Interim report of Technology Transition Task Force

to the Secretary of Energy Advisory Board (July 20, 2011)

DOE is the agency responsible for creating, demonstrating, and encouraging deployment of energy technology that provides reliable and affordable energy necessary for a growing economy and personal use without adverse environmental effects. Energy security and improving economic competitiveness are important additional goals. The basic principle that should govern DOE's involvement is that DOE engages when the private sector is unable or unwilling to make investments that are in the public's interest.

There are four stages at which government support can occur: (1) creation of new ideas (basic research and exploratory development), (2) development of new technical ideas to a process development scale that defines system operation (advanced engineering) and validates feasibility, (3) system demonstration that creates a practical option for the private sector by establishing the technical performance, cost, and environmental effects of supply or demand side technology, and (4) deployment assistance or regulatory mandates to encourage the adoption of new energy technologies at a faster pace than would occur without government involvement because of (a) the absence of policies that internalize external costs, e.g. GHG emissions, (b) imperfect information, or (c) imperfect market conditions. One of the factors that distinguishes the energy enterprise from other industries is the size of the investments needed to make the transitions between these different stages.

Government action under (1) and (2) is generally accepted because the private sector cannot be expected to undertake technical activities when it cannot reliably capture benefits. [(1) + (2) accounts for about 30% of the energy portion of the 2012 DOE budget request; these are direct outlays and do not include federal and state R&D tax credits.] It follows that the R&D activity taken by the private sector, while substantial, is weighted toward less risky developments and short time horizon technical matters. The

Task Force favors greater DOE investment in early stage R&D performed by industry, DOE lab and universities, and believes this critical fundamental science program can be strengthened by incorporating the new approaches taken by the department (ARPA-E, Hubs, EFRCs) and by focusing the energy related fundamental research program to achieving significant practical applications.

Categories (3) and (4) programs are more costly (because of the size of individual projects) and generally more complex. These programs involve the government in inherently private sector activities that are more difficult for the government to judge and manage. For these activities the government may rely on indirect mechanisms such as loan guarantees, guaranteed purchase agreements, regulatory mandates to extend support. [(3)+(4) account for approximately $5billion of the $12 billion DOE energy budget but there are additional amounts, undetermined, in tax expenditures and in activities of the states]. Innovation is not unidirectional from (1) to (4); there is important forward and backward feedback: basic research advances can influence the design of first-of-a-kind demonstration, e.g. advanced CO_2 capture methods, and issues that arise in demonstration projects create new opportunities for basic technology advances, e.g. better interpretation of fracture geometry from micro-seismic signatures accompanying shale gas production.

The Task Force has not reviewed individual programs or the balance among program efforts. However some technology areas stand out as deserving greater emphasis: manufacturing technology, e.g. for batteries and PV modules, simulation and modeling tools to analyze the technical and economic behavior of networks, and as the Macondo deep water oil spill and Fukushima nuclear plant illustrate, R&D on safety and resilience to environmental disasters and other threats.

The Task Force offers four recommendations for improving DOE technology innovation efforts. We believe our findings and recommendations are consistent and complimentary with the Secretary's initiatives to undertake a Quadrennial Technology

Review of the status and goal of the department's programs and to strengthen the analytic and policy analysis basis for the program choices that are made.

1. **DOE should build a strong energy policy and systems analysis capability (EPSA).** As fiscal pressures rise, the DOE will need strong justification for its program and budget. The department needs a system that produces and integrates: (a) engineering and economic analysis of energy systems based on modeling, simulation and engineering data, (b) policy studies that analyze multi-sector energy market trends, prices, and policies, including both domestic and international developments that bear on U.S. economic performance and competitiveness, (c) ability to carry out independent cost analysis of major projects, and (d) a comprehensive collection of federal/state and industry experience.

   Creating this EPSA capability is a major undertaking. The TF recommends a structure consisting of a relatively small DOE HQ staff, comprised of no more than 20 professionals, supported by significant dedicated analytic resources provided by non-conflicted industry contractors or perhaps a new dedicated FFRDC. The director of the EPSA office should be at the Assistant Secretary level, separate from the international function.

   Ideally the required engineering and economic analysis, modeling and simulation for the individual technologies should be carried out in the energy program offices, with oversight and integration provided by the EPSA staff. We have not assessed the extent of current capability in these offices for such analysis in detail but believe that there is room for improvement. The DOE can do a better job of informing the public about the technical status, road map, and progress of individual energy technologies, based on technology assessments validate by peer review. Annual technology assessments of individual technologies with realistic estimates of performance and cost would inform investors and the public about the progress being made.

The DOE labs do not have the capability to provide the functions we envision for EPSA and the labs will be perceived to have a conflict if they are assigned a central role. EIA's projections, analysis, and its National Energy Modeling System, NEMS , will be useful for EPSA but EIA's purpose is quite different and not a substitute for these system planning and analysis needs. A strong advisory group of outside experts should be established to assure quality control.

2. **The DOE should establish a Technology Demonstration Selection Board to manage the process of selecting and structuring technology demonstration projects**. The Secretary (or Deputy Secretary) should chair the board, composed of the CFO, the new Assistant Secretary for Policy, the new assistant secretary responsible for EPSA, and the Undersecretaries for Science and Energy. At the beginning of each budget cycle the Secretary should issue guidance about the available budget and areas of priority interests. Program offices would then submit candidate demonstration projects for consideration with consistent documentation, supported by specified analysis (vetted by the EPSA office) to assure rigorous evaluation of the technical readiness and expected cost and outcome (with milestones) for each system demonstration project. If there are multiple purposes then there must be some indication of weighting among them. A clear mechanism for transferring information and know-how to investors and policy makers is a key attribute of a successful technology demonstration project.

   The board would also evaluate and approve the project management structure including funding mechanisms. Successful technology demonstration projects will require best (commercial) practices of program and project management. The mechanism for transferring technical, economic, and environmental performance information to the commercial sector should be addressed. The TF recommends that the board evaluate both new and existing technology demonstration projects to establish a common baseline. The board should also review technology demonstration projects directed by congress so that the relative merits of these projects can be understood.

It is important to stress that while the evaluation system should have a common framework, demonstration projects are not needed for all technologies and when needed, the design of the demonstration project must be tailored to the specific technology. In general government support for demonstration projects should be limited to those instances where the demonstration reduces risk and provides information to private sector investors about the technical performance, economic costs, and environmental effects of various technology options.

The TF has discussed several cases: carbon sequestration, first-of-a-kind nuclear power plants, and battery and PV manufacturing (other important candidates are cellulosic biofuels and smart grids). The discussion is instructive because it reveals the different circumstances that may justify or not justify technology demonstration depending upon policy circumstances (a carbon emission charge or regulation), prices (natural gas), and technology readiness (batteries), and because it underlines the need of a rigorous process to prioritize public investment.

The TF has not discussed the pros and cons of various mechanisms that have been proposed to implement technology demonstration projects: DOE management, DOE supported industry consortia, Clean Energy Development Authority, Green Bank, quasi-public Energy Technology Corporation. The functions of the proposed TDSB could be realigned depending upon the authority and structure of the implementing organization.

3. **ARPA-E should remain focused on initial support of potentially disruptive technology.** ARPA-E has had a very promising start in supporting new enterprises that have the potential for dramatic improvements in key energy technologies. The first two rounds of ARPA-E award demonstrate the benefit of a focus on exceptional talent, key technology applications, a nimble organization for solicitation, selection, and contracting. Many good ideas have come forward and there are indications that the U.S. technical community has the capacity for many more meritorious proposals. No other country could mount such a successful effort.

However, as the first round ARPA-E awards expire, the successful projects are seeking funding to traverse the first "valley of death:" translating a validated laboratory idea into a technical system ready for process development: (1) →(2). ARPA-E recognizes this need and understandably may be tempted to provide needed development funding.

The Task Force believes that ARPA-E should remain focused on the front-end activity. Graduating ARPA-E awardees should seek funding from venture capital and the private sector or the DOE applied energy programs, and other government agencies, such as DOD. ARPA-E should facilitate the transfer of information to potential funders but in general should not become a funder itself.

The TF believes that assuring a stable and growing base for ARPA-E funding should be a top priority for DOE. ARPA-E has succeeded in attracting a talented group of employees because of its mission and unique way of doing business. If the ARPA-E funding falters, future technology initiatives will have a hard time attracting talented individuals. In the TF's judgment the FY2011 funding for ARPA-E falls far short of what is merited by the opportunities.

4. **Strengthening commercialization of DOE laboratory technology.** The TF is favorably impressed about how the new "Technology Transfer Coordinator" is addressing this subject and supports the initiatives that are being proposed: liberalizing lab ownership of software copyright, greater use of the flexibility of "other transactional authority" for partnering with industry, creation of a small technology commercialization fund (already authorized), and establishing an IT system to disseminate information about commercialization opportunities at the laboratories to the commercial sector. The recent policy statement on technology transfer at DOE facilities, issued by Secretary Chu, is a positive step.

   At a more fundamental level, the TF questions whether the DOE is managing the laboratories in a way that maximizes their potential contribution to energy

technology innovation. The separation of the Undersecretary of Science and the Undersecretary for Energy creates split budget authority and unnecessary barriers to integrated planning of early and late stage R&D for both industry and laboratory programs. At least for the multi-purpose (non-weapons) laboratories – ANL, ORNL, PPNL, INEL, BNL, and NREL – it may be timely to launch a coordinated multi-disciplinary sustained technology development effort, at scale, combining support from both the Office of Science and the Energy Offices. This coordinated effort should exploit the specialized facilities and engineering competence of the lab around larger multi-disciplinary teams that perform R&D from basic research to engineering at the process development unit level. The relevance of the laboratory effort, including the potential for commercializing laboratory technology, would be greater if the outside in energy industry and financial communities had input in the process of shaping the energy technology R&D programs.

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