DOE FY2016 Congressional Budget Request for EERE
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EESI Briefing: February 25, 2015
Outline

• Overview & Background
• Key Funding Changes, by Four Themes
• Key Funding Changes, by Program
• Program Highlights: Goals & Funding
• Additional Reference Material
  • Context for Innovation & Demonstrations
  • Historical Spending Context
  • Framework of Issues for Staff
  • Further CRS Information for Staff
Overview & Background

- Highlights
- Administration’s Goals
- FY2016 EERE Emphasis
- Funding Calculation References
- Thematic Grouping of Accounts
Highlights (FY2016 Request vs. FY2015)

- DOE total request up $2.5 B (9%)
- EERE up $809 M (42%)
- Largest EERE program increases are for manufacturing and vehicles
- Revenue Offset: Request would repeal $4 billion in FY2016 fossil fuel tax incentives
  - Fossil fuel incentives elimination effort promised at G-20 Climate Meeting
  - For annual dollar estimates: See Treasury Dept., General Explanations of the Administration’s Fiscal Year 2016 Revenue Proposals, Table 2
Administration’s Goals

• Reduce oil imports 1/2 by 2020
• Lead the world in clean energy technologies
  • Double renewable energy production by 2020
  • Double energy productivity by 2030, relative to 2010
  • Non-residential buildings 20% more efficient by 2020
  • 80% clean energy power generation by 2035 (includes nuclear and efficient gas)
  • Cut greenhouse gases 17% below 2005 level by 2020
FY2016 EERE Emphasis

Entire EERE effort: Transformation to Clean Energy Economy

- International Competitiveness (Manufacturing & Jobs)
- Climate Change (Reduced Carbon)
- Oil Imports (EVs & Biofuels)
Funding Calculation References

- All funding changes shown in the presentation follow those in the DOE request.
- The differences are calculated between the FY2016 request and the FY2015 appropriation.
- For simplicity, many figures are rounded-off.
- DOE still presents a thematic grouping of major program accounts, first used in FY2014 request.
Thematic Grouping of Accounts

- Current appropriation accounts are grouped by renewable energy, energy efficiency, grants, and management.
- The request preserves the major program accounts (e.g., “Solar Energy,” “Building Technologies,” etc).
- DOE organizes those accounts into four functional groups, which help reveal program connections:
  1. Sustainable Transportation
  2. Renewable Electricity Generation
  3. Energy Efficiency
  4. Corporate Management
Key Funding Changes, by Theme

- Sustainable Transportation
- Renewable Electricity Generation
- Energy Efficiency
- Corporate Management
### Sustainable Transportation (FY2016-FY2015 difference)

<table>
<thead>
<tr>
<th>Program</th>
<th>Increase</th>
<th>Percent Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>$191 M</td>
<td>32%</td>
</tr>
<tr>
<td>Vehicles*</td>
<td>$164 M</td>
<td>59%</td>
</tr>
<tr>
<td>Bioenergy</td>
<td>$21 M</td>
<td>9%</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>$6 M</td>
<td>6%</td>
</tr>
</tbody>
</table>

* Note: Main activity increased under Vehicles is the Electric Vehicle (EV) Everywhere Grand Challenge Program (2012).
## Renewable Electricity Generation (FY2016-FY2015 difference)

<table>
<thead>
<tr>
<th>Program</th>
<th>Increase</th>
<th>Percent Increase</th>
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</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>$189 M</td>
<td>42%</td>
</tr>
<tr>
<td>Solar</td>
<td>$104 M</td>
<td>45%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>$41 M</td>
<td>75%</td>
</tr>
<tr>
<td>Wind</td>
<td>$39 M</td>
<td>36%</td>
</tr>
<tr>
<td>Water</td>
<td>$6 M</td>
<td>10%</td>
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</table>
## Energy Efficiency (FY2016-FY2015 difference)

<table>
<thead>
<tr>
<th>Program</th>
<th>Increase</th>
<th>Percent Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>$388 M</td>
<td>60%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>$204 M</td>
<td>102%</td>
</tr>
<tr>
<td>Buildings</td>
<td>$92 M</td>
<td>54%</td>
</tr>
<tr>
<td>Weatherization/IG*</td>
<td>$75 M</td>
<td>31%</td>
</tr>
<tr>
<td>FEMP</td>
<td>$16 M</td>
<td>60%</td>
</tr>
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</table>

* Note: Main activities increased under this program are:
  • Weatherization Assistance Program ($35 M, 18%) and
  • Local Government Energy Grants ($20 M, new)
# Corporate Management (FY2016-FY2015 difference)

<table>
<thead>
<tr>
<th>Program</th>
<th>Change</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>$18 M</td>
<td>8%</td>
</tr>
<tr>
<td>Facilities</td>
<td>$6 M</td>
<td>11%</td>
</tr>
<tr>
<td>Program Direction</td>
<td>$5 M</td>
<td>3%</td>
</tr>
<tr>
<td>Strategic Programs</td>
<td>$7 M</td>
<td>33%</td>
</tr>
</tbody>
</table>
Key Funding Changes, by Program

- Major Program Increases
- Small Program Decreases
## Major Program Increases (FY2016-FY2015 difference)

<table>
<thead>
<tr>
<th>Program</th>
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<th>Pct. Increase</th>
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<td>$21 M</td>
<td>9%</td>
</tr>
<tr>
<td>Weatherization</td>
<td>$35 M</td>
<td>18%</td>
</tr>
<tr>
<td>State Energy</td>
<td>$20 M</td>
<td>40%</td>
</tr>
<tr>
<td>Local Energy</td>
<td>$20 M</td>
<td>New Program</td>
</tr>
</tbody>
</table>

**Total Increase:** $903 M | **Total Pct. Increase:** 41%
Program Decreases

None
Program Highlights: Goals & Funding

- Manufacturing (2 pages)
- Vehicles (2 pages)
- Solar
- Buildings
- Geothermal (2 pages)
- Wind
- Bioenergy
- Grant Programs
- Innovation Hubs
Manufacturing Program, Highlights (FY2016-FY2015 difference)

- **Goals & Objectives**
  - Anchors the Clean Energy Manufacturing Initiative (started in 2013)
  - Improve competitiveness in global markets for products (e.g., solar PV modules, LED lights, batteries, wind turbine blades)
  - Increase competitiveness by raising industrial energy productivity (Race to the Top)
  - 50% energy savings through advanced materials & processes
  - 40 gw (million kilowatts) of combined heat and power by 2020
  - Help leading companies cut energy intensity by 25% over 10 years

- **$204 M (69%) increase:**
  - + $149 M (161%) for Advanced Manufacturing R&D Facilities:
    [which include Clean Energy Manufacturing Innovation Institutes, Critical Materials Hub, Manufacturing Demonstration Facility]
  - + $49 M (58%) for R&D Projects (includes Advanced Incubator)
  - + $7 M (28%) for Industrial Technical Assistance
The increase is for two ($70 M each) new Clean Energy Manufacturing Innovation Institutes (CEMIs) & support for four existing institutes:

- New Institutes focus may include manufacturing of: advanced materials, two-dimensional roll-to-roll, and/or high efficiency modular chemical process
- Four existing institutes: Next Generation Power Electronics (2013), Advanced Composites (2014), Smart Manufacturing (2014), and one to be announced in FY2015
- Institutes are part of the President’s National Network for Manufacturing Innovation (NNMI)
- Institutes focus on technologies applicable to multiple industries and markets
- Institutes bring together government, industry, & academia
- Each Institute to be financially sustainable within 5-7 years

- $25 million for the Critical Materials Hub (final year)—led by Ames National Lab (Iowa)—to develop processes and materials to reduce or eliminate need for rare earth elements and other key materials
- $20 million of further support (final year) for Manufacturing Demonstration Facility at Oak Ridge National Lab
Manufacturing Program: Advanced Manufacturing R&D Projects, + $49 M

• The $49 million increase would provide a total of $133 M for Advanced Manufacturing R&D Projects, of which:

• $113 million for new projects of $15 to $20 million each, covering up to six “foundational” areas:
  • Chemical process intensification and smart manufacturing—two likely areas of focus
  • Grid and resource integration—including advanced combined heat and power, waste heat recovery, advanced insulation materials, and integration of energy infrastructure (grid and natural gas)
  • Next generation electric machines—including ultraconductive materials
  • Sustainable manufacturing—including water-energy nexus

• $20 million for the Advanced Manufacturing Incubator—focused on “fundamental” applied R&D projects for small- and medium-sized manufacturing companies
Vehicles Program, Highlights (FY2016-FY2015 difference)

- **Goals & Objectives**
  - Parity for Plug-in EV affordability & convenience by 2022
    - 50% cut in combined battery & drive cost, from 2012 to 2022
  - Cut battery cost from $300/kwh in 2014 to $125/kwh 2022
  - Reduce vehicle materials weight by 30% from 2002 to 2022
  - Cut electric drive cost from $16/kw in 2013 to $8/kw by 2022
  - Grid Modernization Crosscut
    - 1.8 million barrels per day (16%) cut in oil use trend by 2020
    - 62 miles per gallon (mpg) fuel economy for cars by 2025

- $164 M (59%) increase, esp. for EV Everywhere Grand Challenge:
  - + $41 M (39%) for Batteries & Electric Drives:
    [advanced batteries, power electronics, charging stations]
  - + 28 M (100%) for Outreach and Deployment
  - + 35 M (98%) for Materials Technology
  - + 17 M (85%) for Fuels and Lubricants
Vehicles Subprogram Changes (FY2016-FY2015 difference)

- Batteries & Electric Drives (+ $41 M)
  - Reduce weight and costs
  - Develop rare earth-free motors and magnets
  - Improve wide bandgap power electronics
  - Atomic/molecular coatings for lithium-ion electrodes

- Materials Technology (+ $35 M)
  - Carbon fiber composites & alloys (steel, aluminum, magnesium)
  - Lightweight materials compatible with manufacturing infrastructure
  - High temperature materials for valves & turbochargers

- Outreach and Deployment (+ $28 M)
  - Initiate Alternative Fuel Vehicle Community Partner projects
  - Up to five IAFVCP projects, with 50% cost share

- Vehicle Systems (+ $28 M)
  - PEV vehicle-grid integration, wireless charging, codes/standards, modelling/simulation; Supertruck II (idling, HVAC)
Solar Program, Highlights (FY2016-FY2015 difference)

Goals & Objectives

- 6 cents/kilowatt-hour for utility-scale photovoltaic (PV) plants, a 75% cost cut from 2010 to 2020 (SunShot Initiative)
- Installed PV capacity cost targets of $1 M/megawatt-hour (mwh) for utility-scale ($1.25 M/mwh commercial, $1.50 M/mwh residential)
- Concentrated solar power (CSP) installed cost of $3.5 M/mwh (includes storage), equivalent to 6 cents/kwh
- Grid Integration Initiative

Solar, + $104 M (45%)
- + $33 M (75%) for Systems Integration (grid, dispatchability)
- + $27 M (76%) for Photovoltaic R&D (reliability, cell efficiency)
- + $27 M (65%) for Balance of Systems (barriers, new markets)
- + $16 M (27%) for Manufacturing Innovations (process, tools)
Buildings Program, Highlights (FY2016-FY2015 difference)

Goals & Objectives

• 50% cut in energy use for new buildings, from 2010 to 2030

Buildings, + $92 M (54%)

• + $57 M (102%) for Emerging Technologies, R&D on sensors, controls, and grid integration; and new air conditioning & refrigeration technologies

• + $25 M (111%) for residential buildings, to support retrofits & building codes for new construction

• + $16 M (29%) to accelerate federal equipment standards & model building codes

• Note: Major long-term barriers (Cong. Staff, see CRS report R40670 by Paul Parfomak)
Geothermal Program: Hydrothermal + $24 M ($37 M total)

Goals & Objectives:
- Cut cost from 22 cents/kwh to 10 cents/kwh by 2030
- Develop 30 gw of new, undiscovered resources

Program Activities:
- Complete phase 1 of Play Fairway Analysis (PFA)
  - Identify target “blind” resource areas (2-3 miles deep)
  - Adapt tools to predict heat & permeability
  - Adapt oil/gas/mining technology to higher temperatures & pressures
- For target areas, launch phase 2 of PFA
  - Conduct further seismic, gravity, and other sensing surveys
  - Conduct other geological studies & exploratory “slimhole” drilling
- Subsurface engineering crosscut (SubTER)
  - Safe, adaptive control of subsurface fractures and fluid flow
  - Use intelligent wellbores, induced seismicity, permeability manipulation
  - Coordinated with USGS, NSF, DOE Nuclear, DOE Fossil
Geothermal Power Program: EGS + $13 M ($45 M total)

Description:

- EGS (enhanced geothermal systems) are engineered reservoirs
  - Pressurized fluid injected into hot rock opens existing fractures
  - Increased permeability lets fluid circulate into production well
- 2006 MIT Study (Idaho National Lab)
  - Existing fields: cut failure rate, add to capacity & lifetime
  - At six miles deep, enough usable heat nationwide for 100 gw
  - Study focused on resource, technology, and economics
- Some debate over fracking aspect
  - Concerns: earthquakes, leakages/spills
  - Responses: DOE seismicity protocol, best practices (Newberry)

Goals & Program Activities:

- Develop 100 gw of resources
- FY2016 focus on first field lab drilling (FORGE); further CO2 tests
Wind Program, Highlights (FY2016-FY2015 difference)

Goals & Objectives

- **Land-Based**: 5.7 cents/kilowatt-hour (kwh) for energy cost of utility-scale turbines by 2020 and 4.2 cents/kwh by 2030
- **Offshore**: cut energy cost from 21 cents/kwh in 2010 to 17 cents/kwh by 2020 (unsubsidized); install three demonstrations by 2017
- **Increase installed windfarm capacity** from 65 million kilowatts (gw) in 2014 to 125 gw by 2020 and 300 gw by 2030

Wind, + $39 M (36%)

- + $24 M (68%) for Technology RD&T & Resource Analysis
  - New initiatives: rotor design, drivetrain, and atmosphere-to-electrons (A2e) smart technology demonstration partnerships
- + $17 M (150%) to Mitigate Market Barriers
  - Transmission access, radar, environmental, and permitting barriers
  - Largest share of increase is for eagle/wildlife impact mitigation
Bioenergy Program, Highlights (FY2016-FY2015 difference)

Goals & Objectives

• $3 per gallon of gasoline equivalent (gge) for “drop-in” fuels (to replace gasoline, diesel, jet fuel) by 2017
• $3/gge for biofuel from algal biomass by 2030

Bioenergy, + $21 M (9%)

• + $8 M (10%) for Demonstration & Market Transformation: three biorefinery pilot projects, or one new demonstration project—to broaden pathways for converting biomass to hydrocarbon fuels
• + $7 M (21%) for Feedstocks: increase yield of algal biomass (phase 2) conversion to biofuel intermediate oil
Grant Programs (FY2016-FY2015)

• +$35 M, Weatherization Program
  • + 19 M, for additional 3,000 retrofits
  • + 15 M, test financial models for multifamily buildings

• +$20 M, State Energy Program (SEP)
  • + $15 M, for competitive grants that promote regional, sectoral, and national public-private partnerships for innovative scale-up & best practices

• +$20 M, Local Energy Program
  • New program, structured like SEP to enhance local government capacity for energy planning, analysis, and program implementation
  • Competitive grants would support best practices, technical assistance, and leadership-by-example
Innovation Hubs (FY2016 requested amount)

Hub focus: innovation & commercialization

- Critical Materials Hub (Manufacturing Program), + $25 million (final year)
- Buildings Efficiency Hub (became PSU Consortium), zero funding (end of project)
Additional Reference Material
Context: Innovation & Demonstration Projects

- Innovation Valley of Death. Long-standing policy debate over the federal role in filling the gap between R&D and market commercialization.
- Demonstration projects tend to be very expensive.
- ARPA-E was created to spur development of “breakthrough” technologies.
- Loan guarantee program for innovative technologies still open, some funding available to cover subsidy costs.
- Budget deficit concerns tend to limit spending.
Historical Spending Context for Major Energy Technologies R&D

- Chart of Energy R&D Shares, FY1948-FY2014
- Table with Energy R&D funding for FY2014, FY2015, and FY2016 request
- Chart of Energy R&D funding for FY2014, FY2015, and FY2016 request
Note: Nuclear includes Fission and Fusion. Source: DOE, Analysis of Federal Incentives, 1980 & DOE History Table. Also, see CRS report RS22858.
Charts of Energy R&D Funding Shares: 67-year, 37-year, & 10-year totals

Note: Nuclear includes Fission and Fusion. Source: DOE, Analysis of Federal Incentives, 1980 & DOE Budget History Table. Also, see CRS report RS22858.
### DOE Energy R&D Funding Shares for FY2014, FY2015 and FY2016 Request ($ millions)

<table>
<thead>
<tr>
<th></th>
<th>FY2014</th>
<th>FY2015</th>
<th>FY2016R</th>
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<tbody>
<tr>
<td>Fusion</td>
<td>505</td>
<td>468</td>
<td>420</td>
</tr>
<tr>
<td>Nuclear</td>
<td>888</td>
<td>833</td>
<td>908</td>
</tr>
<tr>
<td>Fossil</td>
<td>562</td>
<td>561</td>
<td>560</td>
</tr>
<tr>
<td>Electric</td>
<td>147</td>
<td>147</td>
<td>270</td>
</tr>
<tr>
<td>Renewables</td>
<td>884</td>
<td>885</td>
<td>1,122</td>
</tr>
<tr>
<td>Efficiency</td>
<td>750</td>
<td>748</td>
<td>1,250</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>3,736</strong></td>
<td><strong>3,642</strong></td>
<td><strong>4,530</strong></td>
</tr>
</tbody>
</table>

Source: DOE FY2016 budget request. Nuclear Fusion is funded under the Office of Science, all others under Energy Resources Supply and Conservation.
Energy R&D Funding Shares: FY2014 Final, FY2015 Final, & FY2016 Request

Framework of Issues for Staff

- Role of government
- Budget deficit
- Trade deficit & competitiveness
- Energy security
- Energy prices
- Pollution & greenhouse gas emissions
Further information available to Congressional Staff:

- CRS R43567, DOE FY2015 appropriations
- CRS R43121, DOE FY2014 appropriations
- CRS R42498, DOE FY2013 appropriations
- CRS RS22858, on R&D funding history
- All are on the CRS web site at:
  - www.crs.gov
- Fred is at 7-7039, fsissine@crs.loc.gov