UTC Power Corporation
195 Governor's Highway
South Windsor, CT 06074

UTC Power
A United Technologies Company

Michael O. Brown
Vice President, Government Affairs & General Counsel
Telephone: (860)727-7905
Cell: (860)372-8567
Email: michael.brown@utcpower.com

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Department of Energy
Office of the Under Secretary for Science (S4)
1000 Independence Ave., SW.
Washington, DC 20585

Re: DOE Quadrennial Technology Review Framing Document

UTC Power Corporation ("UTC Power") is pleased to provide comments on the Quadrennial Technology Review Framing Document (76 FR 13607, March 14, 2011).

UTC Power, a United Technologies Company located in South Windsor, CT employs 475 people in the development, design, production and service of fuel cells for use in stationary, transportation, space and defense applications. UTC Power began working with fuel cells in 1958, has broad experience in the development and deployment of fuel cells and has worked with all five fuel cell technologies. Without the fuel cells produced in South Windsor, man never would have set foot on the moon.

Today we are producing fuel cells for stationary applications that fulfill the promise for clean energy generation with system efficiencies approaching 90%, no combustion, no noise, no green house gas emissions and a significantly reduced carbon foot print from the same amount of energy input compared to traditional power generation devices. We also provide fuel cells and fuel cell technology for transportation applications, from working with various automotive manufacturers on fuel cell technology for light duty vehicles, to underwater vehicles, to the Space Shuttle, to fuel cell powered transit buses deployed with AC Transit in California (the nation's largest fuel cell powered bus fleet) and with CT Transit in Hartford, Connecticut. Our fuel cell bus technology is world class in durability, operability and efficiency. Our fleet leader has over 9000 hours of operation without an overhaul or replacement of the cell stack. Sixteen new buses deployed earlier this year with advanced technology promise even greater durability and fuel efficiency, challenging the durability, availability and efficiency of diesel powered transit buses. We are also working on new technology, including the Solid Energy Conversion A (SECA) program as the prime contractor for one of the industrial teams.

We support the Department's general approach to the energy technology review and believe that the activity begins to address key issues that face the nation in increased cost, environmental footprint and national security issues created by the current use of energy in this country.

Fuel Cells and Hydrogen

The Department has limited the discussion of distributed generation technologies and has made fuel cell technology conspicuous by its absence in the framing document. The United States has the technology leadership in the commercial application of fuel cell technology. Three fuel cell technologies are currently in limited production and commercial deployment for large stationary power applications. Many other countries are interested in these fuel cell technologies. Some of those countries have made it a national priority to develop the fuel cell technology and create their own export industry for that technology. Principles for allocation of resources should focus on the ability of certain technologies to achieve the energy goals established by the Department. If a roadmap has been established with objectives along a path to commercialization, progress should be measurable. Overall energy policy should have current, near and long range goals and objectives. Key objectives should be established on anticipated returns on investment by economic sector, technology durability, maintenance costs, efficiencies in terms of total energy made available and ease of deployment. Products that require significant technology breakthrough would, under the TRL system described above, result in a lower priority and longer time horizon. Products that are in the marketplace but require some government support to validate the technology and "seed" commercial deployment should be given a higher priority if the key objectives can be met in the necessary time frame. Considerations should also be given to domestic opportunity as well as the potential for export markets for US businesses. As the framing document points out, energy, its deployment and cost are major objectives of developing countries and it is likely that these countries will not repeat the experiences of the developed world in central generation and distribution. This provides a major opportunity for fuel cell technology which, if the United States maintains its leadership, would result in significant jobs and economic growth in the U.S.

For the stationary application of fuel cell technology, UTC Power today provides a fuel cell that produces electricity and efficiently recovers the heat generated from the electrochemical process. This recovered thermal energy displaces heating or cooling which is typically powered by other energy sources. By recovering the thermal energy, energy input efficiencies of up to 90% can be achieved. Significant carbon footprint reduction is achieved and, since the electrical generation is not a combustion process, there is virtually no emission of other criteria pollutants normally associated with combustion-based electrical production.

The current cost of electrical production using the fuel cell, without consideration of federal or state incentives, and with gas cost at $10 per million Btu's, results in an electric only cost to the end user of about 18 cents per kWhr. This assumes a multimillion dollar investment in generating costs. This electric only rate is the same as high cost electric rates available off the grid. The current issue in the market place is the return on the investment to the end user. In order to generate that return to the investor, the actual cost of the electricity must be at least two cents per kWhr lower than grid electricity. Fuel cells compete with other capital projects and are evaluated on commercial returns which are different from how investments are evaluated by utilities. Policies that encourage utilities to deploy distributed generation technology to support and supplement the central grid would provide significant stimulus to the market development. Running as a base load unit, a fuel cell would also help ensure better utilization of the grid

resources and avoid further upgrades to the central generation, transmission and distribution system. With the use of the thermal energy, the effective cost of electricity (giving credit for the heat generated and used) can be reduced by about one cent for each 25% of the produced thermal energy that is recovered. The cost of fuel cells today results from a very low volume of fuel cells produced and delivered today. With increases in volume from about 20MW annually to 100MW annually, the cost of the fuel cell would be dramatically reduced. The reduction comes not from some change in the underlying technology, but from the creation of a robust supply base that competes to provide supply. With this competition in the supply base, the cost will come down on the components, improving the first cost position in the evaluation of the payback to the end user.

In the transportation area, fuel cells in light duty vehicles are difficult in wide spread deployment due to infrastructure concerns, however, central fleets could significantly benefit from the clean and highly efficient deployment of fuel cells. UTC Power believes that heavy duty fleet vehicles, which are high consumers of diesel fuel, operate in urban environments and contribute to pollution in the urban environment, could be converted to clean, quiet fuel cells with ranges that are equal to or better than current conventional heavy duty transportation power. The framing document, while appearing to support clean transportation alternatives, also leans toward the continued use of “liquid fuels” to support the internal combustion engine. Continued reliance on liquid fuels will, by necessity, involve significant trade offs in key policy areas. Liquid fuels will continue to be dominated by petroleum and an ever increasing percentage of petroleum used in this country is outside the control of the United States. Alternative fuels, such as ethanol, could lead to consequences in other sectors of the economy. Hydrogen is a fuel that is widely available and within the control of the United States. No trade off would be required with other sensitive policy positions. Continued emphasis on liquid fuels, while a near term necessity, could be supplanted in the longer term by non liquid fuels. Particularly in the area of fleet vehicles, where there is central maintenance and fueling, hydrogen could play a significant role and also drive other policy considerations, such as a greater use of mass transit options over personal vehicles. UTC Power is the only US manufacturer of fuel cells for heavy duty vehicle operation. We believe the technology is viable and competes with diesel engines in this application. The only issue that needs to be addressed is volume. Policies that would drive the volume, such as zero emission transit vehicle requirements that have been debated in California, would begin to drive that volume and push first cost down to compete with diesel hybrid and all electric bus systems.

Energy Efficiency & Policy

We support the goals set forth in the Federal Register notice of reduced green house gas emissions and the generation of electricity from clean energy sources. However, we believe that the goal of deployment of electric vehicles and the limitation to ***electricity*** from clean energy sources necessarily limit the broader definition contained in the DOE Energy Technology Mission of “enabling options” which the Department states does not “pick winners or losers”. It would appear that the Department has selected only certain approaches to be included in the framing document, but we believe the document should openly consider all options and set forth the rationale if certain technologies are not included in the review. Where the Department has defined key elements of its mission statement, we believe that the framing document meets the objectives of the mission statement for certain terms. With regard to “facilitate” through convening resources to evaluate and perform basic research; the support for both evolutionary and revolutionary technologies in “Invention and refinement”; “early deployment” by supporting ***some*** activities beyond first commercial deployment; and, “meaningful technologies” through

evaluation of economics, scale and timeliness of those technologies, we believe the framing document meets those pieces of the mission. We also agree with the definition of "enabling options for scaling by the private sector" as support for commercialization "as an ***essential part"*** of what the Department should do. In "enabling options", however, the goal of the mission statement to not pick winners and losers and let the market make those choices is not achieved in the approach of the framing document or in the actions of the Department.

In the US Energy Framework discussion, the focus is on electricity in both transportation (increased deployment of electric vehicles) and in stationary (modernization of the grid and clean ***electricity*** supply). The technology review tackles some difficult questions, but more clarity into the conclusions or assumptions implicit in the framing document need to be explained or documented. While parts of the review talk about clean energy (we assume this means both electrical and thermal energy), it also slips into priority for electrical objectives as controlling the decision process. Clean energy is critical and a significant opportunity for the United States through the improved efficiency of ***energy*** generation. Simply by improving the energy capture or deploying electrical systems that also capture thermal energy, many of the objectives of the mission statement and the national energy goals can be obtained. While the central grid will always be an important element of the national energy strategy, distributed electrical generation that can capture and provide the heat element of electrical generation displacing traditional, additional heat generation, will provide a cleaner energy generation system in terms of useable kilowatts (both thermal and electrical) per kilowatt of energy input. This will result in more energy per unit of carbon or green house gas emissions, lower overall energy consumption and lower energy costs. Distributed generation combined heat and power systems can significantly improve the energy efficiency and reduce the carbon footprint of end users.

The Department must lead the development of a comprehensive energy policy and the transition to a more energy efficient economy. There are many tools that can be adopted by the Department in the analysis of the readiness of the technology for the marketplace. NASA uses the Technology Readiness Level (TRL) methodology which is also adopted at United Technologies and provides a consistent basis on which to judge the technology in a commercial environment. Whichever tool is selected, it needs to be consistently applied and communicated to the various stakeholders. Similarly, there are tools that can be used to assess the marketplace impact of the technologies that are under consideration. Development of clear milestones that tie to a roadmap that addresses the national energy goals and the standards by which are technologies and applications are judged must be communicated clearly and the private sector must be a participant in the process. The private sector, government expertise (both on technology and as an energy consumer) and academia provide great opportunities for analysis and debate that should produce sound decision making. This leadership needs to also ensure that local and state regulations, as well as policies set by other federal agencies and departments, encourage and support the overall national policy objectives. However, the Department must be aware of its role as a leader in the world in terms of energy policy and technology endorser. Dramatic actions that it takes to alter a course that has been established over years without the benefit of well communicated and data driven analysis, results in significant disruption to the national economy in terms of jobs and resource distribution. It also communicates to the world that only certain technologies or applications of technology have been endorsed by the Department.

The questions on balancing the role of the Department in partnering with the private sector, technology demonstration and non-technical barriers are important in ensuring that technology is deployed effectively and efficiently. Particularly in the area of electricity, the market forces have been shaped by one hundred years government economic and energy policy that is substantially different from the current environment. Private sector innovation must be protected to ensure not only an incentive in the market for the commercialization of the technology, but also to ensure that American jobs and global competitiveness are maintained. For the Department to spend US funds on the development of a technology and then have that technology generally available to be exploited both in the US and outside the US could put US businesses at a competitive disadvantage. A balance needs to be struck, however, in the event that the technology is not developed. At some point technology that is not advancing to the marketplace needs to be made more widely available so market forces can decide if the technology should succeed or fail.

It is critical that in the demonstration phase that is funded by the Department, that there be a full a complete disclosure of information to a broad population to ensure that decisions both on policy and commercialization are made on a sound footing. While the information does not have to be public, it is important that the bad news is shared along with the good. This is essential if the convening function of the Department set forth in the Department's Mission statement is perform the function contemplated and provide the analysis to ensure appropriate direction in energy policy.

The Framing Document provides a tremendous tool to facilitate the dialog on opportunities in shaping future energy policy and the energy footprint of the United States. UTC Power is interested in continuing to participate in the dialog that this document will generate. We believe the framing questions set forth in the document are critically important to the establishment of sound energy policy in the United States. The dialog around those questions must be data driven and complete to ensure that appropriate goals and milestones are established.

Very truly yours,

Michael O. Brown
Vice President Government Affairs
and General Counsel

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