TESTIMONY BY
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Good morning, Mr. Chairman. My name is Frank Preli. I am Vice President of Engineering for UTC Power, a United Technologies Corporation (UTC) company. With more than 40 years of experience, UTC Power is the world leader and the only company in the world that develops and produces fuel cells for applications in each major market: on-site power, transportation and space flight applications. We are also the world leader in the development of innovative combined cooling, heating and power applications in the distributed energy market.

Summary

Fuel cells provide an opportunity to address a variety of U. S. energy needs including:

- Reducing dependence on foreign oil;
- Delivering assured, high quality reliable power;
- Decreasing toxic air and greenhouse gas emissions; and
- Improving energy efficiency.

UTC Power does not see any "show stopper" technical barriers to the advancement of fuel cells, but continued U.S. commitment to research, development, demonstration and market transition initiatives are essential to reduce cost, improve durability and enhance performance. Hydrogen storage and infrastructure requirements represent challenging obstacles for transportation applications, but near term opportunities exist with fleet vehicle applications such as transit buses that minimize these concerns. Stationary fuel cells for assured power represent another opportunity for near term commercialization at lower cost targets.

Fuel cells are available today for the transit bus and stationary markets. Near term successes in these applications are required to create public awareness and acceptance, establish a viable supplier base and stimulate continued investment. Last year's Energy Policy Act provides the basic framework for a comprehensive strategic focus, but a sustained national commitment to robust funding will be critical to our success. Hurricane Katrina reconstruction efforts represent an opportunity to deploy fuel cells in schools to serve as emergency shelters, hospitals and other critical infrastructure facilities to demonstrate their ability to provide sustainable energy for assured power requirements.

As we enter the summer hurricane and electric grid blackout season, concerns regarding reliable assured power increase. UTC Power believes there is an opportunity to enhance the value of fuel cell vehicles by enabling them to deliver power to the grid or other critical infrastructure such as emergency shelters. We are currently working with the Department of Defense to validate this concept with our heavy duty vehicle PureMotion™ 120 fuel cell power plant system.

Company Experience and Leadership

UTC Power has led the development and introduction of fuel cell technology for more than four decades. We hold the unique distinction of having:

- produced all the fuel cells that provide electrical power and drinking water for both the Apollo and Space Shuttle missions;
- sold more than 255 stationary 200 kW units that have produced more than 1.2 billion kilowatt-hours of electricity and have accumulated more than 7 million hours of operating time by customers in 19 countries;
- provided stationary fuel cells that have a stack life of 40,000 hours (an 80,000 hour life cell stack is in the final stages of development);
- developed fuel cells for a number of automotive customers including Hyundai, Nissan and BMW and working with almost all of the major automobile manufacturers on fuel cell powered vehicles; and
- provided 120 kW fuel cell power systems that are currently powering four zero emission transit buses in revenue service in California.

UTC Power has participated in public-private partnerships with the Departments of Defense, Energy and Transportation in the development of its technology solutions for the stationary and transportation markets. Our proprietary low pressure drop, internally humidified natural water management proton exchange membrane (PEM) fuel cell technology has led to significant advances in efficiency, power density and cold weather performance.

Our longstanding involvement in these varied markets and applications provides a unique vantage point to discuss how fuel cell technology can help address U.S. energy needs, the status of technology today and the barriers we face.

Need for Short Term Successes

Our dependence on imported oil is well documented and personal automobiles consume the lion's share. Deployment of fuel cell vehicles powered by renewable sources of hydrogen can break our dependence on imported oil and at the same time take transportation out of the environmental debate. The auto market also represents the highest volume market, which is another reason this sector has received so much attention. But fuel cell vehicles for private use in meaningful quantities are a decade away since they represent the most demanding application in terms of cost, packaging and infrastructure. Existing electrical infrastructure and state and federal regulations create hurdles for any form of base load distributed generation to overcome.

Nothing breeds success like success. We therefore need to increase our immediate focus on near term applications that are available today such as stationary and fleet

vehicles, including transit buses, to stimulate early volume and build the industry's supplier base. Since fuel cells represent a disruptive technology, the supplier base is reluctant to make the necessary investment. Early successes in the transit bus and stationary applications will help to overcome these fears.

In addition, stationary and fuel cell fleet vehicles have less demanding requirements and can compete at costs higher than those required by autos. Concentrating on these applications would enhance our ability to establish a profitable industry today and create stepping stones to the most demanding longer term auto application. Few companies can survive the next ten years waiting for the high volumes offered by the car market. Instead, they must find applications where profits can be realized today that will support the development of a strong industrial base in preparation for the future auto market. Success in these early applications can build the necessary public awareness and public confidence.

Transit Buses and Fleet Vehicles

Fuel cell transit buses offer the best strategic, near term potential to address the energy concerns cited above. In 2002, transit buses consumed the equivalent of more than 43,000 barrels of crude oil per day. The fleet of zero emission hybrid fuel cell buses currently powered by our fuel cells in revenue service in California is demonstrating greater than twice the fuel economy of a conventional diesel bus. Transit buses and fleet vehicles present an opportunity to begin to reduce oil imports in the near term while also improving air quality and reducing greenhouse gas emissions.

Buses and heavy duty commercial vehicles travel a relatively low percentage of the nation's vehicle miles, but they produce significant levels of toxic air emissions in densely populated urban areas. The transit buses equipped with UTC Power's PureMotion™ 120 fuel cell power system significantly reduce overall emissions due to the zero-emissions technology inherent in hydrogen fuel cells.

As we enter the summer hurricane and electric grid blackout season, concerns regarding reliable assured power increase. In light of this vulnerability, we believe there is an opportunity to enhance the value of fuel cell vehicles by enabling them to deliver power **to** the grid rather than **from** the grid as some people have proposed with the plug in hybrid approach. The "exportable power" approach could improve reliability and provide assured power during times of emergency to shelters, hospitals and critical infrastructure.

UTC Power is currently working with the Department of Defense to validate the ability of our PureMotion™ 120 fuel cell power system for heavy duty vehicles to export power to the grid or to provide power to emergency shelters. This approach would enable a transit authority, military base or school system to use their fuel cell buses to transport people in zero emission, efficient, hydrogen powered, quiet buses under normal conditions and provide emergency power during natural disasters or terrorist incidents.

Bus durability requirements assume a life of more than 30,000 hours for a system that must operate up to 16 hours per day, but with frequent starts and stops. We offer a warranty of 4,000 hours for the four buses that are operating today in AC Transit and SunLine Transit revenue service in California and have a technology plan to increase the life of these power plants to 25,000 hours by 2010 and up to 40,000 hours by 2015.

Cost targets for buses are more forgiving than for autos and their infrastructure requirements are limited since they rely on centralized fueling and maintenance. The four buses produced last year cost over $3 million per bus, but we have been able to reduce this cost to under $2.5 million and with volume of 100 units per year we can see a path to $1 million per bus. We are actively engaged in pursuing a number of worldwide opportunities to aggregate bus orders and achieve volume sales that will result in potential near term commercialization of the technology in this strategically important application.

Stationary Fuel Cells

We also view stationary fuel cells as another near term opportunity to address air quality, climate change, reliability and energy efficiency concerns. The stationary fuel cell mission involves 24/7 steady state operation and a life of at least ten years or 80,000 hours.

Early adopters have been attracted by the ability of these systems to operate as base load grid-connect or grid independent assets. We've deployed units at schools, hospitals, law enforcement, research, telecommunications and military facilities to address assured power and other customer concerns. In addition, one of our units is operating at a Connecticut high school that enables the school to be designated as an emergency shelter. This concept could be replicated in areas subject to natural disasters to provide additional community benefits.

We also believe there's a significant opportunity in the Katrina reconstruction effort to rebuild with sustainable energy objectives. For example, we could reduce the environmental footprint of power generation and increase reliability by installing onsite, assured power fuel cells to help meet future emergency needs at schools serving as mass care shelters, hospitals and health care facilities, prisons, and other critical infrastructure facilities.

Since fuel cells can be deployed at the point of use, in addition to not relying on the vulnerable transmission and distribution assets of the grid, customers can benefit from the ability to capture waste heat and put it to constructive use for space heating, domestic hot water heating and industrial processes. Our units operating in the combined heat and power mode can operate at 85-90% efficiency thus generating energy savings that can reduce the cost of electricity by four to five cents per kilowatt hour.

Our PureCell™ stationary fuel cell power plant uses phosphoric acid technology and has demonstrated best in class durability with 27 of our units surpassing 40,000 hours without significant maintenance or replacement of the original cell stack. Our current

high time unit has 60,000 hours and we are testing a new generation of technology that we plan to introduce to the market in the next several years that we are confident will achieve 80,000 hours.

The cost of these units is currently around $4,500 per kilowatt, but at volumes of 500 units per year and with the aggressive cost reduction efforts we have underway, we expect our next generation technology to be competitive at less than $2,000 per kW.

Automobiles

Cars are only driven an average of two hours a day which means their life requirement is low compared to other applications, However, autos experience many starts and stops and changes in speed that create unique needs for a robust and durable system through many different duty cycles. The Department of Energy's (DOE) short term durability goal for cars is 2,000 hours by the end of the learning demonstration program in 2008 with 5,000 hours as the ultimate objective.

We are participating along with Hyundai in DOE's Hydrogen Fleet and Infrastructure Learning Demonstration program as part of the Chevron led team. Ten cars using our power plant are currently operational with a total of 32 vehicles planned.

As part of this initiative, we have cars on the road today that have passed the 500 hour mark and are still accumulating hours. In the laboratory we have run stationary loads for 13,000 hours, auto stress-test cycles of 5,000 hours and one million acceleration cycles, which gives us confidence that we can meet the goal of 5,000 hours in production vehicles.

Fuel cell cars must be capable of both starting and operating in cold conditions if they are to gain broad market acceptance. The consensus performance criteria are the ability to survive at -40 degrees Celsius and start at -30 degrees Celsius. Great progress is also being made in this arena. For example, one of our cars has run 25 cycles from frozen conditions as low as -10 degrees Celsius and we have demonstrated 43 cycles at -35 degrees Celsius in the laboratory.

Barriers

In short, technology development barriers for transportation fuel cells are being addressed at a rapid pace. At a small scale, we can meet the identified requirements and we don't envision any formidable show stoppers. This doesn't mean, however, that we don't need to continue our public- private partnership research, development or demonstration efforts. We strongly endorse the continuation of these activities and increased financial commitment to accelerate the progress we have made in the last few years.

The basic concepts of fuel cell technology have been proven. Our task now is to enhance key performance characteristics (such as durability); reduce costs; validate the technology in real world operating conditions; identify hidden failure modes through extended operation; and then identify and incorporate cost effective solutions. In the case of transportation applications, infrastructure and hydrogen storage still represent key challenges.

Three strategies are necessary for cost reduction:

- Internal programs to reduce cost through material substitution, longer life parts, and fewer parts. Examples include less expensive membranes; better seals; reduced use of platinum; enhanced performance materials for bipolar plates; and reduced system complexity.
- Improved manufacturing processes to eliminate labor intensive processes and identify high volume manufacturing solutions; and
- Incentives to help increase volume thereby spreading costs over a larger product base.

Recommended Actions

When I testified before this Committee in 2003, I called for a comprehensive national strategy to achieve fuel cell commercialization. Last year's enactment of the Energy Policy Act (EPAct) establishes such a framework, but more work needs to be done.

Budget requests and appropriation figures for this year fall far short of levels authorized by Congress. We recognize there are tight budget constraints, but given the benefits of fuel cell technology and the price we pay today for imported oil, health costs associated with poor air quality and lost productivity due to lack of reliable power, substantial increases in fuel cell technology investment represent a fiscally sound strategy.

While we are pleased that EPAct provides a fuel cell investment tax credit, the term is only for two years. We support legislative efforts to extend the tax credit timetable for the maximum length possible.

In addition, as I stated earlier, we believe more attention needs to be paid to ensuring the successful commercialization of near term fuel cell applications such as transit buses, fleet vehicles and stationary units. There are opportunities today for government purchases of fuel cell technology as part of Katrina reconstruction and pilot programs for schools powered by fuel cells to double as emergency shelters as well as the concept of fuel cell vehicles exporting power to the grid or critical infrastructure that merit consideration.

Thank you Mr. Chairman for the opportunity to testify. I would be happy to answer your questions.