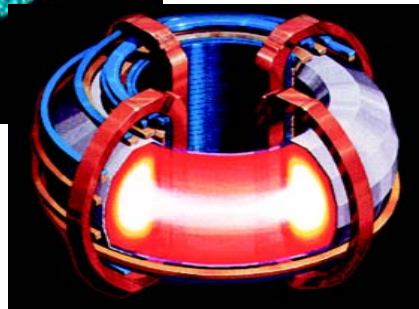
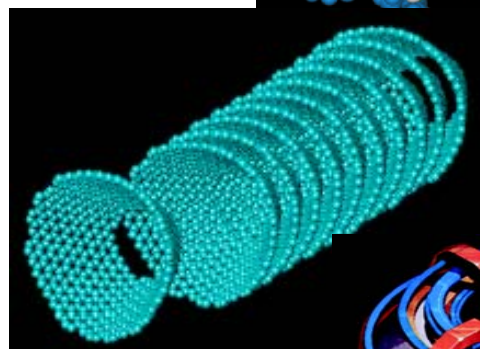
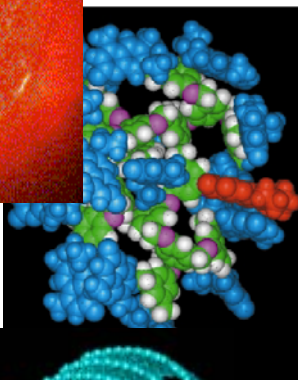
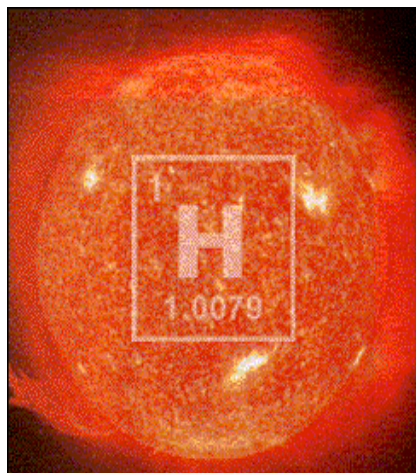




Climate Change Science and Technology

Raymond L. Orbach
Director
Office of Science
U.S. Department of Energy



October 5, 2004

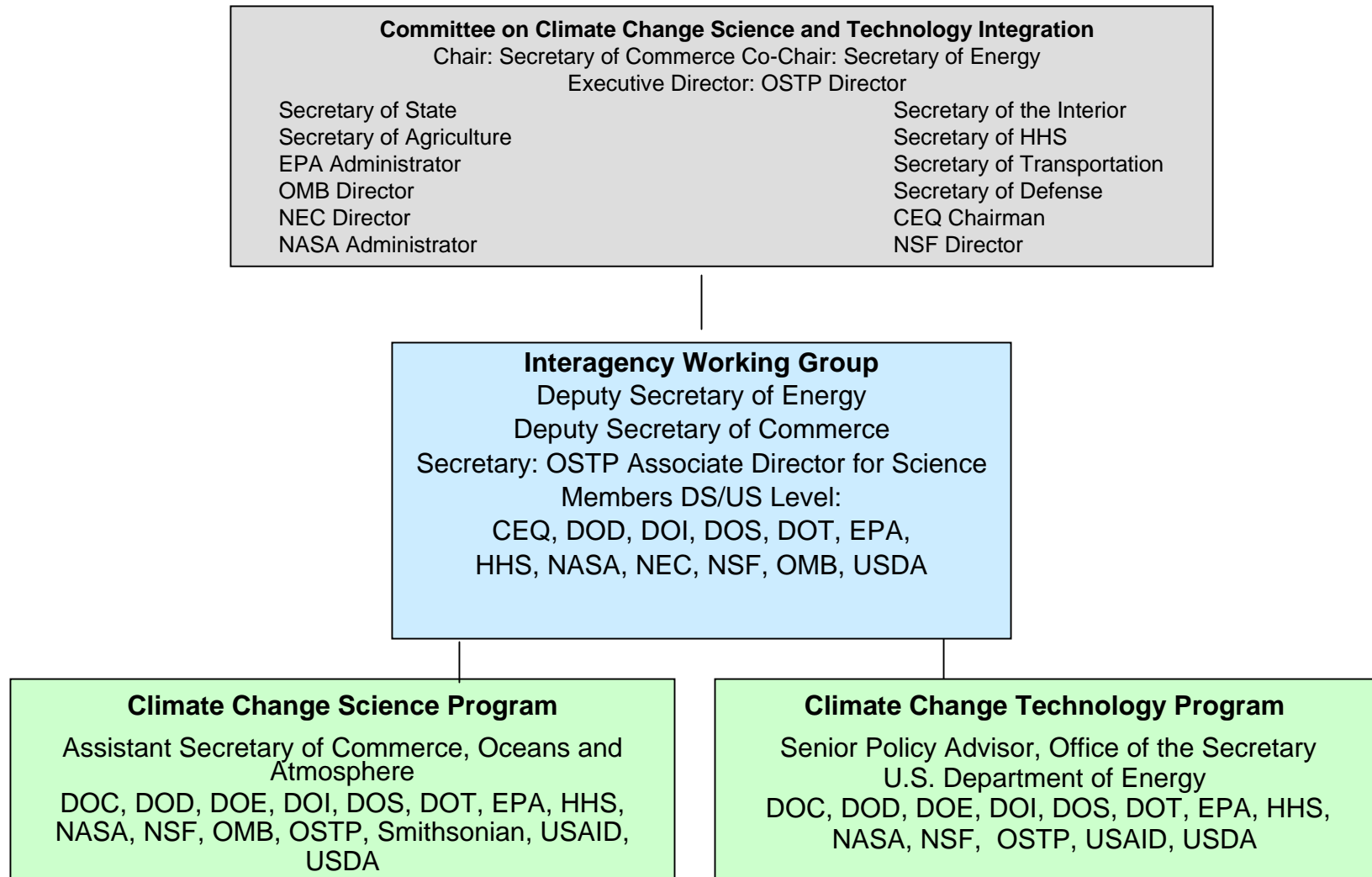
The U.S. Path Forward

“I reaffirm America’s commitment to the United Nations Framework Convention and its central goal, to stabilize atmospheric greenhouse gas concentrations at a level that will prevent dangerous human interference with the climate.”

“(We will) set America on a path to slow the growth of our greenhouse gas emissions and, as science justifies, to stop and then reverse the growth of emissions.”

- President George W. Bush
February 14, 2002

Climate Change Science and Technology - an Integrated Program



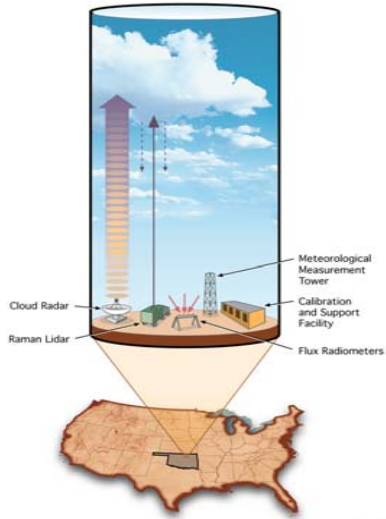
CCSP: Reducing Uncertainty

- Improve Knowledge of Climate and Environment
- Improve Quantification of Forces Driving Changes to Climate
- Reduce Uncertainty in Projections of Future Climate Changes
- Understand Sensitivity and Adaptability of Natural and Manmade Ecosystems

CCTP: Providing Technology Options

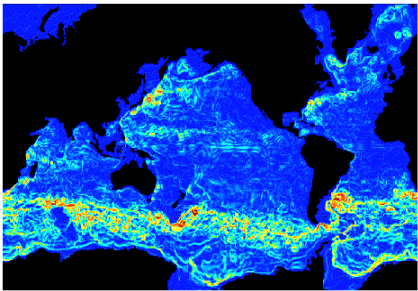
- Transportation
- Buildings
- Infrastructure (Grid)
- Industry
- Low-emissions fossil-based power and fuels
- Hydrogen
- Renewable energy and fuels
- Nuclear fission
- Nuclear fusion
- Geologic sequestration
- Terrestrial sequestration
- Ocean sequestration
- Methane emissions
- Other High GWP Gases
- Tropospheric Ozone Precursors and Black Carbon
- Measurement and Monitoring

Office of Science CCSP Research



Atmospheric Radiation
Measurement Program
(ARM)

- **Climate modeling** - Improves regional & global scale simulations and predictions of climate. In FY 2004, further develop and apply comprehensive, coupled general circulation models for ensemble climate predictions with higher resolution and containing accurate and verified representation of important climate processes.
- **Atmospheric Radiation Measurement** - Improve understanding of radiative transfer processes in the atmosphere and to formulate better numerical submodels of these processes in climate prediction models..
- **Carbon and ecosystem research** - Quantify and identify the location of the North American carbon sink and understand the effects of climate and atmospheric changes on terrestrial ecosystems.
- **Integrated assessment** - Develop models and methods to evaluate environmental and economic costs and benefits of technology options to reduce emissions of carbon dioxide to the atmosphere.



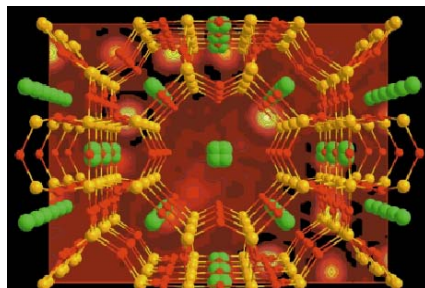
Climate Modeling

Office of Science – Building Foundations for New Technologies

Producing Clean Fuels

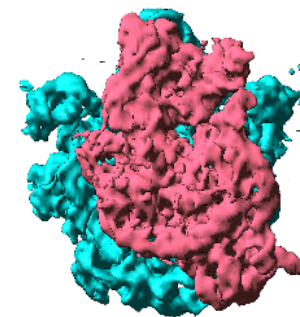
Catalysis for Efficient Pathways

Molecular understanding of catalysts for petroleum refining and chemical manufacturing.... catalysis of carbon-hydrogen bonds....catalysis for fuel cells...biocatalysis



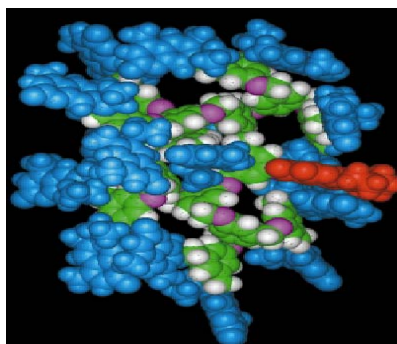
Bio-fuels Through Microbial Conversion

Organisms and processes for conversion of lignocellulosics into fuels...biochemistry... bioenergetics microbial fermentation.....



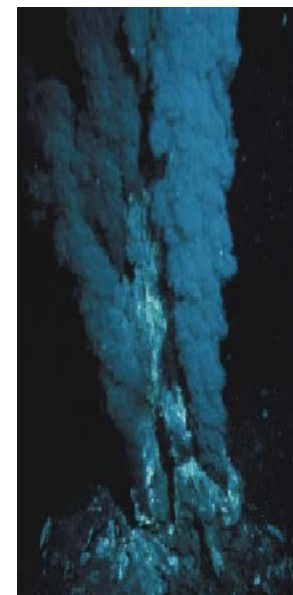
New Approaches for Capturing Solar Energy

Photochemical processes for solar energy conversion.....
....photocatalysis foundations for future efficient light energy to chemical energy conversions...



Hydrogen/Clean Fuel Systems through Exotic Microbial Processes

Genetic components that regulate methane and hydrogen producing organisms....enzymatic processes for possible fuel conversion....possible exploitation of extremophiles to ingest feedstocks, sequester carbon, and give off hydrogen...



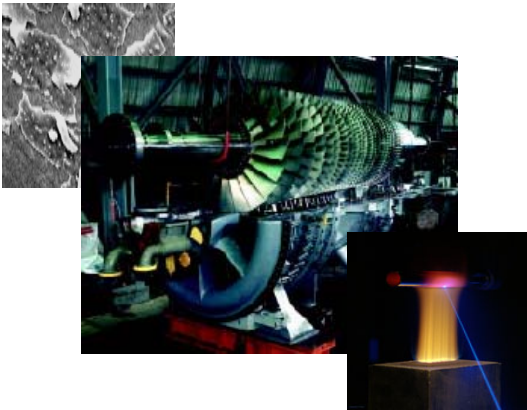
Improved Fuel Feedstocks Through Plant Biology

Genetic, metabolic, and enzymatic properties of plants supporting biomass fuels.....
regulation of photosynthetic processes...biochemistry
... bioenergetics...

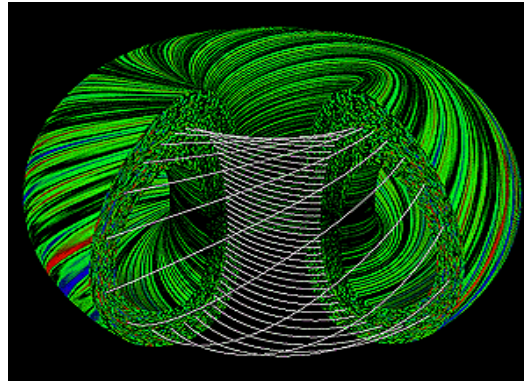
...And More...

Cleaner, Efficient, Large Fossil Power Systems

Combustion science.. intermetallics and other materials for efficient turbines.... corrosion science....new classes of magnets...fluid dynamics for lubrication and hydraulic systems... ..



Advanced Power Systems

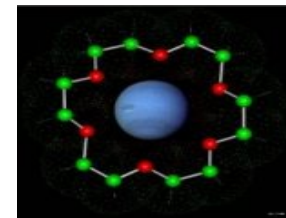
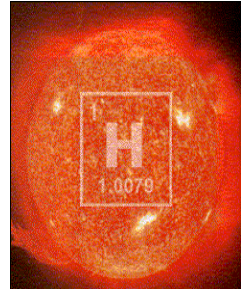


Exploring Fusion as a Power Source for the Future

Fusion energy sciences, including plasma science and plasma confinement research as foundations for long-term exploration of fusion as a commercially viable power source...

Enabling Hydrogen Power Systems

Basic materials research leading to new fuel cell membranes, e.g. PEMs....new hydrogen storage media based on nano-science....



Safer, Improved Nuclear Energy

Heavy element chemistry... radiation effects on materials...high temperature materials...welding and joining science to reduce failure rates...basic geophysical and hydrological research supporting nuclear waste storage...science behind aqueous, galvanic, and high temperature gaseous corrosion prevention

Expanding Options for Renewable Power

Materials science behind photovoltaic materials... fluid-flow modeling and materials science supporting wind power.... geosciences supporting geothermal....electrochemistry supporting efficient batteries for integrated renewable designs...

