

Testimony of

Ernest J. Moniz
Cecil and Ida Green Professor of Physics and Engineering Systems
Director, MIT Energy Initiative
Massachusetts Institute of Technology

Before the
United States Senate Committee on Energy and Natural Resources

November 15, 2011

Quadrennial Energy and Technology Reviews

Chairman Bingaman, Ranking Member Murkowski, and Members of the Committee, thank you for the opportunity to offer views on the Quadrennial Energy and Technology Reviews (QER/QTR) that were recommended one year ago by the President's Council of Advisors on Science and Technology (PCAST) and on actions that this Committee might take to advance the process in concert with the Administration. Establishing the QER/QTR was the key recommendation in the PCAST *Report to the President on Accelerating the Pace of Change in Energy Technologies through an Integrated Federal Energy Policy*. I also thank the Committee because the fact that you are holding a hearing on the QER/QTR itself provides impetus and indicates support for the level of Administration-Congress dialog that will be needed for success of the QER/QTR. The QER is a major undertaking that will inevitably sharpen the key issues that must be addressed for a consistent, sustained and bipartisan approach to American energy technology and policy innovation.

I start by emphasizing that, although I am a member of PCAST and co-chaired the Energy Technology Innovation System Working Group, I testify today as a private citizen and not as a member of PCAST. Clearly, my views are shaped by multiple experiences and perspectives, including the PCAST working group discussions that led up to the QER recommendation; those discussions included input from many individuals in academia and labs, the private sector, and government, most notably Senator Bingaman. In addition, I was part of the Office of Science and Technology Policy (OSTP) for the scoping of and initial work on the 1997 major PCAST study on *Federal Energy Research and Development for the Challenges of the 21st Century*, led by John Holdren, now the President's science advisor and PCAST co-chair; that report recommended a portfolio approach to DOE energy RD&D programs that remains relevant for the QTR. I then served as Undersecretary of Energy and had the opportunity to initiate portfolio and roadmapping approaches that engaged multiple stakeholders and led to some new research thrusts (large scale modeling and simulation of energy systems, electricity system reliability,...). In my current role as Director of the MIT Energy Initiative, I have the opportunity to work with over sixty members across the energy technology innovation chain and most closely with fifteen major energy companies that support a broad research portfolio engaging hundreds of MIT faculty and students. Finally my own research program for the last decade has centered on advancing multidisciplinary studies that link technology, analysis and policy in order to enable clean energy innovation. All of these experiences underpin the views on QER/QTR that I will summarize briefly in the testimony and in the discussion that follows.

In thinking about the need to accelerate energy technology innovation, it is useful to reflect on the nature of the energy enterprise:

- multi-trillion dollars/year revenues
- Very capital intensive

- Commodity business/ *cost sensitive*
- Established efficient supply chains, delivery infrastructure, and customer bases
- Essential services for all activities
- Reliability of energy delivery valued more than innovation
- Highly regulated
- Complex politics/policy driven by regional and local considerations.

This is not the prescription for an agile system that is easily transformed to meet new challenges, and indeed history tells us that many decades have been required for major changes of the energy enterprise. However, the imperative for accelerating change is real:

- for economic competitiveness, while recognizing that the U.S. will not be the principal market for new energy technology and infrastructure;
- for the environment, as prudence calls for starting to reduce greenhouse gas emissions substantially in the near and intermediate term;
- for security, by reducing oil dependence and lowering the bill for imports.

An integrated Federal energy policy up to these challenges needs staying power, and that in turn requires a bipartisan Administration-Congress dialog based on clear objectives and analysis. Substantial input from the private sector is essential, gathered in an inclusive transparent process. The governmental dialog is challenging in the face of multiple Executive agencies and multiple Congressional committees with stakes in the game. The QER is intended to facilitate the dialog.

While most decisions about new energy technology, production, delivery and use are taken in the private sector, the Federal government has crucial roles to play by investing and sharing risk along the technology innovation chain and in “setting the rules” through policies, standards, and regulations that reflect public goods. Yet, it has proved difficult to establish consistent, comprehensive and integrated Federal energy policies and programs. An “energy policy” is in many ways the sum of environmental, security, economic competitiveness, tax, land use, and other policies. And the diversity of policy instruments is just as broad: research support, technology development and demonstration, deployment incentives, government procurement, IP rules, standards and regulation, public-private and Federal-state collaboration, human resource development through education and immigration, international agreements, and more.

The QER and its derivative QTR were put forward as a way to bring more structure and transparency to the process. Key organizational principles put forward in the PCAST report lead to prominent roles for the Executive Office of the President (EOP) and for the Department of Energy (DOE). The former has the convening power to bring together the many agencies with stakes in energy and with the levers for implementation. The DOE has core energy responsibilities, especially for technology, and the scale to staff a major effort; it would provide the QER Administration-wide Executive Secretariat. The DOE also has the breadth of industry contacts and domain knowledge needed to ground the QER in energy sector reality. The PCAST report left the decision to the President as to who in the EOP would lead the QER along with the Secretary of Energy. I will return later to specific comments on the bills S.1703 and S.1807, which are pretty well aligned with these organizational principles.

The PCAST report listed key objectives of the QER, which I repeat:

- lays out an integrated view of short-, intermediate-, and long-term objectives for Federal energy policy in the context of economic, environmental, and security priorities;
- outlines legislative proposals to Congress;

- puts forward anticipated Executive actions (programmatic, regulatory, fiscal, and so on) coordinated across multiple agencies;
- identifies resource requirements for the RD&D programs and for innovation incentive programs; and
- provides a strong analytical base.

I pay special attention to the call for an analytical basis for constructing the multiyear roadmap. This is essential for developing a resilient plan that maintains stability in the face of major events in the energy sector and changes in the political makeup of the government.

The PCAST report recognizes that a government-wide QER is a major undertaking calling for new processes and new alignments of the many departments and agencies that must work together. It is more complex than the Quadrennial Defense Review, which requires much less input from outside the department. Consequently, it was recommended that the first installment in 2011 focus on energy science and technology, which is mostly within the purview of DOE. This has been termed the QTR, and a number of characteristics were indicated in the PCAST report (where the term DOE-QER was used, rather than QTR). The first QTR builds on technology roadmapping processes that had already gone on at DOE, but importantly adds processes and principles needed to prioritize portfolio choices. It balances different energy challenges, different timescales, and different strategies. It also begins the process of establishing contact with other departments and agencies involved in energy R&D. I congratulate Secretary Chu, Undersecretary Koonin and their staffs for carrying out this first QTR and providing a clear set of priorities and a rationale that, if followed, will shift the DOE portfolio in significant ways. I would also like to thank the Undersecretary for his distinguished service at DOE, to which he brought a unique background in both academia and the energy industry.

The QTR recommendations should generate considerable discussion. In particular, the recommendation that the DOE portfolio give more weight to transportation technologies that reduce oil dependence and the subsequent priority for engine efficiency and electrification of transportation are well argued but of course will not have uniform agreement. A test of the QTR is whether it will stimulate the kind of discussion that can build sufficient agreement to support long term stable portfolio planning with both Administration and Congressional endorsement. If we return to the “technology du jour” approach of the past (e.g. the hydrogen car), it will be difficult to follow through on key programs that eventually make a material difference in the marketplace and help provide technology leadership.

Here it is important to repeat the PCAST report call for substantially higher levels of funding for energy RD&D if the economic competitiveness, environment, and security goals are to be met. There is no magic number for what Federal support should be, but numerous analyses, including those of business leaders who put together *A Business Plan for America’s Energy Future*, converge around a \$10B/year shortfall. Clearly the severe pressures on the Federal budget make it very unlikely that such funding could be found through the appropriations process any time soon, so PCAST recommended that the Administration, Congress and the private sector work together to explore new revenue streams based upon energy production, delivery and/or use. There are good examples of such approaches, in which the funds are managed by non-profit organizations with strong industry guidance in setting the RD&D agenda. This is relevant to the QER/QTR since portfolio design can be quite different for substantially different anticipated funding levels and mechanisms.

There are several examples within the QTR that point to the importance of placing recommendations within the broader context envisioned in a QER. For example, the QTR justifiably emphasizes the importance of efficiency for vehicles, buildings and industry. However, technological developments that increase efficiency do not necessarily equate with demand reduction. A classic example is the failure to capture the benefits of

automobile engine efficiency increases as the advances were played off against increased horsepower. This emphasizes how technology development and policy need to be integrated in order to address the ultimate policy objectives (reduced oil usage in the example above).

Another example is the near absence of mention of natural gas in the QTR, even though increased gas supply and lowered prices stimulated by shale gas development may be the prime U.S. energy gamechanger for this decade. This is understandable for an effort focused on advanced technology, although the MIT *Future of Natural Gas* study did point out a number of areas for which a public-private partnership should support important natural gas R&D (testimony before this Committee in July 2011). The natural gas story of bridging to a low-carbon future has significant implications for how one establishes R&D priorities for clean electricity. These considerations would be part of the broader multi-agency QER.

Another important objective for the QER would be clarity on the variety of risk-sharing mechanisms for government support of energy technology adoption and diffusion and on their application in different situations. For example, legislation since 2005 has favored up-front loan guarantees over mechanisms that reward successful project performance. An analytical approach based on historical performance would provide the basis for an Administration-Congress conversation on best practices fit to purpose. The PCAST report recommends a comprehensive cataloging of existing energy subsidies and incentives as a first step towards realignment with QER priorities.

As recognized in the QTR, there is much to do for further iteration of the QTR and for building up capacity to support a full QER. The most striking need is to build up substantial government strength in energy engineering-economic analysis as a core competence. The DOE (and its labs) have little strength in this area in comparison to the private sector, but such skills are essential for going to the next meaningful stage of the QTR. The ability to integrate technical, economic and policy analysis is in turn essential for the QER Executive Secretariat function. I urge that the Congress support buildup of this capability within the DOE. This function could be placed in an expanded Office of Policy supporting the Secretary; the PCAST report recommends establishment of a policy office separate from the international affairs function. In my view, the first QTR should be followed in 2012 by a renewed effort to build on the first edition, incorporating more analytical functions, engaging more agencies, and building momentum towards a QER that will presumably be launched more aggressively in early 2013.

Since the QER depends on strong analysis, I note that there is underinvestment in support for energy economic/policy/social science research and analysis at universities and NGOs. In addition to building up internal capability, DOE should be authorized to provide extramural funding for such research through the Office of Policy, EIA, and/or Science/BES. This need might also be addressed through establishment of an independent non-profit with core government funding, perhaps with matching funds from industry. The National Bureau of Economic Research could provide an organizational model, with research affiliates drawn from universities across the country. The QER could benefit greatly by drawing on the independent research results of such an organization.

Finally I will comment briefly on S.1703, the “Quadrennial Energy Review Act of 2011”, and S.1807, the “Energy Research and Development Coordination Act of 2011”. Both would have the Secretary of Energy and the Director of the Office of Science and Technology Policy in the EOP as co-chairs of multi-agency activities.

S.1807 would establish the National Energy Research Coordination Council, co-chaired as indicated above and including the OMB Director, the heads of departments and agencies with energy RD&D annual budgets in excess of \$10M, and others at the discretion of the President. It would generate an annual cross-cutting

Federal energy RD&D program plan and budget proposal based on the QER/QTR. The Council would represent the agencies with input into the QTR and would codify the QTR role in guiding coordinated annual plans. It would facilitate multi-agency collaborations as appropriate, both within the Administration and in discussions with multiple Congressional committees. This would be a positive development. I make two additional observations. First, the Council might draw upon the analytical capabilities that we feel is essential for the QER Executive Secretariat. Second, the QER/QTR and Council processes would be helped enormously if Congress could adopt four-year authorizations in sync with the QER. The QER would provide an integrated government-wide roadmap that would provide a basis for Congressional discussions spanning committee jurisdictions and for a multiyear authorization. More realistic multi-year budget projections from DOE, consistent with the QER/QTR, would be an important part of the discussion. The annual appropriations process would continue in response to the Council program plans and budget proposals.

S.1703 would legislate the QER as a required submission to the Congress, providing “an integrated view of national energy objectives and Federal energy policy, including alignment of research programs, incentives, regulations, and partnerships.” Clearly this is in accord with the intentions put forward in the PCAST report. An interagency working group would be established at the beginning of each Administration, with the QER due one year later. This date is displaced by one year from that recommended by PCAST. In steady state, this shift by one year is quite reasonable. My concern is whether the first QER can be put together well by early 2014, given that the entire process needs to be invented. This can be ameliorated to some extent if the buildup of analytical capabilities and process development are funded and pursued aggressively in 2012.

The second significant difference to the PCAST recommendation is the naming of the Secretary of Energy and the OSTP Director as co-chairs. The PCAST report left selection of the EOP lead to the President. Clearly today, OSTP is headed by John Holdren, who is one of the nation’s leading energy researchers and analysts and thus well suited to being a leader in the QER development. He would be an outstanding choice. Nevertheless, I would still favor leaving the President with the discretion to choose, since the EOP convening power is very important for the QER. This is especially so since agencies with policy and regulatory equities but without appreciable science and technology programs will be key players.

In conclusion, a successful QER process would establish a new opportunity for weaving together the many threads that make up a comprehensive energy policy and for applying multiple policy instruments in a targeted way. It would also provide a vehicle for framing a productive Administration-Congress dialog on moving the U.S. towards widely-held energy economic, environmental, and security goals. The QTR is both an important first step towards the QER and a guide to constructing an energy RD&D portfolio aligned with national strategic goals. Mr. Chairman, Ranking Member Murkowski, and members of the Committee, your support for and engagement with the QER/QTR process will be important for its success.

I look forward to addressing your comments and questions.