Technology Commercialization Showcase 2008
EERE Overview

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National security, environmental and economic goals form the basis for a robust National Energy Policy but historical data demonstrates the magnitude and urgency of the challenge.

Energy Security

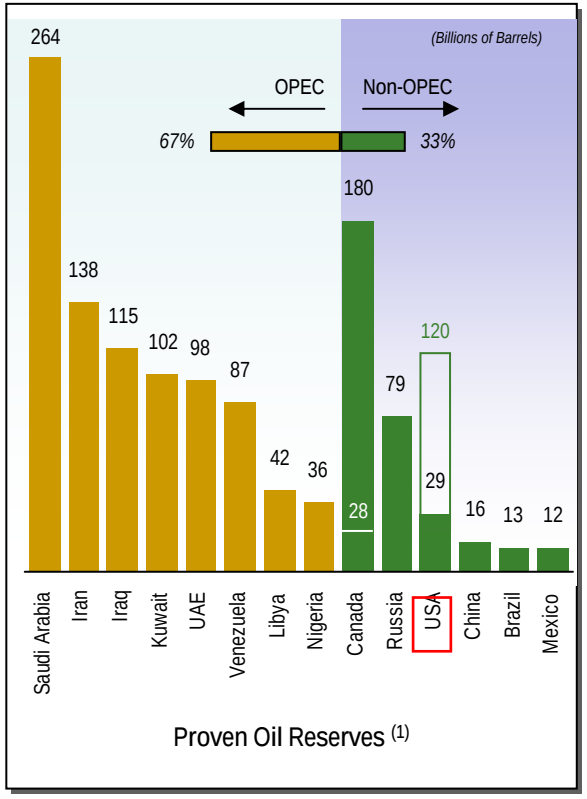
- *Diversify our energy mix and reduce dependence on petroleum*

Environmental Stewardship

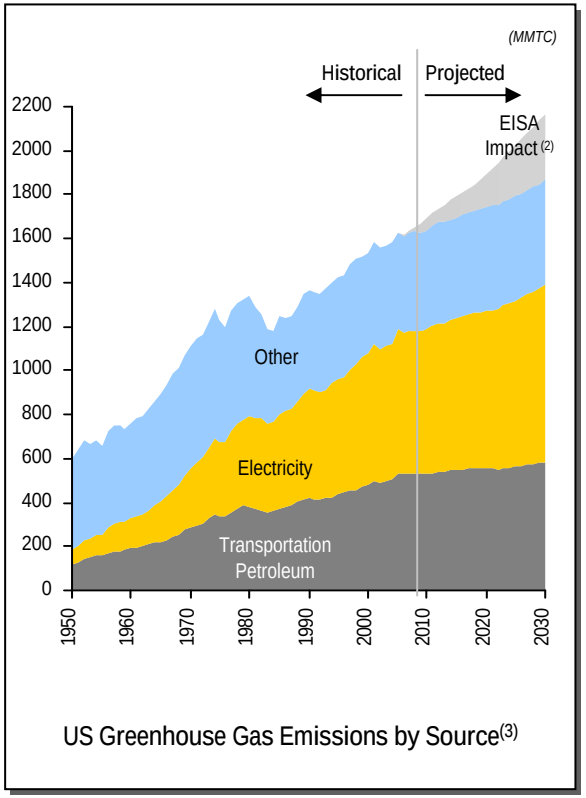
- *Reduce greenhouse gas emissions and other negative environmental impacts*

Economic Competitiveness

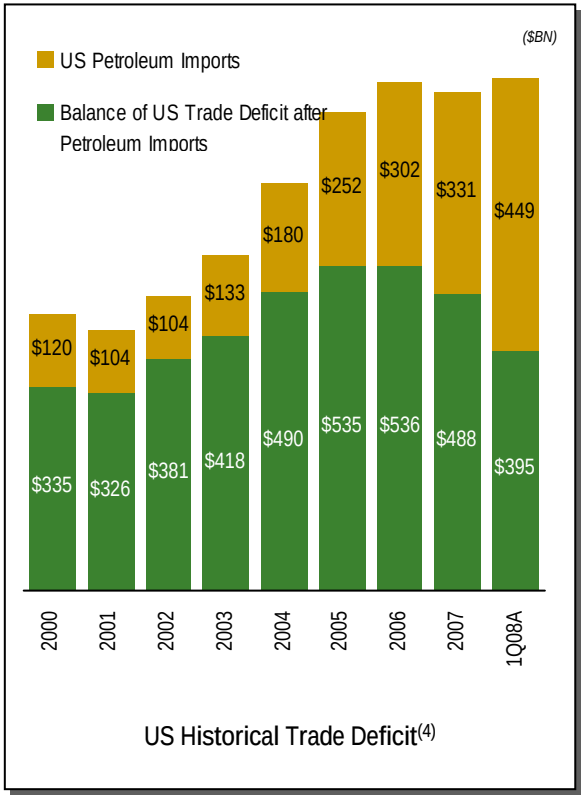
- *Create a more flexible, more reliable and higher capacity U.S. energy infrastructure*
- *Improve the energy productivity of the U.S. economy*



Proven Oil Reserves (1)



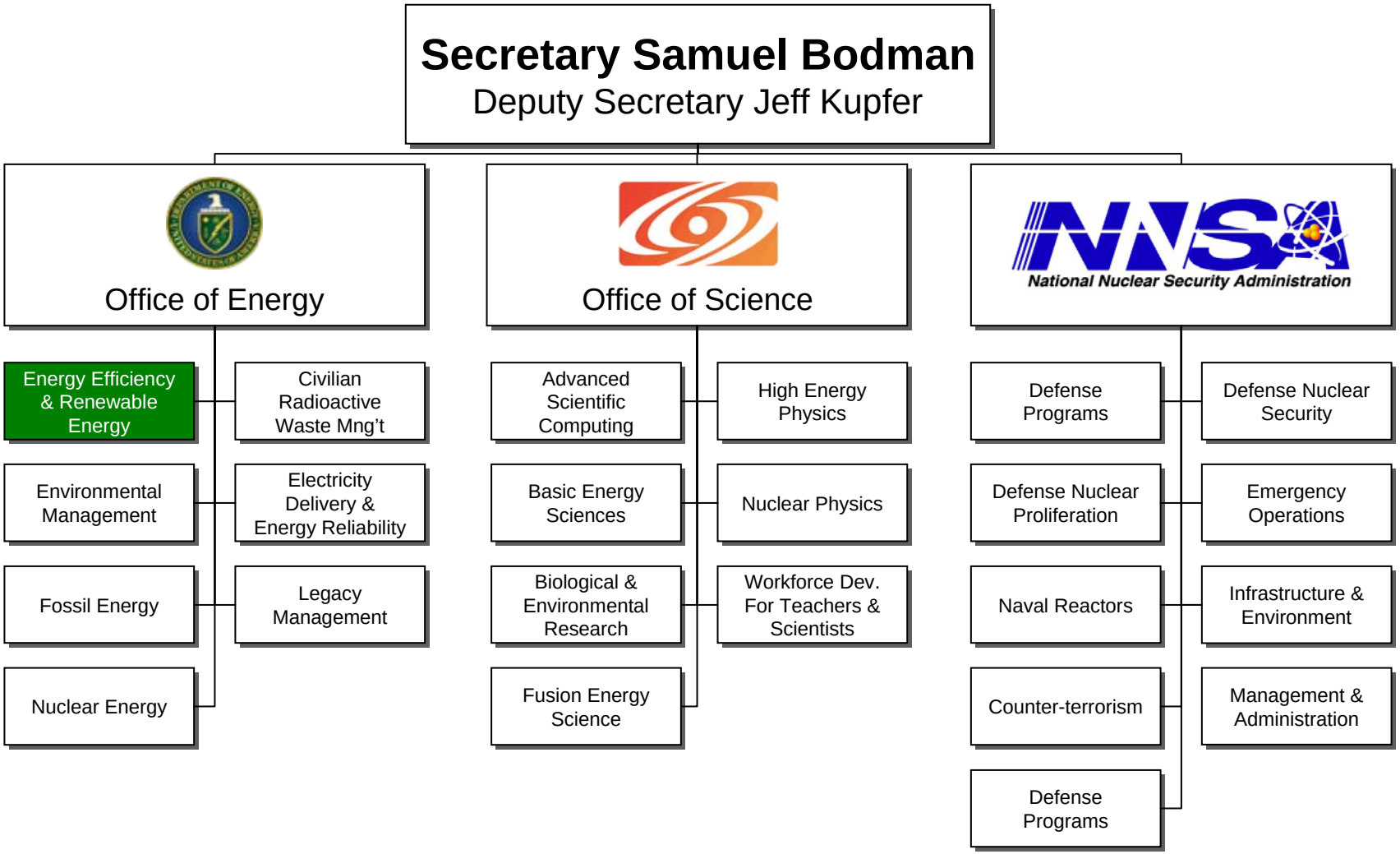
US Greenhouse Gas Emissions by Source(3)



US Historical Trade Deficit(4)

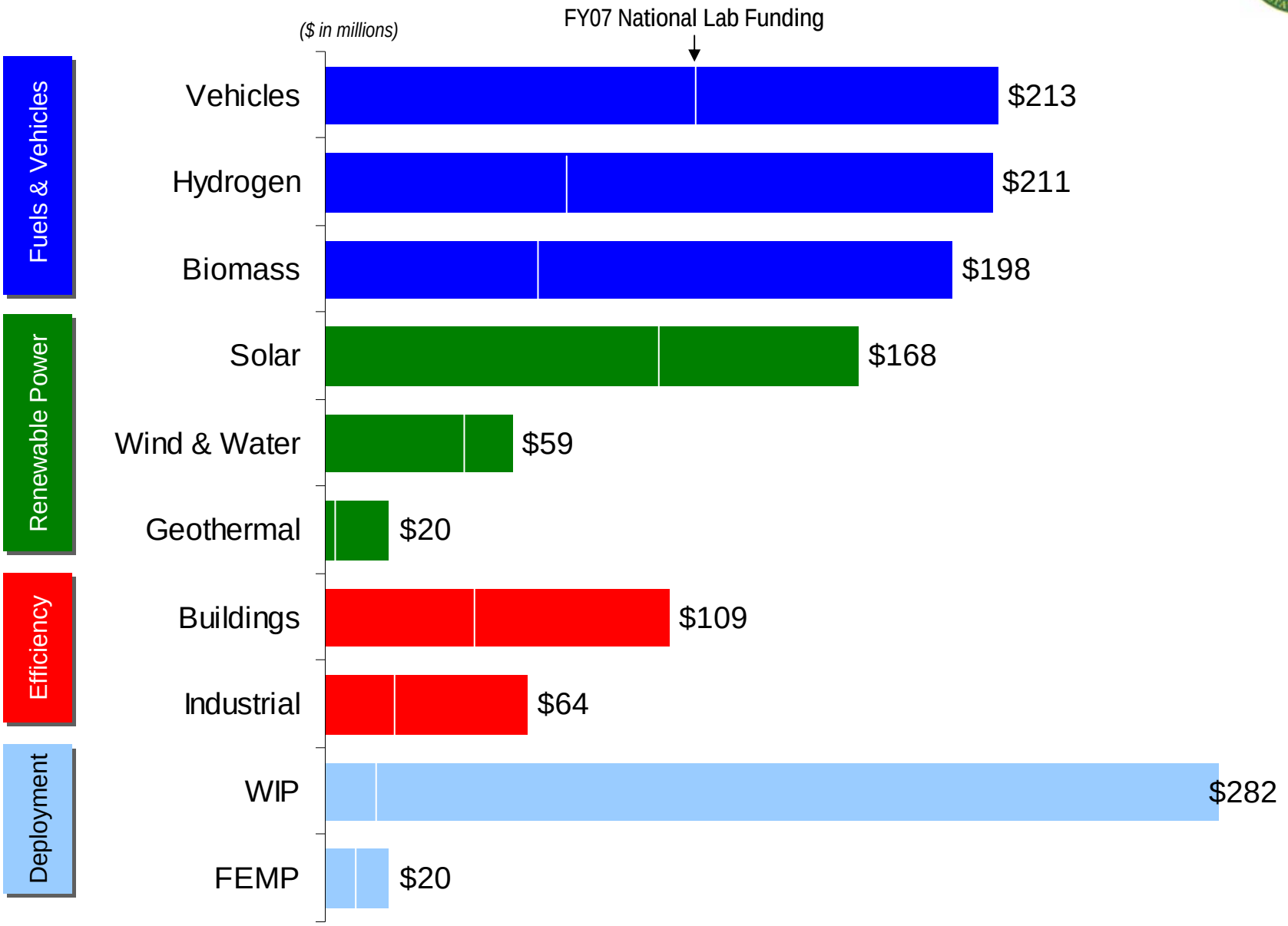
(1) Source: BP Statistical Review of World Energy, June 2008. Note: Includes 152 BN barrels of Canadian Tar Sands. Higher USA figure includes 86 BN barrels and 4 BN barrels in the Outer Continental Shelf and Arctic National Wildlife Refuge, respectively according to EIA. Only top producing nations shown.
(2) Difference between 2007 and 2008 American Energy Outlooks largely attributable to the passage of the Energy Independence and Security Act of 2007 signed by President Bush in December 2007.
(3) Source: American Energy Outlook 2008, Energy Information Agency.
(4) Source: US Department of Labor, Bureau of Economic Analysis, International Transactions Accounts. Note: 2008 annualized from Q1 data.

The DOE is divided up into three units concentrating on energy R&D, basic science research and nuclear security



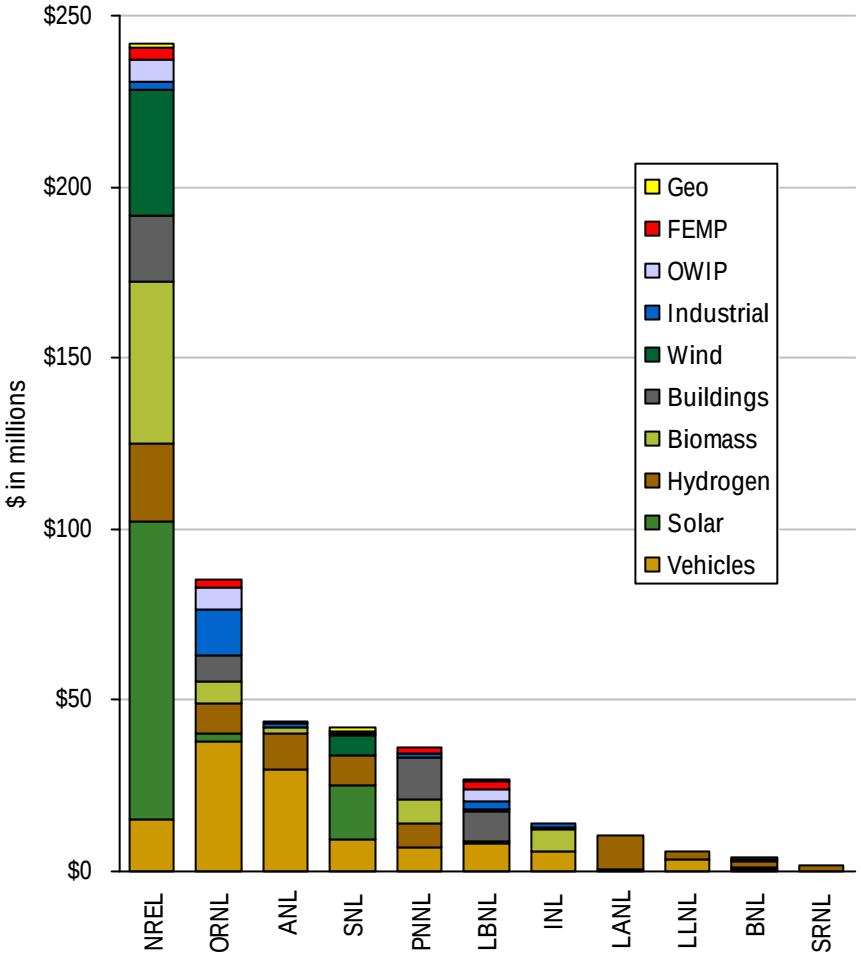
The U.S. Department of Energy focuses on energy R&D, basic science research and nuclear security

EERE develops a broad range of clean energy technologies as shown in the FY08 budget

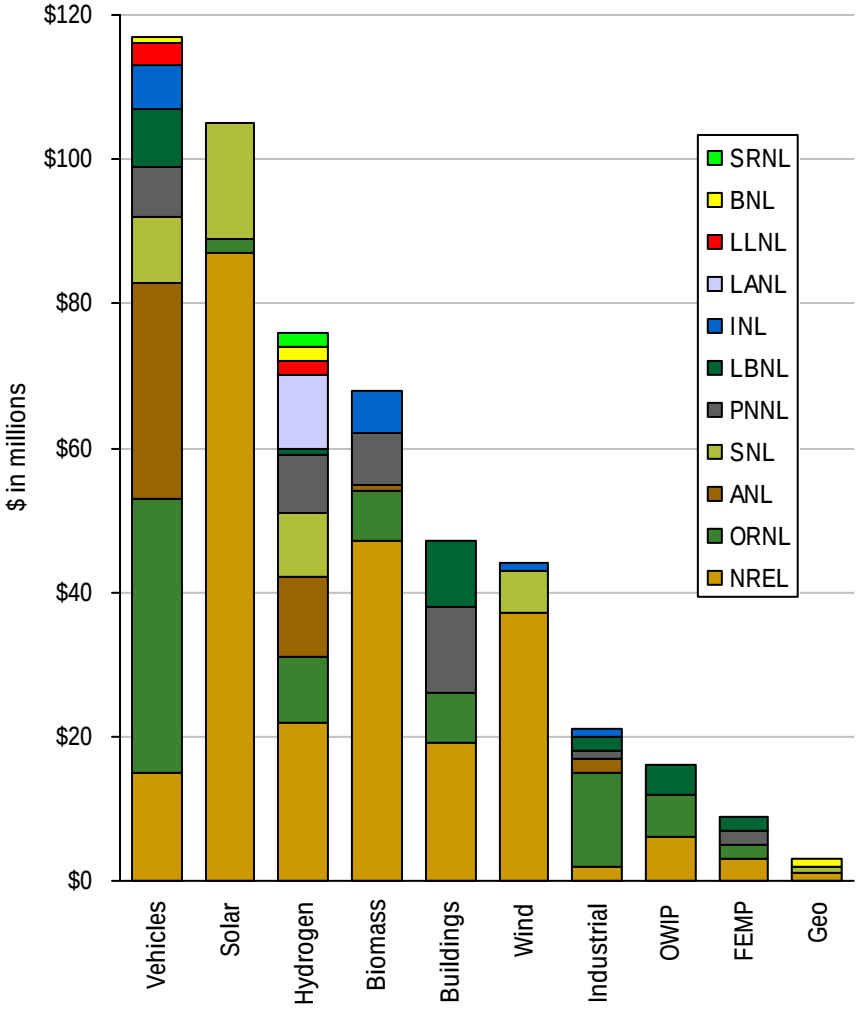


EERE spreads the federal R&D funding across multiple laboratories but works predominately with NREL

EERE FY07 National Laboratory Funding by Laboratory



EERE FY07 National Laboratory Funding by Program



Key: ANL, Argonne National Laboratory (IL); BNL, Brookhaven National Laboratory (NY); INL, Idaho National Laboratory (ID); LANL, Los Alamos National Laboratory, (NM); LBNL, Lawrence Berkeley National Laboratory (CA); LLNL, Lawrence Livermore National Laboratory (CA); NREL, National Energy Laboratory (CO); ORNL, Oak Ridge National Laboratory (TN); PNNL, Pacific Northwest National Laboratory (WA); SNL, Sandia National Laboratories (NM & CA); SRS, Savannah River National Laboratory (SC)

Accelerating commercialization is Assistant Secretary Karsner's primary policy objective

"I believe that success will be defined by enabling commercial frameworks and free enterprise to **accelerate the development and deployment of new energy technologies** to address these challenges head on… I will seek to expand the efforts to **more rapidly commercialize** and deploy the under-harvested yield of decades of public sector investment..."

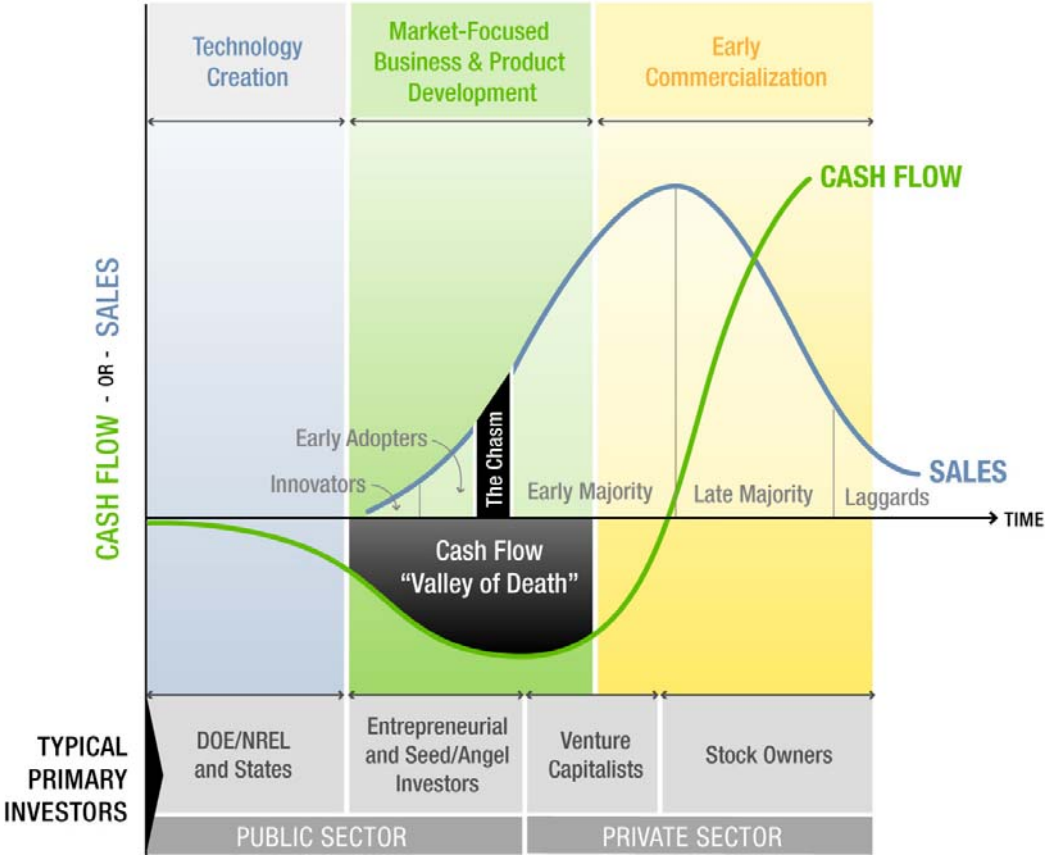
- Assistant Secretary Andy Karsner,
Senate Confirmation Testimony, March 6, 2006

Fall 2006 Question to DOE Program Managers:

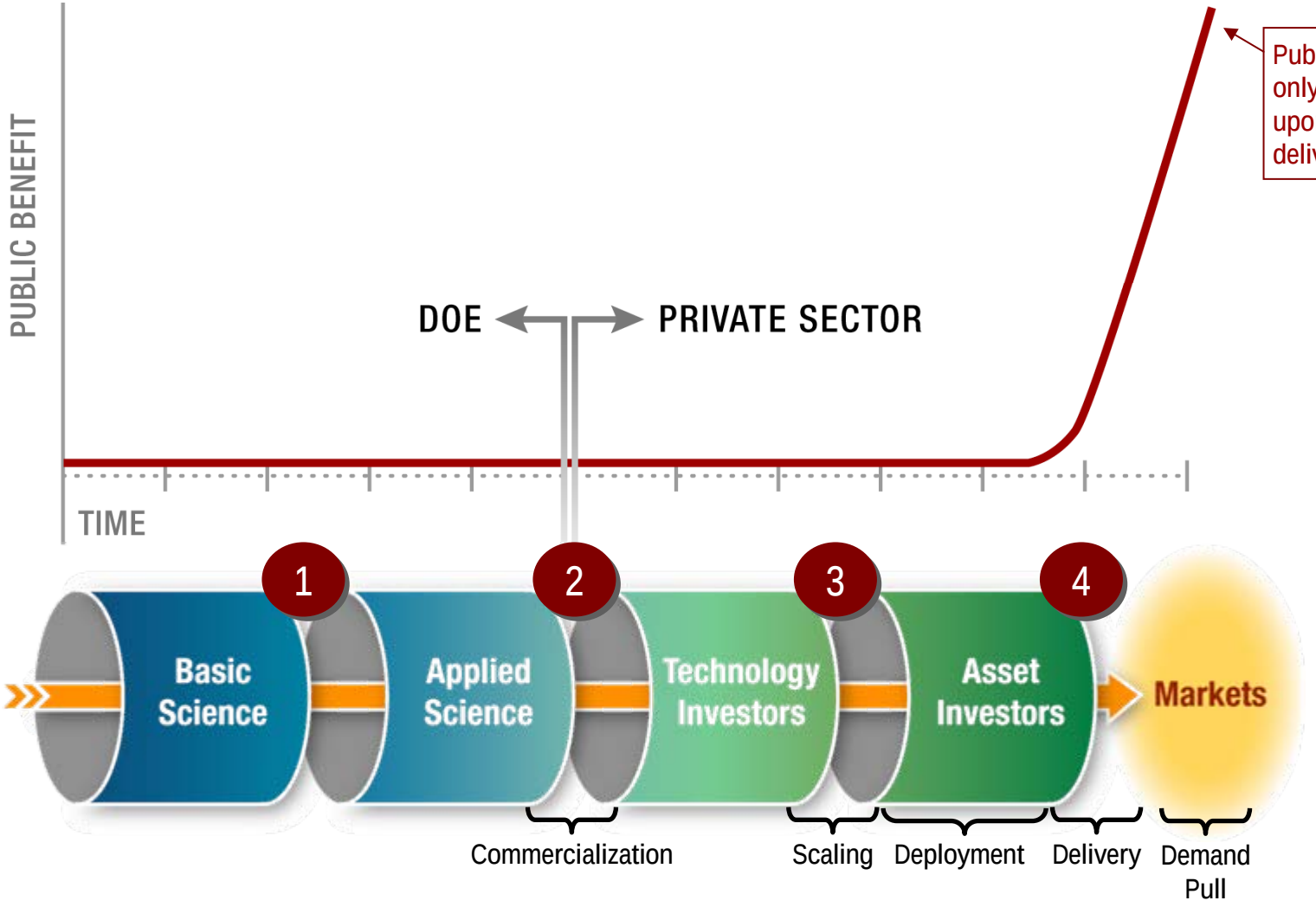
"How has your program impacted the life of the American taxpayer?"

Answer:

"[Good Answer]…but the 'Commercialization Valley of Death' has prevented us from being as effective as we'd like."



A technological innovation must overcome four challenging transitions before reaching the market.



EERE Commercialization Bridges are designed to overcome four primary gaps

Talent

- DOE traditionally hires scientists – not businessmen
- Commercializing technologies requires both technical & business skill sets

Information

- Communication is a fundamental prerequisite of commercialization
- Technical language fails to resonate with the business community

Capital

- Competition is stiff for venture capital funding
- VCs more likely to fund business plans and prototypes than research papers

Strategy

- The Commercialization Valley of Death is not unique to national laboratories
- Best practices have been developed to foster a culture of innovation

Designed to introduce investors to technology opportunities, the Technology Commercialization Showcase forms the primary plank of the **INFORMATION BRIDGE**

Need

- Many EERE funded technologies stall in the “commercialization valley of death” simply because the innovation has not been clearly communicated to the business community

Structure

- Challenged EERE Program Managers to identify 8-10 most promising technologies in their portfolio
- Created simple, layman’s descriptions of the innovation opportunity
- Invited prominent investors to a two day conference showcasing technologies

Investors Represented

NGP ENERGY TECHNOLOGY PARTNERS

khosla ventures
venture assistance, strategic advice, venture capital

PINNACLE VENTURES

KPCB

Nth POWER
Energy | Vision | Capital

MASSACHUSETTS GREEN ENERGY FUND

ROCKPORT CAPITAL PARTNERS

MATRIX PARTNERS

Good Energies

@Ventures

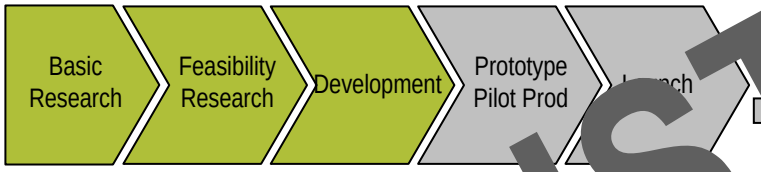
MDV
MOHR DAVIDOW VENTURES

BATTELLE | VENTURES

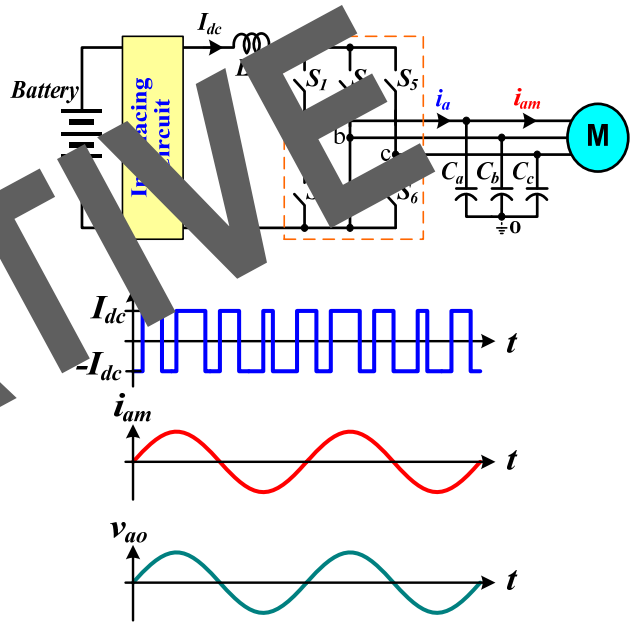
FLAGSHIP VENTURES

Current Source Inverter for Hybrid Electric and Fuel Cell Vehicles

- **Description**
  - A new inverter topology based on a current source inverter to relieve cost, size, and technology barriers
- **Impact**
  - Increased reliability
  - Improved efficiency
  - Boosted output
- **Technology Readiness**



- **Estimated Time to Market**
  - 2-3 years
- **Estimated Commercialization Cost**
  - $1M (to complete/build and test a prototype), no industry partner involved at present (assume additional costs for packaging and automotive qualification in order to commercialize and deploy)



Topology of the proposed current source inverter yields sinusoidal output voltage and current waveforms.

Customer	Partner	Successful Demonstration
Automotive supplier of electronic devices*	Laboratory	Laboratory

*Potential

Current Source Inverter for Hybrid Electric and Fuel Cell Vehicles

- PROBLEM: Electric and hybrid electric vehicle inverters operate from a DC voltage source (batteries) which presents several drawbacks:
  - Requires a very high performance direct-current buss capacitor bank that is costly and bulky
  - Reliability is limited by the capacitors and possible shoot through of the phase leg switches
  - Steep rising and falling edges of the output voltage generates high electromagnetic interference -resulting in high stress on the motor insulation, high frequency losses in the copper windings and iron cores of the motor, and leakage currents that erode the bearings over time
  - Capacitor temperature limitations present a significant hurdle to operating in high-temperature environments

- DESCRIPTION OF INVENTION/TECHNOLOGY: A new inverter topology based on a current source inverter is under development at Oak Ridge National Laboratory to eliminate or significantly relieve these problems.
  - No buss capacitors and uses only three small filter capacitors
  - Fewer components, more fault tolerance and increased reliability
  - Enables higher motor speeds allowing inverter to output rated voltage over a wider discharge window

- IMPACT: Advantages translate into a significant reduction in inverter cost and volume, much higher constant power speed range, and improved motor efficiency and lifetime.

- IP POSITION: Patent filed, technology available for licensing.

- TECHNOLOGY STATUS: Completed simulation study and proved the concept. Developed an optimum PWM method and a strategy for maximum torque per amp control of IPM motors. A 55 kW prototype is undergoing fabrication and testing.