

The Evolving Energy Ecosystem: Federal Organizational Recommendations

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The energy ecosystem, and the political and regulatory environment in which it operates, is evolving quickly, with new suppliers, delivery methods, and energy sources, and new relationships developing amongst all of these players. In addition, the federal government has renewed their engagement in the Paris agreement, and has made clear the seriousness with which the U.S. will combat climate change. The implication of pursuing a whole of government approach begs the question: How should the federal government be organized to most effectively contribute to, partner, as well as lead the needed energy system transition within its different roles? This whitepaper considers implications of this question on the US Department of Energy. While DOE handles everything from basic science, to clean energy and nuclear weapons, the specific focus here is on the Science and Energy offices and the associated policy and analysis functions. The purpose of this whitepaper is to suggest some organizational modifications, informed by the current structure, but directed towards its evolving mission.

Organizing around Systems Thinking:

Energy systems are ecosystems, and ecosystems are defined by their *members*, the *relationship* between these members, and the *environment* in which these interconnected members find themselves. As all three of these features of the ecosystem are transitioning, with an overarching theme of increasing interconnection and interaction, the DOE must evolve and direct resources to understand and inform this system-level thinking.

Some progress can be made within existing organizational structures by fostering crosscutting working groups (such as the supercritical CO₂ working group established under Moniz) and longitudinal program reviews (like mini-Basic Research Needs workshops, 'BRNs') that would inform program office budgets. These reviews could help define a technology roadmap, informed by analyses from a revitalized Energy Policy and Systems Analysis (EPSA) office, discussed further below.

To achieve the broad shift to an organization oriented toward outcomes and structured around a systems approach, we view the following as critical steps:

1. Restore the Energy Policy and Systems Analysis (EPSA) office
2. Recombine the Science and Applied Energy programs under an Under Secretary (as proposed by the new administration)
3. Pursue budget formulation with a portfolio approach explicitly oriented around outcomes. These outcomes could include technologies and developments needed for clean energy options across all sectors, reduced emissions, monitoring of emissions, basic science and engineering outcomes.

DOE as a Platform to Enable Systems Thinking:

To inform and frame DOE programs, help define the guidelines and guardrails for the various programs, and support crosscutting work, the Energy Policy and Systems Analysis (EPSA) office should be restored.

As a key additional element, DOE should more broadly envision itself as an enabler, or platform, for a broad range of stakeholders to understand and model the increasingly integrated energy system– and the truly globally integrated nature required to address climate challenge. The DOE focus should be on “open-sourcing” this activity – i.e., develop and support modeling platforms that can be broadly used by a range of stakeholders to do scenario analysis, business case analysis, policy analysis, and so forth; EPSA itself would be a key customer for this platform. Given the global, and fully interconnected nature of climate change, this area could serve as a signature international collaboration activity area, to ensure that these modeling platforms have the fine grained, spatially localized information needed to enable broadly useful results.

Within DOE, this energy systems platform can be viewed as a cross-cut initiative using the same model as has been applied to, for example, the supercritical CO₂ or Grid Modernization initiatives, managed by a steering group comprising representatives from the DOE, the national labs, companies, and academia. Ownership and maintenance of these models could reside in EPSA.

An alternative to EPSA would be to reimagine the current Energy Information Agency (EIA) as an “Energy Information and Models Agency.” The role described above to maintain models that can provide data to inform decision-making is analogous to the role that EIA already plays, serving as a data platform that enables broad based decision support for a diverse set of stakeholders, both inside and outside DOE. The new EIA could be a logical place to steward the models, and under this paradigm, EPSA, the DOE program offices, and the energy research community broadly would be customers for the models.

Science and Energy:

The incoming administration has announced some organizational changes, including reestablishing the Under Secretary for Science and Energy, which existed under Secretary Moniz. As envisioned, and as in practice with Under Secretary Orr, the combination will enable more seamless integration between the science and applied energy programs, and better enables the transition from use-inspired research through development and demonstration.

The combined organization still allows for championing of basic research and curiosity driven work, but at the same time, it helps DOE bridge the “Valley of Death” between laboratory research and prototype development and scale-up. Further, developing Industries of the Future in areas like quantum computing, artificial intelligence, and nano-materials will require tight integration, if the U.S. is to lead in innovation, manufacturing, and their deployment.

However, to make the new combined office effective, much more will be required to achieve integration than simply having these two major organizations report to the same person. In particular, a general commitment to the long game will be required to better integrate and leverage the important work being funded by the Science and Energy programs. A few example approaches are outlined next.

A broader set of performance metrics for both directorates will encourage deeper integration. For example, DOE should consider how they evaluate funded work in the science portfolio. While certainly not the only explicit metric, the dominant “working metric” for the science national labs is publications in top impact factor journals. This needs to be expanded to a broader set of impact measures with real teeth, that reflect stewardship of public resources, and also purposely considers factors related to translation of results to development and demonstration as well as integration of basic science, applied science, and technology development.

Second, DOE should explore decoupling the work of program offices and lab management, by pulling the management of the Labs out of the program offices. To some extent, this has been done within the Office of Science, which has an operations organization that manages the ten Science Laboratories and provides a level of consistency in contract management and performance evaluation. Such a model could be expanded to cover all of the non-NNSA Laboratories. As envisioned, a dedicated office would handle administration, such as contractual work, solicit input from the programs, and manage the distribution of funds including infrastructure dollars. SC, NE, EERE, etc. would be customers and should want to use all Labs, depending only on which can provide the best solutions for the needs, considering all factors.

Third, the crosscutting working groups described above should explicitly be organized across science and applied offices. These working groups should be established with the long view in mind, with major metrics and major reviews established over five year time spans. Given the different cultures and community reward systems which exist in science and engineering, programs to facilitate communication and understanding will also help; e.g., leadership development could explicitly encourage work rotations, details, and special assignments across science and energy offices for DOE and lab staff.

Applied Energy Offices: Evolving Sources, Carriers, and Users

Today’s energy system includes three major subsystems: (A) *energy sources*, (B) *infrastructure and carriers for moving and storing these energy sources*, and (C) *energy conversion devices and/or consumers*. There are multiple potential approaches for organizing around these key systems. Currently, DOE’s applied energy offices are largely organized around energy sources (fossil energy, nuclear, renewables, etc.), which dates back to the early days of the establishment of the agency. This has the effect of scattering the energy carrier and conversion device work throughout the DOE, with the exception of the Office of Electricity. There is an opportunity now to do a major reorganization and shifting of programs, but even short of that, there are some organizational modifications to allow a more responsive and market facing set of applied programs to the evolving ecosystem.

In particular, a higher profile and more integrated approach is needed at DOE around storing and moving energy -an issue which is increasingly emerging as a key choke point with growing non-dispatchable renewable penetration levels. Major questions remain around how to move/balance energy over long distances (e.g., what role will the current oil and gas pipeline play?) and across seasons of the year. The electric, gas, and liquid transmission/distribution systems will become ever more integrated, constituting the internal “plumbing” of the energy system, with highly coupled technology, construction cost, job base, regulatory, and right-of-way issues (even as we push for modernization of the electric grid and explore the potential for distribution of new carriers, such as hydrogen). Some progress can be made within existing structures by fostering crosscutting working groups within this primarily fuel-based organizational system – such as around energy carriers and energy conversion devices. Better yet would be reshuffling some programs to raise the coordination and visibility of energy carrier/storage programs, currently carried out in places like the Office of Electricity, H₂ programs in EERE, or gas pipeline programs in FE. In the marketplace, all of these electrical and chemical carriers, as well as the transmission/distribution systems moving them, are becoming increasingly integrated. This market reality can be reflected in DOE by organizing both electric power and chemical energy carrier/storage work, as well as transmission and distribution infrastructure programs, under a dedicated directorate, such as an Office of Energy Carriers and Storage, that would replace and expand the current Office of Electricity.

DOE should also consider approaches to similarly align its Energy Conversion devices and User offices to markets and technologies. Currently, this work is also carried out across a number of offices, including FE (gas turbines) or EERE (Vehicles, buildings, etc.). One approach would be to organize this under an Energy Conversion and Users Office.

As a result, there would be a reorganization toward a model that includes one or more offices related to each of the major areas: Energy Sources; Energy Infrastructure, Carriers, and Storage; and Energy Conversion and Use.

Summary and Next Steps:

To summarize, while this whitepaper has proposed a number of specific ideas, its core recommendations can be summarized by its major headers: (1) Organizing around systems thinking, (2) DOE as a platform, (3) Integrating science and energy portfolios, and (4) Rethinking the applied energy offices to better reflect the evolving energy source, carrier, storage, and user markets. The ideas above are intended as a framework for a more in-depth discussion in the White House, DOE, and congress.