Office of Energy Efficiency and Renewable Energy

FY 2016 Budget Overview

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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Major Administration Energy Goals

- Reduce GHG emissions by 17% by 2020, 26-28% by 2025 and 83% by 2050 from 2005 baseline
- By 2035, generate 80% of electricity from a diverse set of clean energy resources
- Double energy productivity by 2030
- Reduce net oil imports by half by 2020 from a 2008 baseline
- Reduce CO_2 emissions by 3 billion metric tons cumulatively by 2030 through efficiency standards set between 2009 and 2016

Office of Energy Efficiency and Renewable Energy

EERE Mission:
To create and sustain American leadership in the global transition to a clean energy economy

- **High-Impact Research, Development, and Demonstration to Make Clean Energy as Affordable and Convenient as Traditional Forms of Energy**

- **Breaking Down Market Barriers**

EERE's Guiding Principles

The 5 EERE Core Questions

1. **HIGH IMPACT:** Is this a high impact problem?
2. **ADDITIONALITY:** Will the EERE funding make a large difference relative to what the private sector (or other funding entities) is already doing?
3. **OPENNESS:** Have we made sure to focus on the broad problem we are trying to solve and be open to new ideas, new approaches, and new performers?
4. **ENDURING U.S. ECONOMIC BENEFIT:** How will this EERE funding result in enduring economic benefit to the United States?
5. **PROPER ROLE OF GOVERNMENT:** Why is what we are doing a proper high impact role of government versus something best left to the private sector to address on its own?

Select Recent EERE Accomplishments

Sustainable TRANSPORTATION

- $289/kWh Modeled Li-Ion Battery Cost Achieved in 2014
- SuperTruck – 5 year program exceeded goal of 50% improvement in freight efficiency a year ahead of schedule in 2014
- 3 Pioneering Commercial Cellulosic Ethanol Plants have come online
- Fuel cells - 50% cost reduction, 5 x platinum reduction since 2006

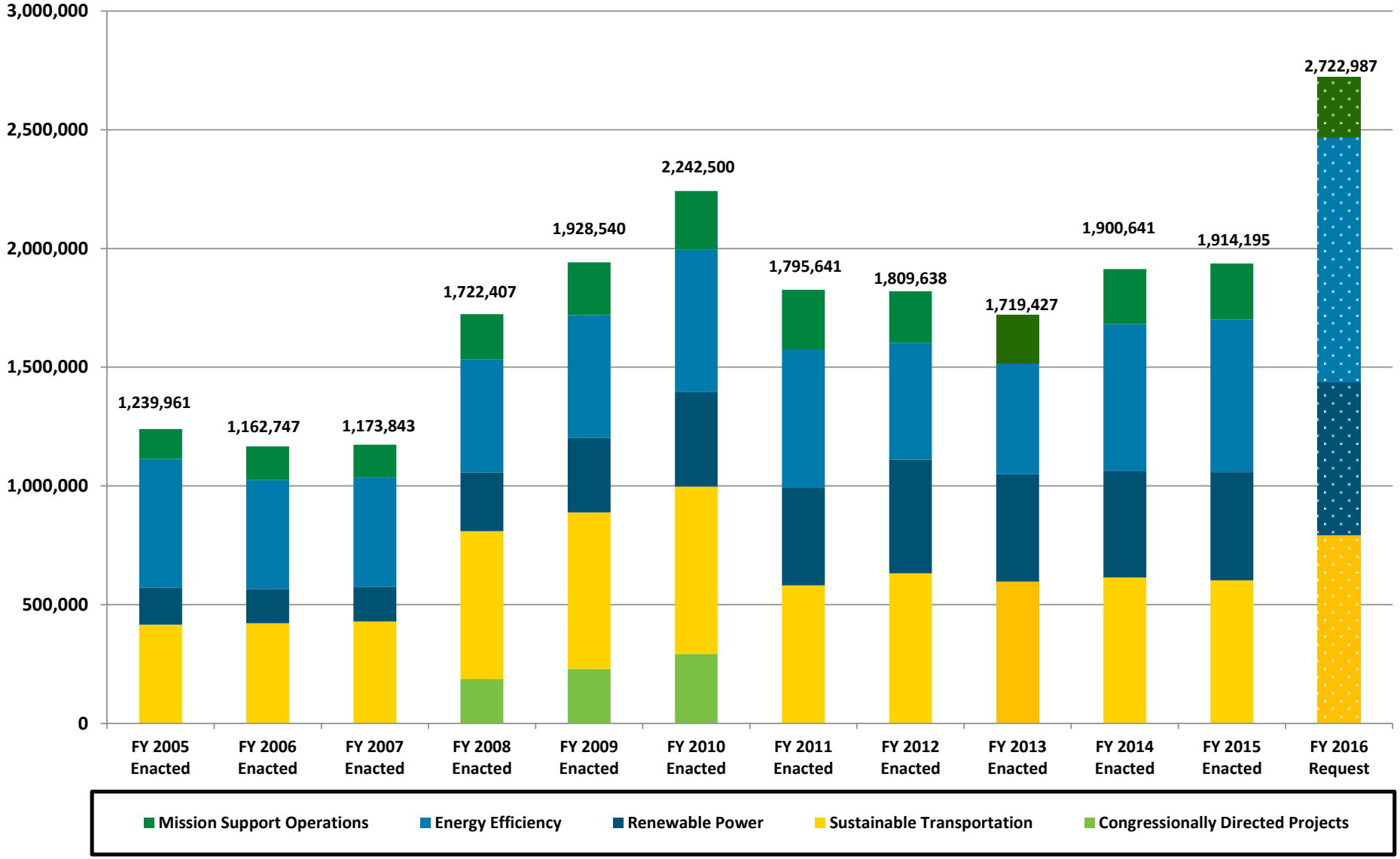
Renewable ELECTRICITY GENERATION

- Achieved more than 60% progress toward SunShot solar PV cost reduction in just first 4 years of 10 year initiative
- Cost of U.S. wind energy decreased by more than one-third in last 5 years to 4.6c/kWh
- First grid connected tidal power plant in US
- First grid connected near-field EGS plant increased power output of nearby operating geothermal field by nearly 38%

Energy Saving HOMES, BUILDINGS, & MANUFACTURING

- Standards enacted since 2009 are projected to avoid a cumulative total of 2.2 billion metric tons of carbon emissions by 2030
- More than 250 DOE partners through the Better Buildings Challenge on track to achieve average energy savings of 2.5% annually and saving 36 TBtus and $300 million since the Better Buildings Challenge began
- LED cost reduction – 90% since 2008

EERE Budget Trends: FY 2004 – FY 2016, ($K)



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FY 2016 Budget Summary Table

Dollars in Thousands	FY 2014 Enacted	FY 2015 Enacted	FY 2016 Request	FY 2016 vs FY 2015
Transportation	**614,955**	**602,000**	**793,000**	**+191,000**
- Vehicle Technologies	289,737	280,000	444,000	+164,000
- Bioenergy Technologies	232,290	225,000	246,000	+21,000
- Hydrogen and Fuel Cell Technologies	92,928	97,000	103,000	+6,000
Renewable Electricity	**449,524**	**456,000**	**645,200**	**+189,200**
- Solar Energy	257,058	233,000	336,700	+103,700
- Wind Energy	88,126	107,000	145,500	+38,500
- Water Power	58,565	61,000	67,000	+6,000
- Geothermal Technologies	45,775	55,000	96,000	+41,000
End-Use Efficiency	**617,449**	**642,000**	**1,029,587**	**+387,587**
- Advanced Manufacturing	180,471	200,000	404,000	+204,000
- Building Technologies	177,868	172,000	264,000	+92,000
- Federal Energy Management Program	28,248	27,000	43,088	+16,088
- Weatherization and Intergovernmental Activities	230,862	243,000	318,499	+75,499
Corporate Support Programs	**231,513**	**237,000**	**255,200**	**+18,200**
Subtotal, Energy Efficiency and Renewable Energy	**1,913,441**	**1,937,000**	**2,722,987**	**+785,987**
- Use of Prior Year Balances	-2,382	0	0	0
- Rescission of Prior Year Balances	-10,418	-22,805	0	NA
Total, Energy Efficiency and Renewable Energy	**1,900,641**	**1,914,195**	**2,722,987**	**+808,792**

Sustainable
TRANSPORTATION

Renewable
ELECTRICITY GENERATION

Energy Saving
HOMES, BUILDINGS, & MANUFACTURING

Mission-Critical Support
OPERATIONS

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Sustainable TRANSPORTATION

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Vehicle Technologies – Overview

Motivation/Focus

- Despite increases in fuel efficiency and petroleum production, the U.S. used almost 9 billion barrels of petroleum in 2013, about 3 billion of which was imported. Vast swings in oil pricing make it difficult to forecast future prices, increasing market uncertainty.
- Over the past ten years, U.S. regular retail gasoline prices have fluctuated from below $1.50 to over $4 – these changes have increased annual household budgets by as much as $1,500 per average passenger car.
- The U.S. transportation sector accounts for approximately one-third of U.S. energy-related carbon pollution.

Achievements

- Reduced the modeled, high-volume production cost of electric drive vehicle batteries to $289/kwh in 2014, a more than 40% reduction from the EV Everywhere baseline cost (2012).
- Reduced the cost of an electric drive system from $30/kW to less than $15/kW. Through a VT project, GM is the first U.S.-based OEM manufacturing electric motors in the U.S., the Chevy Spark EV is using those electric motors.
- Developed an advanced prototype of the 2013 Ford Fusion with a nearly 25% weight reduction with industry and research partners, while maintaining safety and performance.
- Successful R&D and demonstration of a four-cylinder clean diesel engine for a full-sized pickup truck with fuel economy improvements of 40%, achieves an additional 7-10 miles per gallon (average) and complies with new emissions standards.
- One of four SuperTruck industry leads achieved targets one year ahead of schedule with a more than 50% improvement in overall freight efficiency.
- Clean Cities advanced technology and alternative fuel deployment activities reduced petroleum use by 1 billion gallons in 2013, prevented 7.5 million tons of greenhouse gases, and deployed 475,000 alternative fuel vehicles – putting the program ahead of schedule for meeting its petroleum reduction goal of 2.5 billion gallons per year by 2020.

Vehicle Technologies – FY 2016 Budget Request

Goals/Metrics

- Reduce the modeled, high-volume cost of batteries from $289/kWh in 2014 to $125/kWh by 2022;
- Reduce the modeled, high-volume cost of electric drive systems from $15/kW in 2014 to $8/kW by 2022;
- Eliminate 30% of vehicle weight through lightweighting by 2022, compared to a 2002 baseline;
- Improve engine efficiency to demonstrate a 35% fuel economy improvement for passenger vehicles and 30% engine efficiency improvement for commercial vehicles (compared to 2009 baselines) by 2020;
- Improve the freight hauling efficiency of heavy-duty Class 8 long-haul vehicles by 100 percent in 2020, compared to a 2009 baseline vehicle; and
- Through Clean Cities technology deployment activities, reduce petroleum use by 2.5 billion gallons annually by 2020.

(Dollars in Thousands)	FY 2014 Enacted	FY 2015 Enacted	FY 2016 Request	FY 2016 vs. FY 2015
Batteries and Electric Drive	108,935	103,701	144,400	+40,699
Vehicle Systems (formerly Vehicle and Systems Simulation and Testing)	43,474	40,393	68,100	+27,707
Advanced Combustion Engines	49,970	49,000	64,500	+15,500
Materials Technology	38,137	35,602	70,500	+34,898
Fuels and Lubricant Technologies	15,990	20,000	37,000	+17,000
Outreach, Deployment and Analysis	31,231	28,304	56,500	+28,196
NREL Site Wide Facility Support	2,000	3,000	3,000	0
Total, Vehicle Technologies	289,737	280,000	444,000	+164,000

Vehicle Technologies – FY2016 Budget Highlights

- ***EV Everywhere* ($253.2M):** A DOE Grand Challenge to enable the U.S. to be the first to produce a wide array of plug-in vehicle models that are as affordable and convenient as gasoline vehicles by 2022.
- **SuperTruck II ($40M):** Through competitively-awarded, cost-shared projects with industry, develop and demonstrate technologies to increase the freight efficiency of class 8 trucks by 100% in 2020, compared to a 2009 baseline vehicle.
- **Manufacturing/Materials Genome (Magnesium Sheet) ($30M):** Supports DOE's Clean Energy Manufacturing Initiative and Administration's Materials Genome Initiative. High-performance computing and high-throughput experimentation to accelerate the development of high-strength, high-formability, corrosion-resistant, and low-cost magnesium sheet alloys for vehicle light weighting from discovery through qualification, capturing the effects of processing and end-use performance.
- **New Fuels and Vehicle Systems Optima ($17M):** Establishes a link early in the R&D cycle of both fuels and engines for a synergistic, systems-based approach and to create optimized, higher-efficiency solutions for fuels and engines. Involves collaboration with Bioenergy Technologies.
- **Alternative Fuel Vehicle Community Partner Projects ($25M):** Competitively-awarded, cost-shared projects that highly-leverage private-sector investments to accelerate widespread introduction and adoption of commercially-available advanced vehicle technologies to reduce petroleum consumption.

Bioenergy Technologies - Overview

Motivation/Focus

- Development of advanced biofuels has significant potential to address U.S. energy competitive advantage, transportation-related greenhouse gas (GHG) emissions, and U.S. job growth.
- To realize the tremendous promise of advanced biofuels and bioenergy technologies, BETO works to understand the critical linkages along the entire supply chain and reduce technical risks.
- By 2030, the United States could produce more than one billion tons of sustainable biomass resources that can provide fuel for cars, trucks, and jets; make chemicals; and produce power. This could displace up to 30% of U.S. current petroleum usage (not including fuels from algae.)

Achievements

- Significant Progress in Reducing Costs for Advanced Biofuels:
  - BETO's 5 high-tonnage feedstock logistics projects (which included partnerships with original equipment manufacturers) demonstrated significant cost-reductions of approximately $13 per dry ton enabling a total cost of $96.94/dry ton in 2012 to be reduced to $83.94/dry ton.
  - BETO's thermochemical conversion R&D achieved a $4.09 per gallons of gasoline conversion cost target, down from a cost of $4.59 in FY13. This keeps BETO on track to achieve the overall fuel cost target of $3.39 per gallons of gasoline by 2017.
  - NREL demonstrated an innovative technology to deconstruct and selectively convert lignin to key intermediates on a pathway to valorize lignin.
- In 2014 two commercial-scale cellulosic ethanol production facilities opened.
  - The grand opening of POET's Project LIBERTY was in September 2014. This BETO-sponsored project enable this to become the United States' first commercial-scale cellulosic ethanol plant designed to produce up to 25 million gallons of cellulosic ethanol per year from corn waste.
  - The grand opening of Abengoa's cellulosic ethanol plant in October 2014, marked the second commercial scale facility to open in as many months. At full capacity (25mmgy), the Hugoton, KS facility will process up to 1,000 tons per day of biomass.

Bioenergy Technologies – FY 2016 Budget Request

Goals/Metrics

- In 2017, validate technologies at bench or pilot scale that produce drop-in hydrocarbon fuels competitive with petroleum-based fuels at a modeled mature price of $3/gge ($2011), with GHG emissions reduction of at least 50 percent.
- By 2017 validate a modeled mature price of cellulosic ethanol, produced at a pioneer integrated biorefinery, is comparable to the 2012 validated cellulosic ethanol R&D target of $2.15/gallon ethanol ($2007)

(Dollars in Thousands)	FY 2014 Enacted	FY 2015 Enacted	FY 2016 Request	FY 2016 vs. FY 2015
Feedstocks	46,972	32,000	38,800	+6,800
Conversion Technologies	101,384	95,800	99,186	+3,386
Demonstration and Market Transformation	64,790	79,700	87,514	+7,814
Strategic Analysis and Cross-Cutting Sustainability	12,146	11,000	14,000	+3,000
Biopower	1,998	0	0	0
NREL Site-Wide Facility Support	5,000	6,500	6,500	0
Total, Bioenergy Technologies	232,290	225,000	246,000	+21,000

Bioenergy Technologies – FY2016 Budget Highlights

- **Algae ($21M):** Focus on research to address yield, productivity, and integration of downstream logistics at the pre-pilot scale in support of validating the potential for algae supply/logistics systems to produce 2,500 gallons of oil intermediate per acre of cultivation per year by 2018, an important milestone toward FY2022 price goals ($3/gge).
- **Feedstock Supply and Logistics ($17.8M)**: Scale up and integrate advanced preprocessing systems to reduce transportation and logistics costs towards validating feasibility of feedstock price ultimate goal of $80/Dry Matter Ton in 2017 which enables the $3/gge fuel price.
- **Conversion ($99.2M):** Select and complete preparation of at least two pathways for validation at bench or pilot scale of progress toward the modeled mature $3/gge gasoline/diesel blendstock price. One that will meet this price in 2017 and one at a lower TRL that shows strongest promise toward meeting the $3/gge price target in FY 2022.
- **New Fuels and Vehicle Systems Optima ($10M):** Establishes a link early in the R&D cycle of both fuels and engines for a systems-based approach to create optimized solutions for vehicle efficiency and advanced biofuels utilization. Collaboration with Vehicles Technologies
- **New Investments in the Integrated Production and Scale-Up of Drop-in Hydrocarbon Fuels ($32.5M):** New competitive awards (up to three pilot projects or one demonstration project) to scale-up integrated production of drop-in hydrocarbon biofuels to accelerate advanced biofuel manufacturing.
- **DPA ($45M):** Support the military-specification jet fuel in collaboration with DOD and USDA through the Defense Production Act .

Fuel Cell Technologies – Overview

Motivation/Focus

- Through applied research, technology development and demonstration, and diverse efforts to overcome institutional and market challenges, FCTO seeks to enable the widespread commercialization of a portfolio of hydrogen and fuel cell technologies.

Achievements

- Reduced the projected high-volume manufacturing cost of automotive fuel cells to $55/kW at the end of 2014. This represents a more than 30% reduction since 2008 and more than 50% reduction since 2006.
- Improved the catalyst specific power of fuel cells to 6.3 kW/g of platinum group metal in 2014, more than double the 2008 baseline of 2.8 kW/g and approaching the 2020 target of 8.0 kW/g, a 5X reduction in total platinum content in fuel cells. This has been achieved through breakthrough developments such as nanostructured thin film catalysts, core-shell catalysts, and thin-film, nanoframe catalysts.
- Reduced the capital cost of electrolyzer stacks by 80% since 2002.
- Successfully stimulated early fuel cell markets and catalyzed industry investment:
  - The cost-shared deployments of approximately 1,600 fuel cell powered lift trucks and backup power systems have led to more than 11,000 additional orders by industry with no additional DOE investment.
  - A sample of the Office's projects were tracked and found to have resulted in revenues of about 4x the amount of DOE funding, and funds invested in projects were found to result in >5x additional investment by industry.
  - Funding has led to about 40 commercial technologies, about 65 emerging technologies (expected to be commercial within three years) and >500 patents.

Fuel Cell Technologies – FY 2016 Budget Request

Goals/Metrics

- By 2020, reduce modeled, high-volume automotive fuel cell system cost to $40/kW (to be competitive with advanced technology vehicles on a $/mile basis), with an ultimate target of $30/kW and improve durability to 5,000 hours (equivalent to 150,000 miles of driving); and
- By 2020, reduce the modeled delivered cost of renewably produced hydrogen to less than $4/gge.

(Dollars in Thousands)	FY 2014 Enacted	FY 2015 Enacted	FY 2016 Request	FY 2016 vs. FY 2015
Fuel Cell R&D	33,383	33,000	36,000	+3,000
Hydrogen Fuel R&D	36,545	35,200	41,200	+6,000
Manufacturing R&D	3,000	3,000	4,000	+1,000
Systems Analysis	3,000	3,000	3,000	0
Technology Validation	6,000	11,000	7,000	-4,000
Safety, Codes and Standards	7,000	7,000	7,000	0
Market Transformation	3,000	3,000	3,000	0
NREL Site Wide Facility Support	1,000	1,800	1,800	0
Total, Hydrogen and Fuel Cell Technologies	92,928	97,000	103,000	+6,000

Fuel Cell Technologies – FY 2016 Budget Highlights

- **Fuel Cell R&D ($36M):** Develop innovative technologies to reduce cost and improve durability: Increasing PEM fuel cell power output per gram of platinum-group metal catalyst to 6.9kW/g from 2.8kW/g in 2008. (2020 goal: 8 kW/g PGM)
    - **Manufacturing/Materials Genome (Non-PGM Catalysts) ($8M):** Supports DOE's Clean Energy Manufacturing Initiative and Administration's Materials Genome Initiative. Next generation advanced materials manufacturing R&D effort focused on high throughput combinatorial approaches capturing the effects of processing and end-use performance to develop non-PGM catalysts, electrodes, and interfaces and MEA optimization
- **Hydrogen Fuel R&D ($41.2M):** Advance pioneering technologies in materials, components, and processes to reduce the cost of hydrogen from renewable resources to $6.70/gge (dispensed and untaxed) from $8.00/gge in 2011; and the cost of hydrogen storage systems by 25% compared to the 2013 baseline of $17/kWh. (2020 goals: $4/gge, $10/kWh)
- **Technology Validation and Market Transformation ($10M):** Demonstrate zero-emissions medium-duty fuel cell hybrid electric trucks with a projected range of 120 miles, meeting parcel delivery route requirements and initiate new awards for PHEV fuel cell range extenders. Implement prototype for qualifying hydrogen stations through the H2FIRST (Hydrogen Fueling Infrastructure Research Station Technology) project.
- **Safety, Codes and Standards ($7M):** Decrease the hydrogen refueling station footprint requirement through the use of a performance-based risk mitigation approach and develop the initial liquid hydrogen release models that will inform the risk assessment for separation distances.

Questions?

Submit your questions via the “Questions” window on your GoToWebinar dock.

For Further Information

Office of Energy Efficiency & Renewable Energy:
http://www.eere.energy.gov/

Webinar Slides & Fiscal Year 2016 EERE Budget Request Information:

http://energy.gov/eere/eeres-2016-budget

For more information, please contact

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