

# Innovative U.S. Energy Ecosystem: Why R&D Matters



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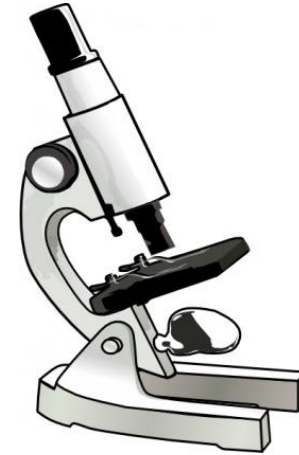


# Why Renewables?

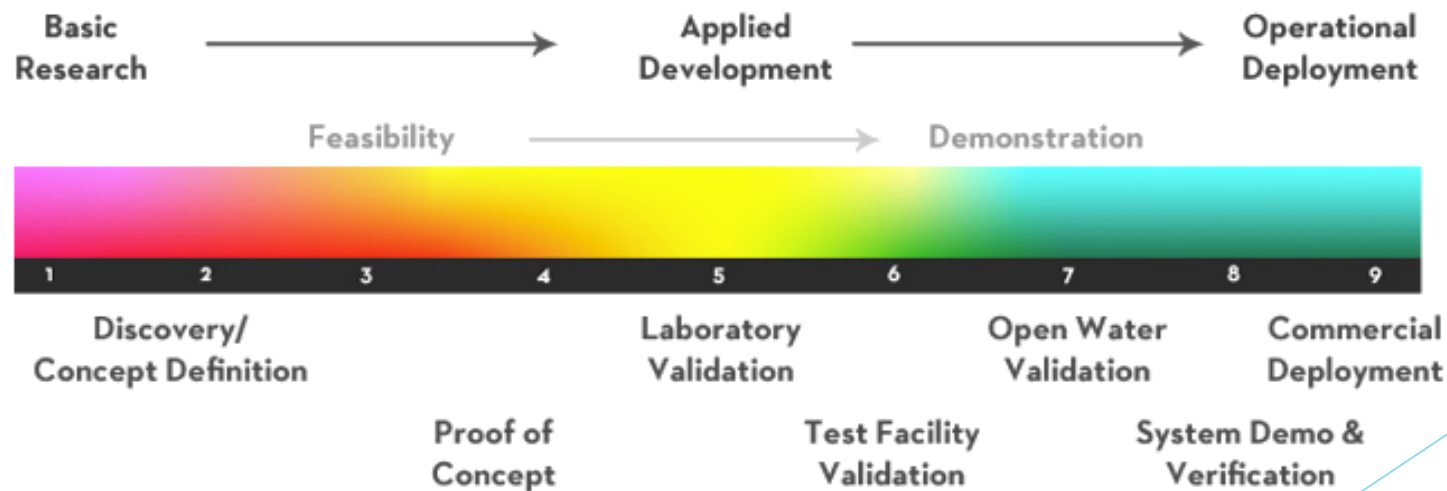


# Stages of Research

- ▶ Basic Research
- ▶ Applied Research
- ▶ Development
- ▶ Demonstration
- ▶ Deployment



## TECHNOLOGY READINESS LEVELS



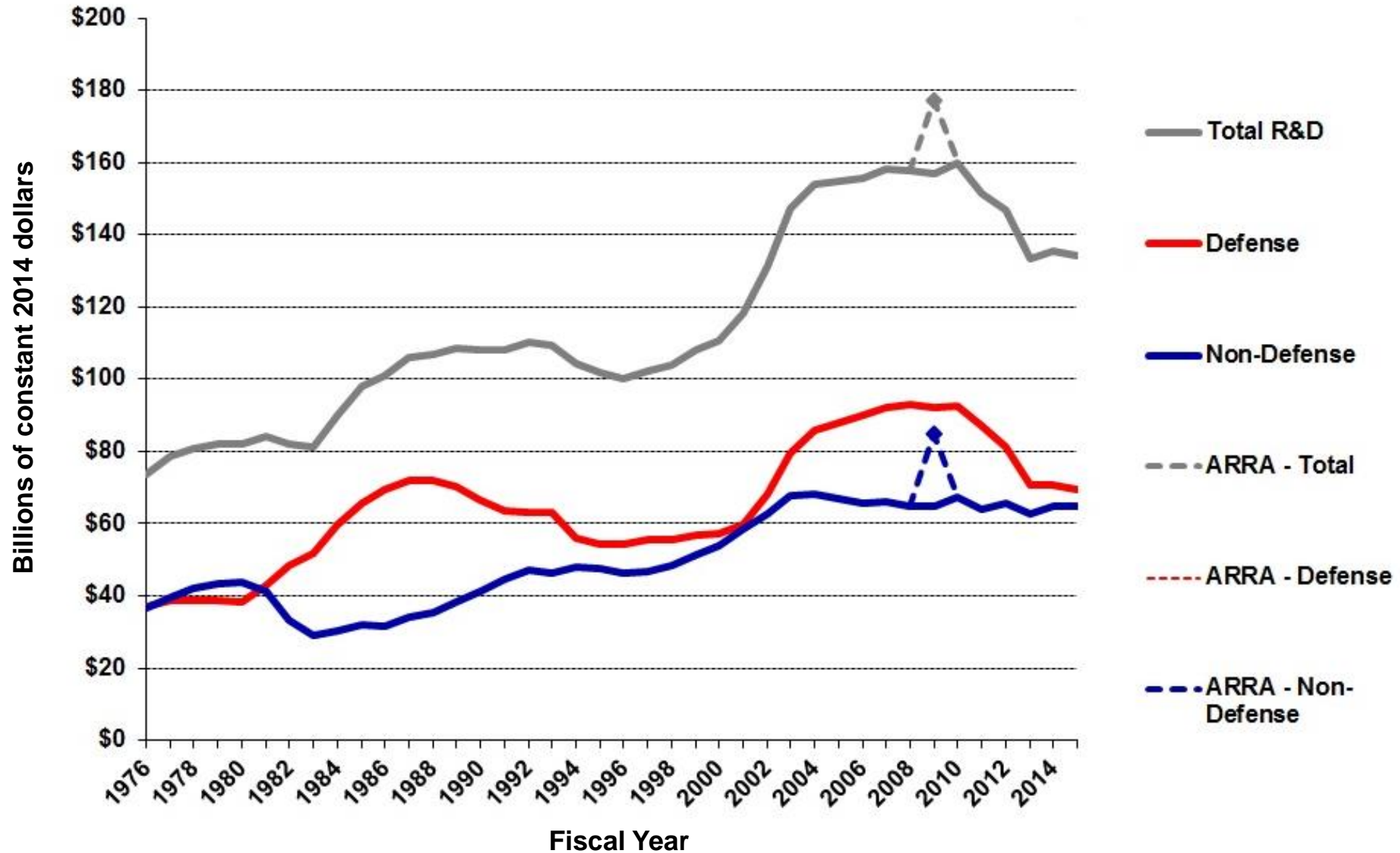
# R&D is Important!

- ▶ U.S. is a world-leader in innovation and technology
- ▶ 40% of Nobel Laureates world-wide
- ▶ The Internet, computers, semiconductors, biopharmaceuticals
- ▶ Science - The Endless Frontier
- ▶ Transformation and Opportunity: The Future of U.S. Research Enterprise
- ▶ Stock of information



# Trends in Federal R&D, FY 1976-2015

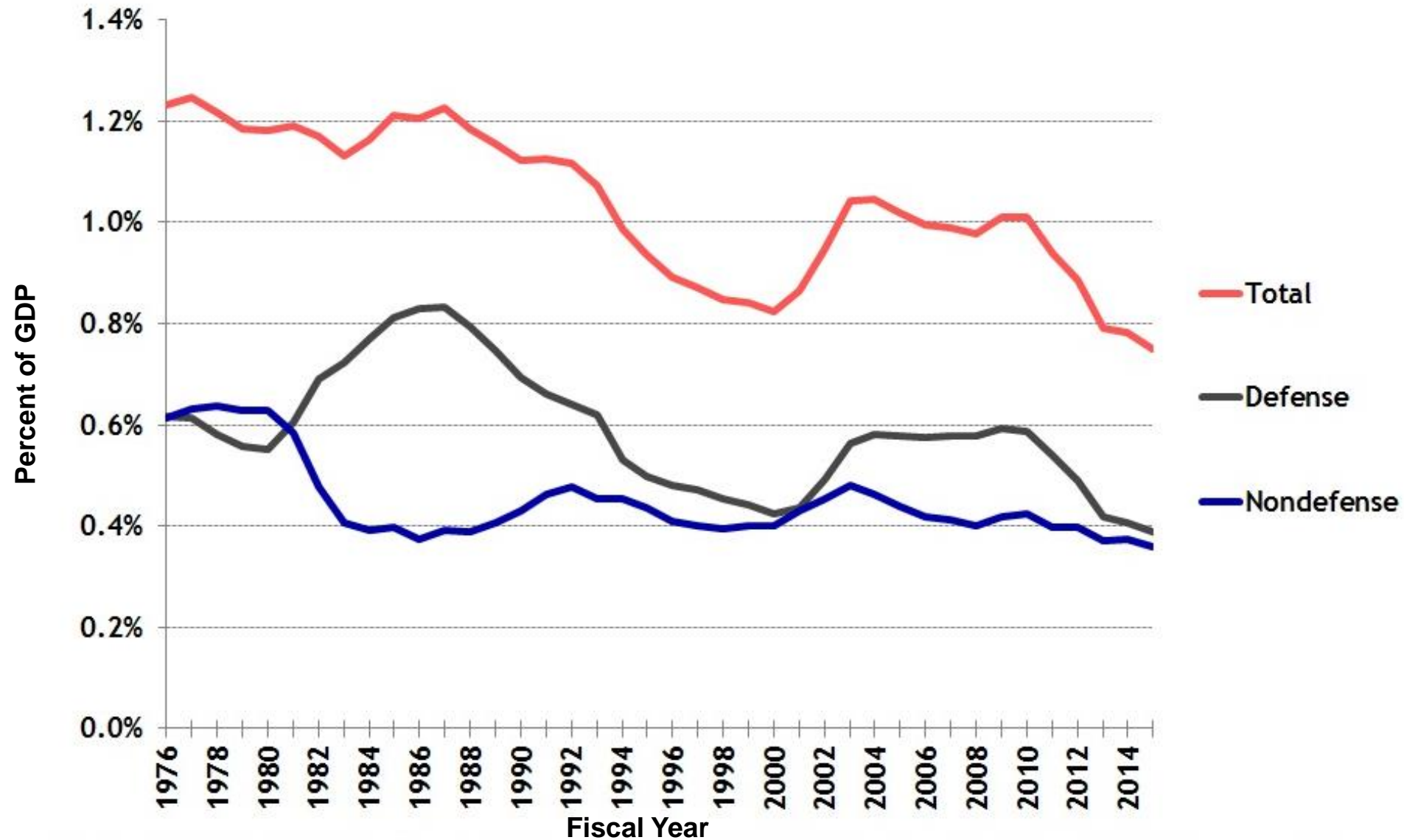
in billions of constant FY 2014 dollars



Source: AAAS *Research and Development* reports and analyses of appropriations. FY 2014 figures are current estimates, FY 2015 is the request. R&D includes conduct and facilities. © 2014 AAAS

# Trends in Federal R&D

As a percent of GDP

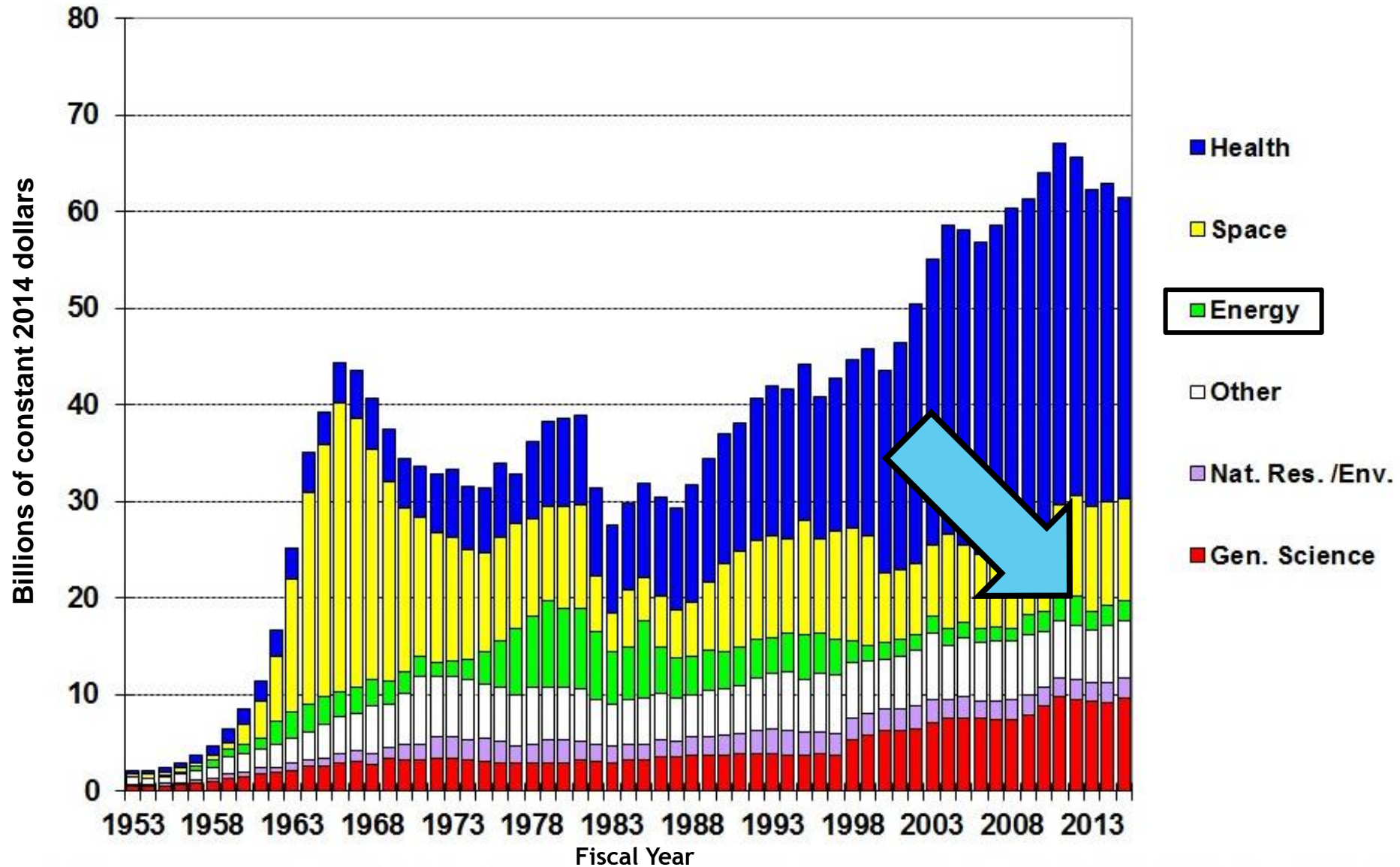


Source: Up to 1994 - National Science Foundation, Survey of Federal Funds for Research and Development; 1995 to Present - AAAS *Research and Development* series. GDP figures are from *Budget of the U.S. Government FY 2015*. FY 2014 and FY 2015 figures are latest estimates. © 2014 AAAS



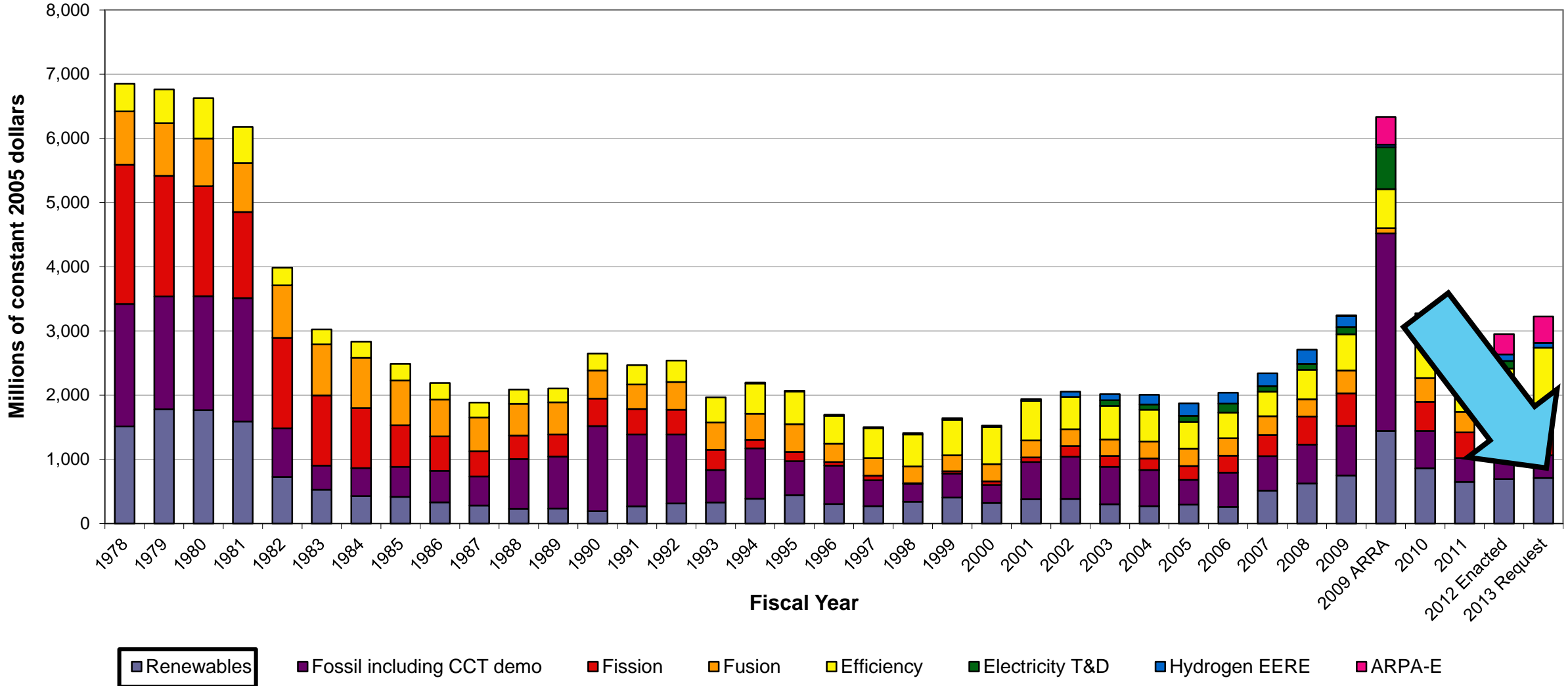
# Trends in Nondefense R&D by Function

outlays for the conduct of R&D, billions of constant FY 2014 dollars



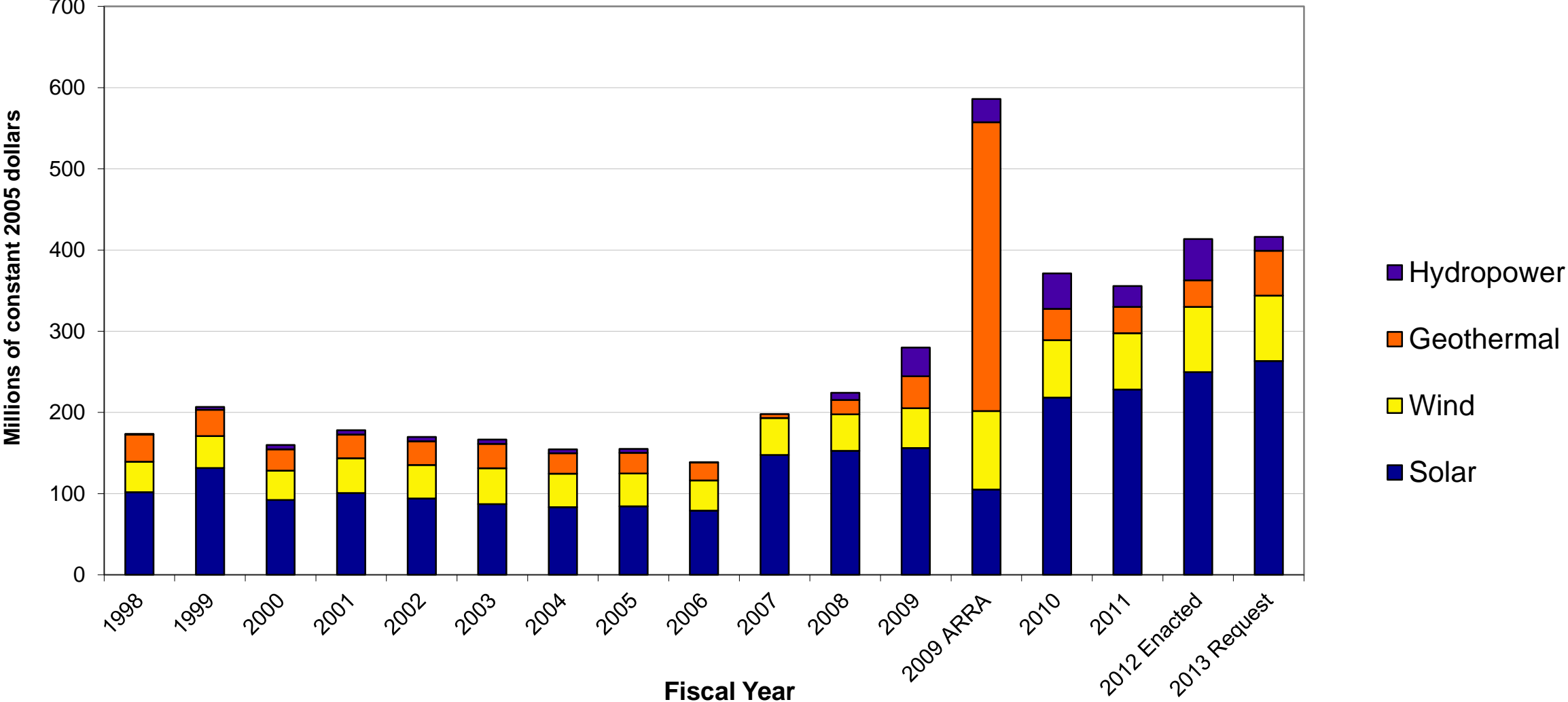
Source: AAAS, based on OMB Historical Tables in *Budget of the United States Government FY 2015*. FY 2015 is the President's request. Some Energy programs shifted to General Science beginning in FY 1998. © 2014 AAAS

# DOE Energy R&D Spending by Type





# Composition of DOE Renewable Energy R&D Spending



Gallagher, K.S. and L.D. Anadon, "DOE Budget Authority for Energy Research, Development, and Demonstration Database," Energy Technology Innovation Policy, John F. Kennedy School of Government, Harvard University, February 29, 2012.

# Road to Renewables

- ▶ Cheaper
- ▶ Higher efficiency
- ▶ Better performance
- ▶ Expansion possibilities
- ▶ Models and simulations
- ▶ Energy storage



# FY2015 Budget Summary

in thousands of dollars

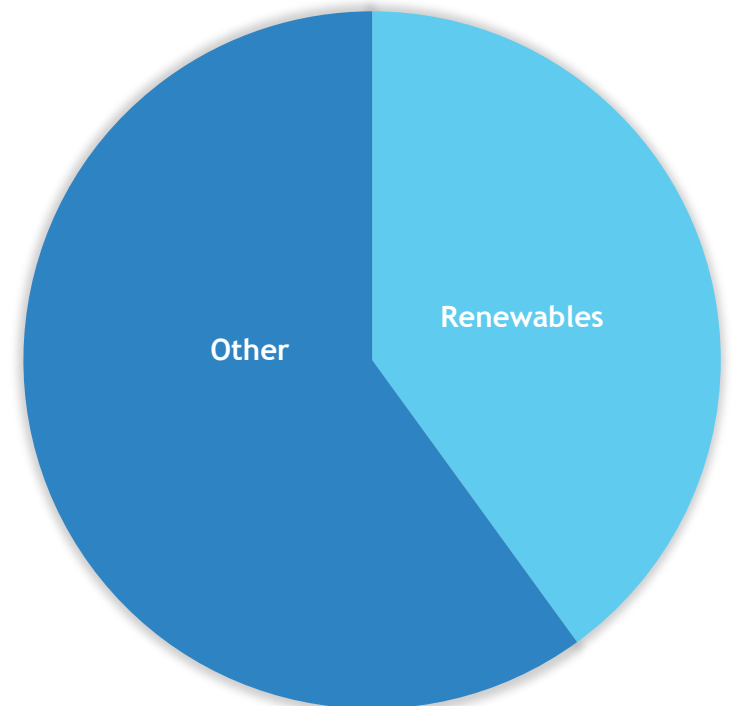
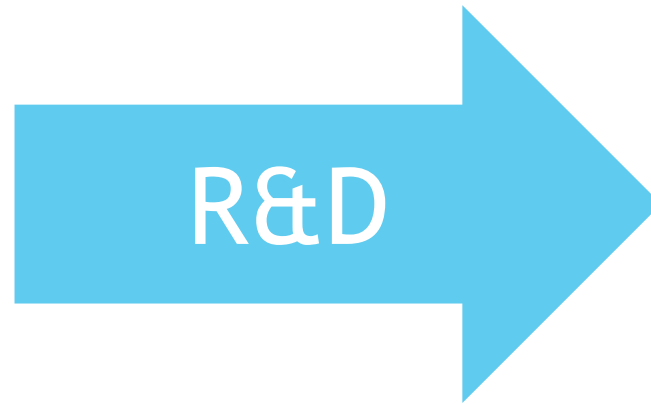
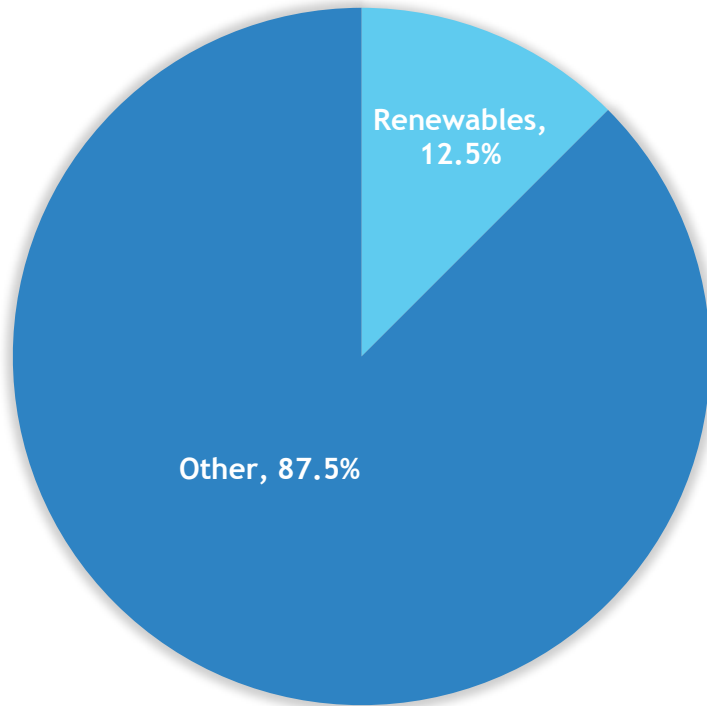
	2013 Current	2014 Enacted	2015 Request	2015 vs. 2014
Solar	269,050	257,058	282,300	+25,242
Wind	86,129	88,126	115,000	+26,874
Water	54,687	58,565	62,500	+3,935
Geothermal	35,025	45,775	61,500	+15,725
Total	444,891	449,524	521,300	+71,776

# Policy Options and Recommendations

- ▶ Government Funding
- ▶ Public-Private Partnerships
- ▶ Carbon Tax
- ▶ Large-Scale Experimentation



# Conclusion





# Questions?

“We need a sustained commitment to research and development. Only R&D can yield game-changing technologies to lower costs, accelerate innovation, and drive new American industries and jobs.”

-Dr. Steven Chu, Secretary of Energy 2009-2013