

**Statement of Alexander Karsner
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Energy Efficiency and Renewable Energy
U.S. Department of Energy
Before the
Senate Committee on Appropriations
Subcommittee on Energy and Water**

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Mr. Chairman and Members of the Committee, thank you for this opportunity to testify on the President's Fiscal Year (FY) 2009 budget request for the Office of Energy Efficiency and Renewable Energy (EERE).

EERE's FY 2009 request of \$1.255 billion, approximately \$19 million higher than the FY 2008 request, provides a balanced and diverse portfolio of solutions to address the energy and environmental challenges facing us today. The request will enable EERE to research and develop renewable energy technologies that can help increase the amount of clean energy produced in the U.S.; advance energy efficiency technologies and practices; and promote adoption by private industry of clean energy technologies.

The need for clean energy solutions is clear. With the nation's energy challenges plainly identified, our efforts today and onward need to be about the development of solutions -- balanced, diverse, well-identified solutions, multipath solutions, as well as parallel path solutions.

On December 19, 2007, the President signed the Energy Independence and Security Act of 2007 (EISA) into law. Together, we have taken great strides to move beyond problem identification and toward problem solving that will enhance our energy security, diversify our energy systems, and reduce emissions that contribute to climate change.

EERE's overall budget request reflects the funding needed to meet our energy challenges head on. Advanced fuels and vehicles, renewable power, efficiency in buildings and industry, and technology deployment comprise EERE's portfolio and multipronged approach to energy solutions. I will now provide a description of the priorities and specific funding requests of EERE's program areas.

BIOMASS AND BIOREFINERY SYSTEMS R&D

In FY 2009, the Department is requesting \$225 million for the Biomass Program, an increase of \$26.8 million from the FY 2008 appropriation. The Biomass Program's funding supports the *Biofuels Initiative* that was launched in 2006 as part of the *Advanced Energy Initiative* (AEI) and is designed to achieve cost competitive cellulosic ethanol by 2012. The funding also supports the President's "*Twenty-in-Ten*" initiative, announced in the 2007 State of the Union, to reduce gasoline consumption by 20 percent by 2017.

EISA includes increased Corporate Average Fuel Economy (CAFE) standards and an increased Renewable Fuel Standard (RFS). The Act increases CAFE standards to 35 miles per gallon for all passenger automobiles, including light trucks, by 2020; and mandates the replacement of 36 billion gallons of gasoline with renewable fuel by 2022, including 16 billion gallons of cellulosic ethanol. The Biomass Program's funding request for technology development and demonstration is expected to support timely achievement of EISA requirements. The Program is focused on: Feedstock Infrastructure to reduce the cost of feedstock logistics; Platforms R&D for efficiently converting feedstocks into cost competitive commodity liquid biofuels; and Utilization of Platform Outputs to demonstrate and validate integrated technologies that achieve commercially acceptable performance and cost targets through public-private partnerships. The Program strategy is to accelerate development of the next generation of feedstocks and conversion technology options for validation and demonstration in integrated biorefineries at commercial and 10 percent of commercial scale. This strategy balances the program's research, development, and deployment (RD&D) portfolio by encouraging technology transfer while maintaining core R&D funding for next generation technologies. The Program will continue to emphasize cellulosic ethanol and expand the focus on other renewable biofuels, such as biobutanol and green diesel.

VEHICLE TECHNOLOGIES PROGRAM

The FY 2009 Vehicle Technologies Program's request is \$221.1 million, an \$8 million increase over the FY 2008 appropriation.

Vehicle Technologies Program activities focus on advanced, high-efficiency vehicle technologies, including combustion engines and enabling fuels, hybrid vehicle systems (including plug-in hybrids), high-power and high-energy batteries, advanced lightweight materials, and power electronics. These technologies are critical to near-term oil savings when used in advanced combustion hybrid and plug-in hybrid electric vehicles (PHEVs). In FY 2009, emphasis will increase R&D for PHEVs, such as high energy storage batteries.

The Program continues to place increasing emphasis on accelerating RD&D on lithium-ion batteries, plug-in hybrids (including plug-in hybrid vehicle demonstrations), and drive-train electrification to diversify and make our nation's vehicles more efficient to reduce petroleum dependency. The R&D centers on improving advanced combustion engine systems and fuels and on reducing vehicle parasitic losses. The Vehicle Technologies budget is modified in the FY 2009 request by transferring three activities from the Hydrogen Technology Program: Education; Technology Validation; and Safety and Codes and Standards. These activity areas have congruent objectives with other efforts within the Vehicle Technologies Program, and combining them within one program enables management efficiencies.

The Program will continue FY 2008 efforts to evaluate the impact of intermediate ethanol blended gasoline (i.e., greater than E10) in conventional (i.e., non-FFV) vehicles and to improve the efficiency of engines operating on ethanol blends. Late model and legacy vehicles will be tested for emissions, performance, and materials impacts. Intermediate blends could provide a

way to increase ethanol use sooner. These efforts support existing requirements and the President's 20 in 10 plan.

HYDROGEN TECHNOLOGY PROGRAM

The Hydrogen Technology Program's FY 2009 budget request is \$146.2 million, \$64.8 million less than the FY 2008 appropriation, due in part to the movement of the three activities mentioned above to the Vehicle Technologies Program. In 2009, the program will focus on remaining critical path barriers to the technology readiness goals for 2015. Substantial increases are included for hydrogen storage and fuel cell R&D. To provide for those increases, all funding for hydrogen production from renewables was eliminated and systems analyses continues at a somewhat reduced funding level.

The Hydrogen Program continues to research and develop critical hydrogen technologies that enable near-term commercialization pathways. Hydrogen Storage is one of the most technically challenging barriers to the widespread advancement of hydrogen and fuel cell technologies in the transportation sector. Our portfolio continues to identify new materials for on-board storage having the potential for greater than 50% improvement in capacity than those available prior to 2004. Much needs to be done to enable these materials to operate at practical temperatures and pressures.

In 2009, the Hydrogen Program will significantly increase investment in applied R&D of novel materials and breakthrough concepts with potential to meet on-board storage system performance targets. R&D funding will be competitively awarded and conducted through both Centers of Excellence and independent projects. The overarching goal is lightweight, low-cost, low-pressure, and efficient on-board vehicular storage systems to achieve a driving range of greater than 300 miles, without impacting vehicular cargo or passenger space to be competitive with today's vehicles.

To address the critical barriers of fuel cell cost and durability, the FY 2009 request significantly increases funding for Fuel Stack Components R&D. Our R&D efforts have made significant progress in this area and will continue efforts to achieve our stated goals, reducing the high-volume cost of automotive fuel cells from \$275 per kilowatt in 2002 to \$94 per kilowatt in 2007. In 2009, we hope to reduce the modeled cost of hydrogen fuel cell power systems to \$60 per kilowatt. One notable recent achievement was the cost-shared development of a membrane with 5,000 hours lifetime, a giant leap toward the 2010 goal of 5,000 hours durability in an automotive fuel cell system.

The Hydrogen Program's fuel cell R&D will continue to pursue a number of technological advancements. Proton-conducting membranes that are low-cost, durable, and operable at a low relative humidity will be developed. Non-precious metal and alloy catalysts will be identified and developed to further lower the cost of fuel cell systems. Gas flow through the flow fields will be modeled and measured while fuel cells are in operation to ensure optimal gas and water distribution over the catalyst and membrane surface. And fuel cells for distributed energy generation will continue to be developed with an emphasis on system integration, cost reduction and efficiency improvements. The Department will also continue its participation in the

International Partnership for Hydrogen Economy (IPHE) – collaborating on R&D of materials for both fuel cells and storage, and working on such projects as the evaluation of fuel cell-related test protocols from different countries, as well as hydrogen pathway and infrastructure analyses.

SOLAR ENERGY PROGRAM

The FY 2009 budget request for the Solar Energy Program is \$156.1 million, \$12.3 million less than the FY 2008 appropriation. Through the President’s *Solar America Initiative* (SAI), announced in the 2006 State of the Union, the Solar Program will accelerate market competitiveness of solar photovoltaic technologies through R&D aimed at less expensive, more efficient, and highly reliable solar systems. Targeting improved performance and reliability with reduced cost, the Solar Program focuses its RD&D activities in two technology areas: photovoltaics (PV) and concentrating solar power (CSP).

The Solar Program’s goal in the area of photovoltaics is to develop and deploy highly reliable PV systems that are cost-competitive with electricity from conventional resources. The Program focuses on improving the performance of cells, modules, and systems; reducing the manufacturing cost of cells, modules, plant components, and systems; reducing the installation, interconnection, and certification costs for residential, commercial, and utility systems; and increasing system operating lifetime and reliability. To lower costs more rapidly and improve performance, the Solar Program is focusing on PV technology pathways that have the greatest potential to reach cost competitiveness by 2015. Industry-led partnerships, known as “Technology Pathway Partnerships,” will be continued in FY 2009 to help address the issues of cost, performance, and reliability associated with each pathway.

The Program’s CSP focus is to develop concentrating solar technologies. A solicitation issued in FY 2007 resulted in 12 industry contract awards focused on establishing a U.S. manufacturing capability of low cost trough components and the technical feasibility of low cost thermal storage. In FY 2008, funds will be provided for Phase I of these contracts with the more promising contracts moving into Phase II in FY 2009. One of the most important advantages of CSP is its ability to thermally store power for later use. The development of advanced thermal energy storage technologies in FY 2009 will be expanded to include single heat transfer fluid systems that eliminate the need for multiple heat exchangers and thereby increase system efficiency and reduce cost. For distributed applications, research in FY 2009 will continue on improving the reliability of dish systems through the operation and testing of multiple units as well as improving the manufacturability of dish systems.

WIND ENERGY PROGRAM

The Wind Energy Program’s FY 2009 request is \$52.5 million, an increase of \$3.0 million from the FY 2008 appropriation. The Wind Energy Program supports the AEI objective to maximize wind energy resource utilization in the United States by leading the nation’s R&D efforts to improve wind energy generation technology and address barriers to the use of wind energy in coordination with stakeholders.

In 2007, the U.S. installed more wind generation capacity than any other country by bringing on-line 5 GW of new wind installations. Wind is now a major source of new electricity generation, and accounts for roughly 30 percent of new capacity from all energy sources. Since 2000, wind energy has increased more than 6-fold, from about 2.5 GW to nearly 16.8 GW today. While there are significant challenges, wind resources have the potential to provide up to 20% of our nation's generation potential.

The Wind Program believes that wind energy is at a transitional point, particularly for large land-based wind systems. The program is concentrating on reducing technological barriers that limit the growth potential of wind energy in the U.S. by focusing on improving cost, performance, and reliability of large scale land-based technology. As a part of the effort, NREL will be testing its first utility-scale multi-megawatt turbine at the National Wind Technology Center in Colorado, through a competitive CRADA solicitation.

In addition, the Wind Program is facilitating wind energy's rapid market expansion by anticipating and addressing potential regulatory, transmission and manufacturing barriers; and investigating wind energy's application to other areas, including distributed and community owned wind projects.

The Program's focus also includes energy storage efforts in coordination with the Office of Electricity Delivery and Energy Reliability to maximize wind energy resource utilization, which supports diversifying the domestic energy supply while enhancing system reliability.

WATER POWER PROGRAM

The Water Power Program's budget request of \$3.0 million will support initial R&D activities, and follows an initial congressional appropriation of \$9.9 million in FY 2008. The program needs to evaluate the results of its FY 2008 R&D projects and technology assessments (which will continue into FY 2009) before considering further applied research efforts. The mission of the Water Power Program is to research and develop innovative and effective technologies capable of harnessing hydrokinetic energy resources, including ocean wave and current energy.

The program will focus on conducting technology characterizations to identify manufacturers, performance limits and issues, known environmental impacts, and other relevant technical and market variables. In addition the program will engage in collaborative international activities.

GEOHERMAL TECHNOLOGY PROGRAM

The FY 2009 request for the Geothermal Technology Program is \$30 million, which is an increase of \$10.2 million from the FY 2008 appropriation. The Geothermal Technology Program works in partnership with industry to establish Enhanced Geothermal Systems (EGS) as an economically competitive contributor to the U.S. energy supply. Geothermal energy generates "base-load" electricity and/or supplies heat for direct applications, including aquaculture, crop drying, and district heating, or for use in heat pumps to heat and cool buildings.

The Program focuses on the innovative technology of Enhanced Geothermal Systems (EGS), which are engineered reservoirs created to produce energy from geothermal resources that would otherwise not be economical. EGS is a new pathway for producing geothermal energy by drilling wells into hot rock, fracturing the rock between the wells, and circulating a fluid through the fractured rock to extract the heat. While EGS reservoirs have been designed, built, and tested in various countries, a number of technical hurdles remain to be overcome, the most important involving creation of EGS reservoirs with commercial production rates and lifetimes. The Department's approach will concentrate initially on issues related to reservoir creation, operation, and management. This may involve working with cost-sharing partners at existing geothermal fields to develop, test, and perfect the tools needed to fracture hot, impermeable rock and efficiently circulate fluids.

A feasibility study by the Massachusetts Institute of Technology (MIT) estimates that EGS could provide 100,000 MW of electric power by 2050 – 10 percent of currently installed electric capacity. This compares with today's 2800 MW of installed capacity at existing U.S. geothermal power plants using today's technology. Expected program outcomes will include creation of a commercial-scale geothermal reservoir and power plant (approximately 5 MW in generating capacity) capable of operating for 7 years by 2015. This initial plant, followed by others in differing geologic environments, should foster rapid growth in the use of geothermal energy as predicted by the MIT study.

BUILDING TECHNOLOGIES PROGRAM

The Building Technologies Program's FY 2009 request is \$123.8 million, an increase of \$14.8 million from the FY 2008 appropriation. The Building Technologies Program develops technologies, techniques, and tools for making residential and commercial buildings more energy efficient, productive, and cost-competitive. The Program's funding supports a portfolio of activities that includes solid state lighting (SSL), improved energy efficiency of other building components and equipment, and their effective integration using whole building system design techniques that will enable the design of net Zero Energy Buildings. The Program also includes the development of building codes and appliance standards and successful education and market introduction programs, including ENERGY STAR and EnergySmart Schools.

The Residential and Commercial Buildings integration components of the Building Technologies Program aim to transform the carbon footprint of the built environment through Zero Energy Buildings. The residential-focused Building America subprogram focuses on reducing total energy use in a new home by 60 to 70 percent. During FY 2009, research for production-ready new residential buildings that are 40 percent more efficient will continue for three climate zones, with completion in two. The Program's activities in the commercial sector are focused on alliances of leading market companies with national portfolios of buildings. The Program will engage with the developers of these buildings, which will provide the opportunity to better understand what R&D is needed to help promote the construction of highly efficient commercial buildings. DOE's role as convener of partnerships with developers and other key actors help promote leveraging of resources and encourage the private sector to undertake market transformation activities.

The Emerging Technologies subprogram seeks to develop cost-effective technologies for residential and commercial buildings that enable reductions in building energy use. Solid State Lighting will develop technologies that can help reduce commercial building lighting electricity consumption. Space Conditioning and Refrigeration R&D will continue work on innovative HVAC design concepts. Other highlights include highly insulating windows and building integrated solar heating and cooling systems.

The Equipment Standards and Analysis subprogram develops minimum energy efficiency standards that are technologically feasible and economically justified as required by law. Federal energy conservation standards that have gone into effect since 1988 are projected to save a cumulative total of 75 quadrillion Btus (quads) of energy by the year 2045 (in 2007, total annual U.S. consumption of primary energy was about 103 quads). Between FY 2005 and FY 2007, the Department identified and carried out significant enhancements to rulemaking activities. The Department has made a commitment to clear the backlog of delayed actions that accumulated during prior years, while simultaneously implementing all new requirements of the Energy Policy Act (EPACT) of 2005. EISA significantly increases the number of efficiency standards and test procedures DOE must develop. The Department will continue to implement productivity enhancements that will allow multiple rulemaking activities to proceed simultaneously, while maintaining the rigorous technical and economic analysis required by statute. Energy conservation standards for 10 products were initiated in FY 2006 and 2007 that will continue in FY 2009. In FY 2008, efficiency standards rulemakings were initiated on 4 additional products. In FY 2008, DOE is proceeding simultaneously on rulemakings for 15 products and 10 test procedures. In FY 2009, 4 more standards and test procedures for 7 more products will be added.

The Technology Validation and Market Introduction subprogram funds activities that validate and promote clean, efficient, and domestic energy technologies. Expanding and modernizing the ENERGY STAR program to include solid state lighting, water heaters, photovoltaics, fuel cells, micro-wind turbines, combined heat and power, and other advanced technologies, as well as targeting the civic infrastructure (e.g., schools, hospitals, libraries, municipal facilities), are central activities that the Program carries out to invest in Energy Smart solutions. DOE will continue to work with the Environmental Protection Agency on the development and implementation of Energy Star and other efforts to minimize duplication and maximize efficiency. In addition to these efforts, the Program focuses on outreach efforts to help move specific technologies – such as solid-state lighting and high-performance windows – toward commercial applications. These efforts include design and rating tools, durability and product lifetime data, testing procedures, demonstrations, retailer education, and training on proper installation.

INDUSTRIAL TECHNOLOGIES PROGRAM

The Industrial Technologies Program seeks to reduce the energy intensity (energy demand per unit of industrial output) of the U.S. industrial sector through coordinated research and development, validation, and technical assistance activities to increase dissemination of energy efficiency technologies and operating practices. The FY 2009 budget request for the Industrial Technologies Program (ITP) is \$62.1 million, which is \$2.3 million less than the FY 2008

appropriation. Internal funding shifts reflect a continued strategy to emphasize more effective ways to increase energy efficiency among energy intensive industries. The shift toward more crosscutting and higher impact R&D activities will allow ITP to develop advanced, energy-efficient technologies to serve a broader set of industries.

The program will continue to support the Secretary of Energy's "Easy Ways to Save Energy" campaign through the Save Energy Now (SEN) industrial energy savings assessments at the Nation's most energy-intensive industrial facilities. This has been a very successful activity, having reached its 24-month goal of conducting 450 assessments from 2006 through 2007. With 89 percent of the plants reporting results from these assessments, the program has identified savings of over 88 trillion Btus of source energy, including more than 71 trillion Btus of natural gas, the amount used by almost a million U.S. homes. If implemented, the improvements recommended through SEN assessments have a potential energy savings of more than \$727 million per year and could also reduce carbon dioxide emissions by 6.3 million metric tons annually, which is equivalent to taking over one million automobiles off the road

Building on this success, ITP will expand partnerships with leading corporations across major manufacturing supply chain and deliver DOE plant assessments, tools, and technologies to enable dramatic energy efficient improvements, contributing to the EPACT 2005 goal of reducing industrial energy intensity by 2.5% per year from 2006 to 2016.

FEDERAL ENERGY MANAGEMENT PROGRAM

The Federal Energy Management Program (FEMP) budget request for FY 2009 is \$22 million, which is an increase of \$2.2 million from the FY 2008 appropriation. FEMP enhances energy security, environmental stewardship, and cost reduction within the Federal Government through reductions in energy intensity in buildings, increased use of renewable energy, and greater conservation of water. These goals are accomplished by means of technical assistance, coordination of Federal reporting and evaluation, supporting alternative fuel use in the Federal vehicle fleet, and supporting the Secretary's Transformational Energy Action Management (TEAM) Initiative.

In a new effort this year, FEMP will support private sector development of alternative fuel stations at Federal sites, help the federal government identify opportunities for petroleum displacement to increase alternative fuel use, and conduct reporting and analysis of the Federal vehicle fleet. In addition, with DOE Specific Investments, FEMP will support the Secretary's TEAM Initiative, which will establish DOE as the Federal agency leader in strengthening energy and alternative fuels management. The TEAM Initiative works with DOE programs to help meet and exceed the goals of Executive Order 13423, such as a reduction of energy intensity of 30 percent by the end of FY 2015.

As part of the TEAM initiative, the Secretary has instructed all DOE sites to host private sector energy service companies to assess efficiency opportunities across the complex, addressing all lifecycle, cost-competitive options. DOE will lead by example, deploying a wide variety of lighting and other advanced technologies to achieve maximum energy savings. The Secretary's TEAM Initiative is bold and, as Congress looks to "green" the Capitol Complex, I would be

pleased to provide additional information and periodic updates to this Committee on our efforts and actions.

WEATHERIZATION AND INTERGOVERNMENTAL ACTIVITIES PROGRAM

The FY 2009 request for Weatherization and Intergovernmental Activities is \$58.5 million. Stakeholders and partners include state and local governments, Native American Tribes, utilities, and international agencies and governments.

Significant changes in the FY 2009 budget request include increases for the State Energy Program and the Asia Pacific Partnership, a refocusing for Tribal Energy Activities, and conclusion of funding for the Weatherization Assistance Program (WAP) and the Renewable Energy Production Incentive. The results of DOE's weatherization assistance activities are little changed in the last two decades: provision of positive limited benefits to selected recipients, but failing to catalyze broader solutions for the tens of millions of eligible homes that have never received retrofits. The Department requests no funding for WAP activities; however, states can continue to support weatherization assistance activities with resources provided by the Low-Income Home Energy Assistance Program at the Department of Health and Human Services. Concluding the program at DOE will allow the Department to focus on higher priority research and development as well as state, local, and utility energy projects in the State Grants program. Through FY 2008, the Renewable Energy Production Incentive (REPI) provided financial incentive payments to publicly owned utilities, nonprofit electric cooperatives, and Tribal Governments and native corporations that own and operate qualifying facilities generating renewable electricity. The incentive value of REPI has diminished over time as renewable energy technologies have become competitive, rendering the program no longer necessary

In FY 2009, the State Energy Program will continue to include competitive grants for State policies and programs that increase adoption and compliance of advanced building energy codes, accelerate the use of performance contracting and alternative financing by state and local governments, and increase investments in utility delivered efficiency programs and other high priority EPACT 2005 and EISA programs.

The State Energy Program helps enable state governments to target their high priority energy needs and expand clean energy choices for their citizens and businesses. Benefits include reduced energy use and costs, environmentally conscious economic development, increased renewable energy generation capacity, and lessened reliance on imported oil. A combination of technical assistance, outreach, and financial assistance support effective program implementation of the National Action Plan for Energy Efficiency and provisions of EPACT 2005 and EISA.

FACILITIES AND INFRASTRUCTURE

The budget request for Facilities and Infrastructure supports operations and maintenance (O&M) for the National Renewable Energy Laboratory (NREL), a single-purpose laboratory dedicated to R&D for energy efficiency, renewable energy, and related technologies. The request for FY 2009 is \$13.9 million: \$10.0 million for core O&M (a \$3.1 million increase) and \$4.0 million required to complete Phase I construction of the Energy Systems Integration Facility (ESIF).

This budget request represents a decrease of \$62.2 million compared to the FY 2008 appropriation, primarily a reflection of Congress's FY 2008 provision of \$54.5 million to initiate construction activities for the ESIF and to begin additional site infrastructure work. Funding beyond that which is requested for FY 2009 is not needed, as much of the construction taking place was fully funded in prior years. The remainder of the decrease is a result of including requested solar research capital equipment replacements within the Solar Energy Program budget, where such equipment is typically funded.

CONCLUSION

The penetration of EERE technologies into the marketplace could save consumers over \$600 billion by the year 2030 and save as much as \$4 trillion by 2050, cumulatively. Similarly, the technologies in our portfolio could avoid 6 gigatons of carbon (GTC) by 2030 and nearly 50 GTC by 2050, cumulatively.¹ With action plans, performance milestones, clearly articulated deliverables, and continued performance, EERE's budget request supports priority R&D and the achievement of stated goals. Our laboratory products and partnerships will help bring cleaner energy technologies and sources to commercial viability in the foreseeable future.

¹ Energy Efficiency and Renewable Energy FY 2009 Congressional Budget, 20.