


<b>DOE Hydrogen and Fuel Cells Program Record</b>		
<b>Record #:</b> 17006	<b>Date:</b> July 2017	
<b>Title:</b> Historical Fuel Cell and Hydrogen Budgets		
<b>Originator:</b> David Peterson and Rick Farmer		
<b>Approved by:</b> Sunita Satyapal	<b>Date:</b> July 12, 2017	

**Item**

The Office of Energy Efficiency and Renewable Energy has spent an average of about \$139 million per year (about 0.5% of the average DOE budget) since 2004 on fuel cell and hydrogen research, development, and demonstration. This investment has led to more than 650 U.S. patents, approximately 30 commercial technologies being developed by industry and being introduced into the market, and more than 75 emerging technologies that are anticipated by industry to be in the market within the next several years.

**Additional Information**

**Program History** – From 1990 through 2016, the DOE activities related to hydrogen and fuel cells occurred primarily through the Office of Energy Efficiency and Renewable Energy (EERE) but also involved other offices and programs. A summary of the contributing programs is below:

- From 1990 through 2002, the hydrogen and fuel cell programs within EERE were two separate programs. The Hydrogen Program was funded from the Energy and Water Appropriations and Fuel Cells from the Interior Appropriations.
- In 2003, EERE combined the hydrogen and fuel cell programs into one program.
- In 2004, President Bush’s Hydrogen Fuel Initiative (HFI) began and continued for 5 years, through 2008. The HFI combined the DOE efforts of EERE, Fossil Energy (FE), Nuclear Energy (NE), and Basic Energy Sciences (BES), which is within the Office of Science. EERE’s Hydrogen, Fuel Cell, and Infrastructure Technologies (HFCIT) Program served as the lead from DOE.
- In FY 2009, hydrogen and fuel cell activities continued in the four DOE offices, as coordinated efforts, with HFCIT – subsequently renamed as the Fuel Cell Technologies Office (FCTO) – as the lead coordinator.
- FE’s Solid Oxide Fuel Cell Program, which was also known as the Solid State Energy Conversion Alliance (SECA), focused on MW scale solid oxide fuel cell (SOFC) development. Although not part of the HFI, the SOFC activities were coordinated with FCTO and other offices.

**Funding** – The charts below summarize the funding for hydrogen and fuel cells since 1990.<sup>1-3</sup> For the years 1990 through 1999, only EERE funding is shown in Figure 1. Funding for FE’s SOFC Program is shown beginning in 2000. The additional funding provided by FE along with NE and BES is shown beginning in 2004. The combined total from 2007 through 2016 corresponds to about 0.8% of the total DOE budget for the same time period.<sup>4,5</sup> Figures 2 and 3 depict the EERE and the FE SOFC funding profiles respectively.

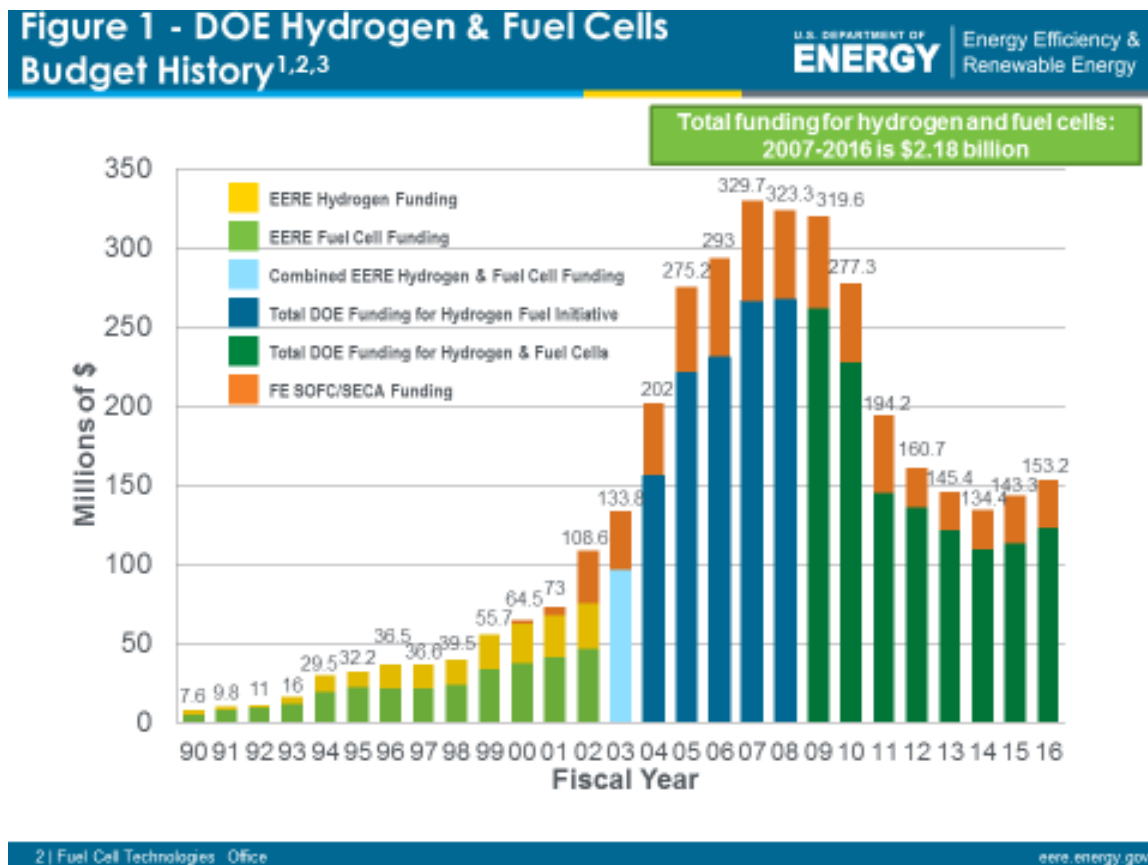
Not included in the figures below are Recovery Act funds. In 2009, FCTO received about \$43 million for Recovery Act hydrogen and fuel cell related activities.<sup>6</sup> Overall, EERE received

nearly \$16.8 billion. The following five EERE programs account for about 94% of the total EERE Recovery Act funding.

- Weatherization and Intergovernmental Activities – \$11.5 billion
- Vehicle Technologies including Advanced Battery Manufacturing, Transportation Electrification, and Alternative Fueled Vehicles – \$2.8 billion
- Biomass and Biorefinery Systems R&D – \$0.8 billion
- Geothermal Technologies – \$0.4 billion
- Building Technologies – \$0.3 billion

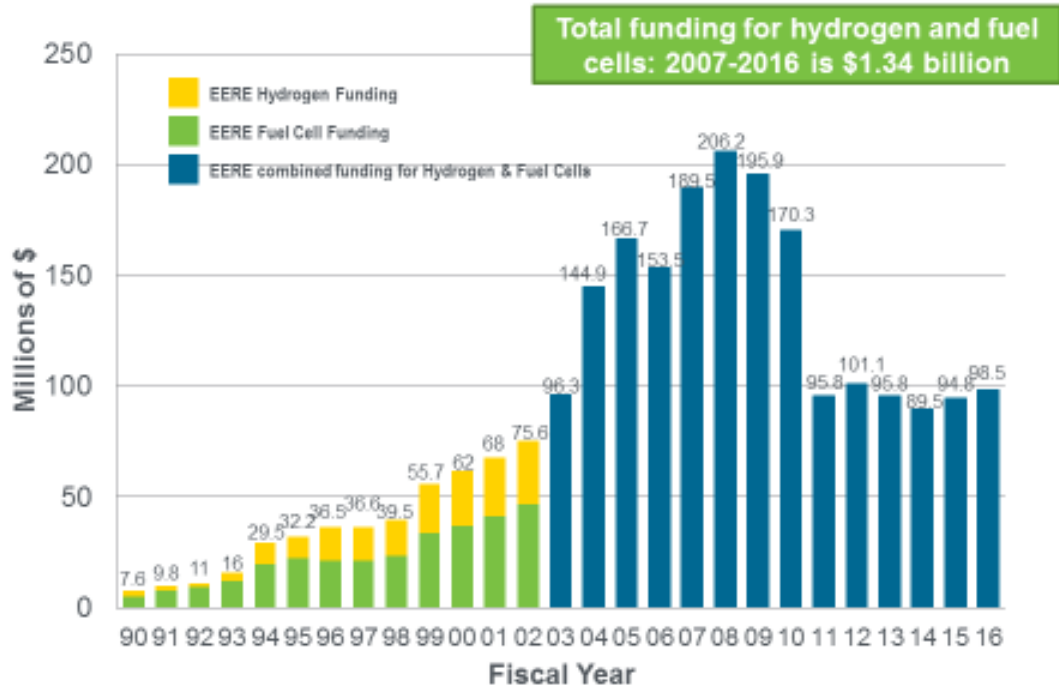
The global 2016 investment in the solar, wind, and biomass industries was more than \$230 billion.<sup>7</sup> Over 10 years, DOE spent about 1% of what was spent in just one year by the solar, wind, and biomass industries.

**Impact** – Sustained DOE funding across early stage R&D to demonstrations enabled significant progress. For example, EERE R&D funded efforts helped to reduce the high-volume modeled cost of transportation fuel cell systems by more than 60% since 2006, quadrupled fuel cell durability, and contributed to more than 650 U.S. patents and about 30 technologies commercialized by industry and introduced to the market.<sup>8</sup>

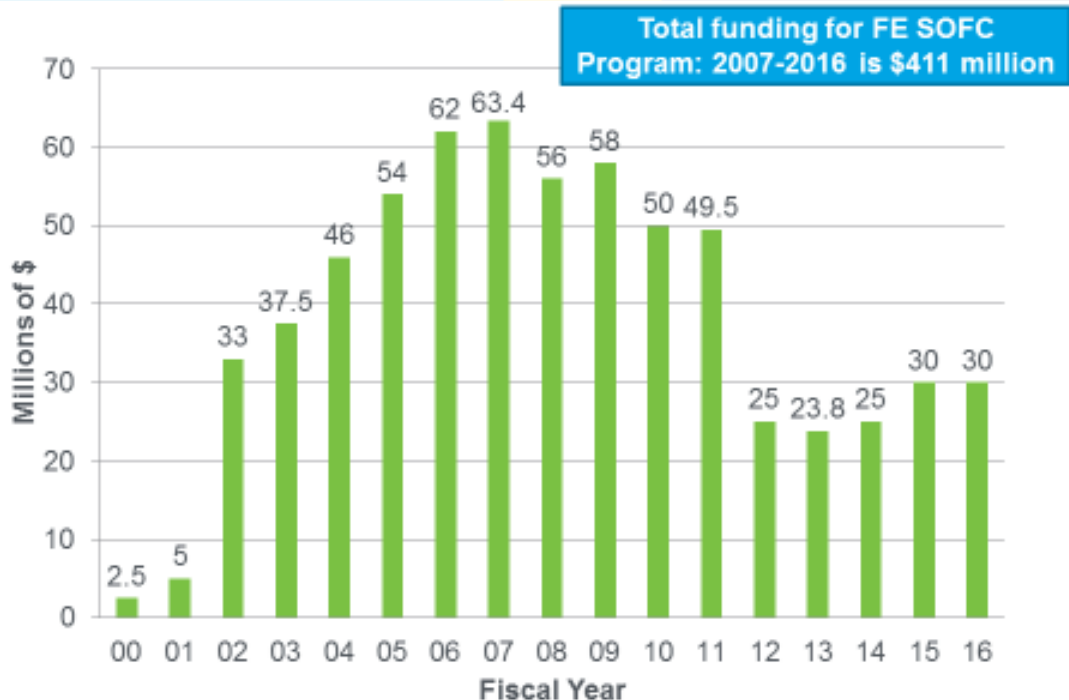


Note: Budget numbers for '04-'11 include funding from the EERE Hydrogen & Fuel Cells Program, Fossil Energy, Nuclear Energy, and Office of Science; '12-'16 includes funding from EERE Hydrogen & Fuel Cells Program and Office of Science

**Figure 2 - EERE Hydrogen & Fuel Cells Budget History<sup>1,2</sup>**



**Figure 3 - Fossil Energy Fuel Cell Program: SOFC/SECA Budget History<sup>3</sup>**



## References

- <sup>1</sup> Dr. JoAnn Milliken, “U.S. Department of Energy Hydrogen Program Annual Merit Review & Peer Evaluation Meeting,” Arlington, VA, June 2008,  
[https://hydrogen.energy.gov/pdfs/review08/0\\_milliken\\_h2\\_program\\_overview.pdf](https://hydrogen.energy.gov/pdfs/review08/0_milliken_h2_program_overview.pdf).
- <sup>2</sup> “Budget,” *Hydrogen and Fuel Cells Program*, U.S. Department of Energy, Web, June 2017,  
<https://www.hydrogen.energy.gov/budget.html>.
- <sup>3</sup> Dr. Shailesh Vora, “17th Annual SOFC Workshop: DOE Office of Fossil Energy’s Solid Oxide Fuel Cell (SOFC) Program,” National Energy Technology Laboratory, July 2016,  
<https://www.netl.doe.gov/File%20Library/Events/2016/sofc/Vora.pdf>.
- <sup>4</sup> DOE Funding History, <https://www.energy.gov/cfo/downloads/fy-2014-funding-history-detail-spreadsheet>.
- <sup>5</sup> FY 2016 DOE Agency Financial Report,  
[https://www.energy.gov/sites/prod/files/2016/11/f34/DOE\\_FY2016\\_AFR.pdf](https://www.energy.gov/sites/prod/files/2016/11/f34/DOE_FY2016_AFR.pdf).
- <sup>6</sup> FY 2011 Congressional Budget Request,  
<https://energy.gov/sites/prod/files/2016/09/f33/FY%202011%20Congressional%20Budget.pdf>.
- <sup>7</sup> Bloomberg New Energy Finance, Global Trends in Renewable Energy Investment 2017, <http://fs-unep-centre.org/publications/global-trends-renewable-energy-investment-2017>.
- <sup>8</sup> Dr. Sunita Satyapal, “Overview of DOE Hydrogen and Fuel Cells Program,” Annual Merit Review and Peer Evaluation Meeting June 2017,  
[https://www.hydrogen.energy.gov/pdfs/review17/01\\_satyapal\\_plenary\\_2017\\_amr.pdf](https://www.hydrogen.energy.gov/pdfs/review17/01_satyapal_plenary_2017_amr.pdf).