpage

The FES program mission is to expand the fundamental understanding of matter at very high temperatures and densities and to build the scientific foundation needed to develop a fusion energy source. This is accomplished by studying plasma and its interactions with its surroundings across wide ranges of temperature and density, developing advanced diagnostics to make detailed measurements of its properties and dynamics, and creating theoretical and computational models to resolve essential physics principles.

The physics of plasmas is at the heart of understanding how stars shine and evolve over billions of years. Plasmas, essentially hot gases of ions and electrons, are found in environments as familiar as fluorescent lighting and lightning bolts, as unimaginably harsh as the centers of stars, and as exotic as the environments surrounding super massive black holes. The science of plasma physics that describes the plasmas in these environments also describes the auroras that gently illuminate the northern and southern skies and the solar corona, where temperatures are far higher than on the sun's surface. At the scale of the very small, plasma physics and materials science combine to enable the exquisitely precise manufacture of semiconductors. Plasma science is also at the heart of advances in efficiencies in the lighting industry.

The first two **Challenges** on page 9 of E. Synakowski's 9 April presentation "The charge for advice on strategic planning" are …

Challenges for Burning Plasma Science: Foundations –
Understand the fundamentals of transport, macro-stability, wave-particle physics, and plasma-wall interactions.

Challenges for Burning Plasma Science: Long Pulse –
Establish the basis for indefinitely maintaining the burning plasma state including: maintaining magnetic field structure to enable burning plasma confinement and developing the materials to endure and function in this environment.