Aggressive Research and Development for Low-Carbon Energy Technology

The Need for Action: *The next President should focus the nation's attention on the need for breakthrough energy technology by establishing and funding the Advanced Research Projects Agency for Energy (ARPA-E) and selecting a top leader to manage it. Most federal energy research and development has focused on technology-specific incremental progress and large-scale demonstration projects. An R&D effort that creates breakthrough technologies with a clear path to market will provide a necessary complement to deploying new low-carbon technology opportunities.*

The U.S. research community has been at the center of our nation's most constructive contribution to the global effort to understand and respond to the threat of climate change. Our past investments in research and development (R&D) have helped drive the development of energy efficiency and renewable energy resources. The new Administration should act early to repair weaknesses and strengthen efforts in low-carbon energy R&D by announcing a new investment in transformational (breakthrough) R&D to accelerate the development of new energy technologies to reduce the drivers of climate change.

Despite the real progress to date, business as usual will not get the world to where it needs to be with respect to energy consumption and release of carbon into the atmosphere. Breakthroughs in technology are needed to increase the availability of zero carbon technologies and drive down the cost of low-carbon energy production. Investment in transformational R&D now is a key part of the strategy to arrest climate change at the minimum possible cost to the U.S. and global economy over time. The current system of federal energy R&D funding has four major components: research aimed at scientific understanding, energy efficiency improvements, technology-specific incremental progress (i.e., renewables or clean coal), and large scale demonstration projects. What is missing is an R&D organization designed and aimed at creating breakthrough technologies, and at exploiting cross-cutting approaches that fall outside the usual bureaucratic stovepipes.

Investment in transformational R&D now is a key part of the strategy to arrest climate change at the minimum possible cost to the U.S. and global economy over time.

The need for this new type of organization has already been recognized by Congress. In the America Competes Act[6], Congress authorized the creation of ARPA-E, the Advanced Research Projects Agency for Energy, with the following goals in mind: reduce energy imports from foreign sources, reduce energy-related emissions including greenhouse gases, and improve energy efficiency of all economic sectors. Although President Bush signed the legislation, his Administration has not yet taken any steps to establish the agency. The management of a federal R&D agency aimed at transformational research is substantially different from that aimed at steady progress. There is a proven example in the Defense Advanced Research Projects Agency (DARPA), which was chartered 50 years ago to provide breakthrough technologies to the Department of Defense. Without DARPA, the US military would not have stealth technology, unmanned surveillance aircraft, or the internet (originally known as the ARPAnet).

6 Public Law 110-69, 'America Competes Act' (HR 2272) August 9, 2007. More information available at: http://opencrs.cdt.org/document/RL34328

ARPA-E will fill the gap, known as the "Valley of Death" that exists between technology discovery and the point at which industry is willing to invest with a path to market. ARPA-E will focus on identifying technologies with the potential to have major impacts on the future national energy mix, and therefore on national greenhouse gas emissions levels. The agency will then fund R&D to get the technology over specific technical barriers which prevent industry from investing and commercializing critical new breakthrough technologies. ARPA-E will do this by tapping the creativity and innovation of private industry, academia, and other R&D organizations, not through creating its own laboratory system. Industry and the venture capitalists have funds available to rapidly develop new technologies into products once the critical technical risks have been identified and overcome, but only after this work has been done.

Recommendation: Establish and empower the Advanced Research Projects Agency for Energy (ARPA-E). Ensure that the structure and design of ARPA-E reflect its unique research mission. The central attributes for a transformational R&D organization include the following:

- *Breakthrough-focused Structure*
    - An ARPA-style organization must be nimble and willing to move to the areas with the greatest promise. Its role will be to identify promising technologies and mature them to the point where private sector product developers can take over.[7]
- *Risk-tolerant Culture*
    - Employees of the organization should be encouraged to take risks with the potential for game-changing impacts on energy security and climate change. This will differ from the status quo in which steady progress is rewarded and major risk taking is discouraged, staff is permanent and the organization may potentially become locked into a set of technologies.
- *Experienced R&D Manager*
    - The organization will need a technically-deep, experienced manager, ideally with professional experience in both the public and private sector. The Director of ARPA-E, a Senate confirmed position, must have the confidence and senior support of the President and Secretary of Energy to succeed against the bureaucratic obstacles that any fledgling agency will encounter.
- *Funding Additive to Existing Incremental DOE Programs*
    - ARPA-E will not and should not replace current DOE funded energy R&D, particularly that conducted by the Office of Energy Efficiency and Renewable Energy, which should be increased. ARPA-E is the missing piece, but does not cover all the needs of a strong energy R&D portfolio.

Recommendation: Fund ARPA-E. ARPA-E was authorized in the America Competes Act in 2007, but not funded in FY2008. The next Administration should consider the following minimum funding profile in a separate funding line in the DOE budget: FY09: $15 million, FY10: $150 million, FY11: $300 million, FY12: $300 million, FY13: $300 million

7 An example of this transition path to industry was DARPA's investment in surface-emitting lasers on a chip. This technology is now the basis of optical communications (FIOS) and CD players, but is also the key component in robust fly-by-light control systems in military aircraft. DARPA's investment reduced the major technical unknowns and risks so that industrial R&D organizations could take over the work.