



Climate Change Technologies and Programs



Presentation to CARB's AB32 Economic and Technology
Advancement Advisory Committee

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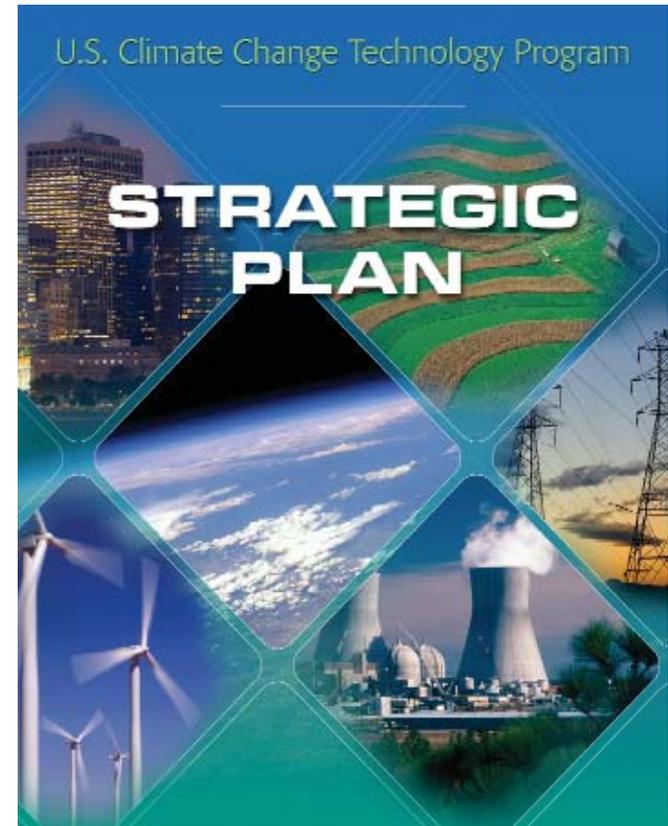
Overview

- 1) U.S. Climate Change Technology Program
- 2) Near-term Technologies and Programs
- 3) Long-term Technologies and Programs



U.S. Climate Change Technology Program (CCTP)

- Annual US investment of more than \$5 billion in climate change research, technology, and tax incentives
- U.S. Climate Change Technology Program led by DOE– 6 Working Groups:
 - 1) Reduce emissions from energy use
 - 2) Reduce emissions from energy supply
 - 3) Capture/sequester CO₂
 - 4) Reduce emissions of non-CO₂ GHGs
 - 5) Improve capabilities to measure and monitor GHG emissions
 - 6) Bolster contributions of basic science to technology development





Near-Term Climate Technologies



Strategic Role of EPA Programs

- Contributing approximately 70% of avoided emissions needed to achieve President Bush's goal of 18% reduction in GHG intensity between 2002-2012
- Challenging businesses to reduce their emissions through voluntary partnerships
- Providing near-term solutions while others invest in longer-term R&D programs such as hydrogen and fuel cells

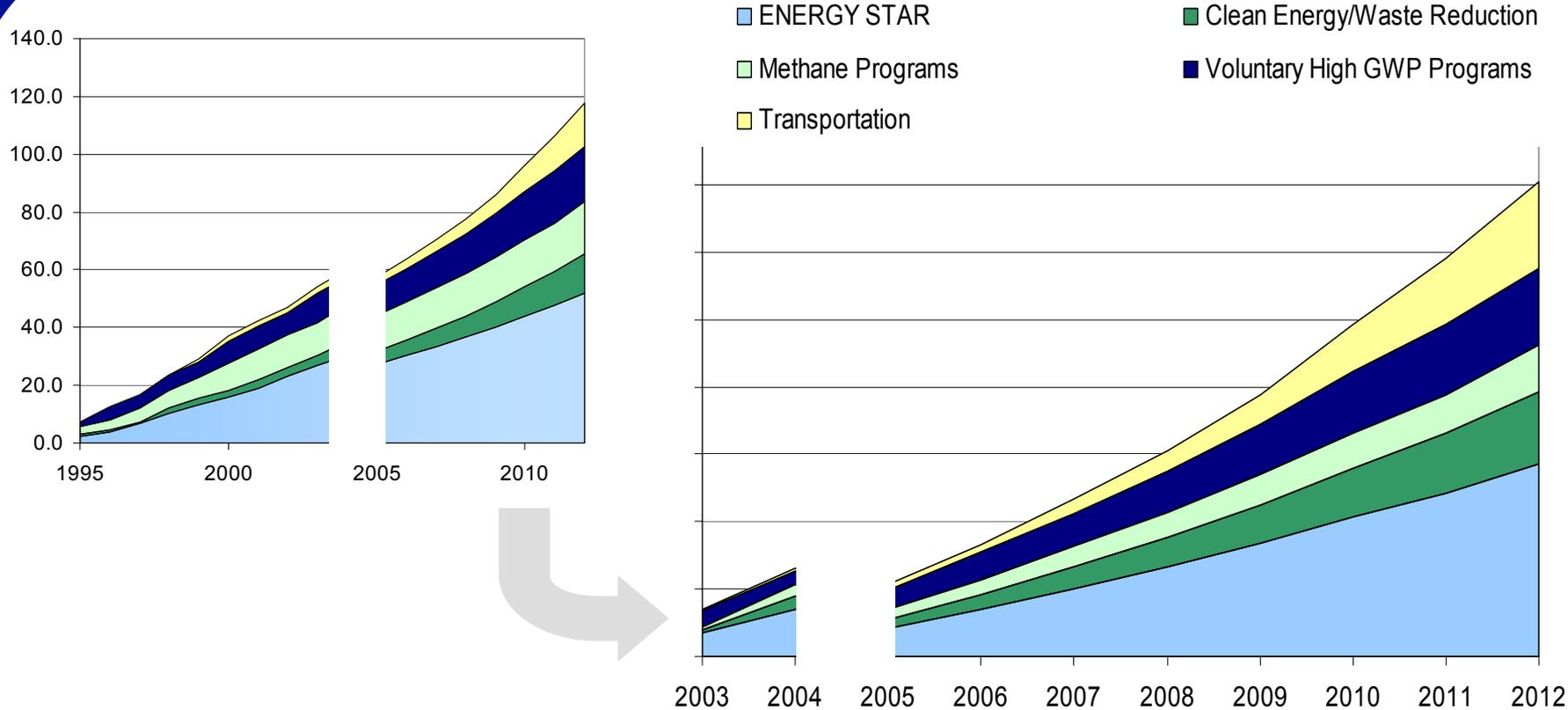


Climate Technology-Related EPA Programs

- **Energy Efficiency**
 - ENERGY STAR
 - Qualified Projects
 - Commercial and Industrial
 - Residential Homes
 - National Action Plan on Energy Efficiency (NAPEE)
- **Clean Energy Development**
 - Green Power Partnership
 - Combined Heat and Power Partnership
- **Cross-Sectoral Initiatives**
 - Climate Leaders
 - State Energy-Environment Partnerships
- **Non-CO₂ Gases**
 - Methane
 - High-Global Warming Potential
- **International**
 - Methane to Markets
 - Asia-Pacific Partnership
- **Transportation**
 - Renewable Fuels
 - Fuel Efficiency
 - Hydraulic Hybrid
- **Water Quality**
 - Underground Injection Control
- **OSW**
 - WasteWise Partnerships



EPA Climate Programs Accomplishments and Goals



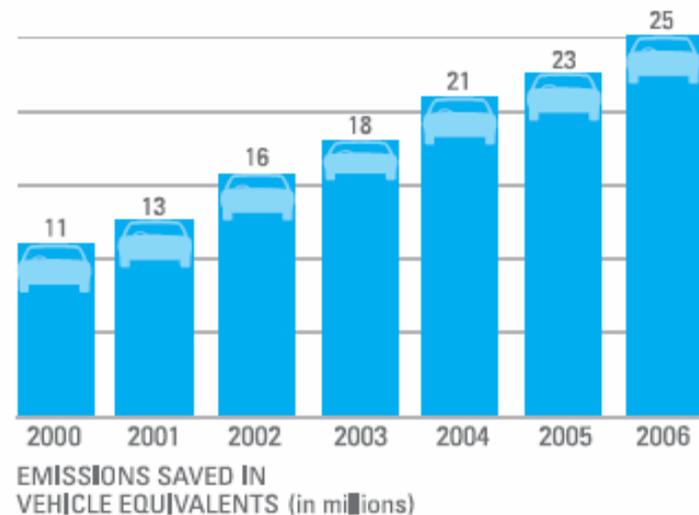
In 2005 alone, EPA climate partnerships prevented 63 million metric tons of carbon-equivalent (MMTCE) GHG emissions, contributing to over 86 MMTCE in total EPA-led reductions that year.



ENERGY STAR



- Americans saved \$14 billion on energy bills while preventing the equivalent annual emissions of 25 million vehicles in 2006
- Saved almost 5% of US electricity demand in 2006
- Delivered one-third of the total GHG emissions reductions from EPA’s climate change programs
- Three main component programs: residential buildings, commercial and industrial programs, and qualified products





EPA Clean Energy Programs

- **Green Power Partnership**
 - Facilitates purchasing of environmentally friendly electricity products generated from renewable energy sources by addressing the market barriers
 - Has commitments by more than 600 partners that will result in the purchase of 4 billion kilowatt-hours of renewable electricity each year
- **Combined Heat and Power (CHP) Partnership**
 - Provides technical assistance to meet CHP project needs and make investments in CHP more attractive
 - Assisted in the development of more than 3,500 MW of new capacity since 2001





Non-CO₂ Gases Are Important

Non-CO₂ gases roughly 20% of U.S. (CO₂-equiv.) emissions:

Greenhouse Gas	Global Warming Potential for 100 years	Atmospheric Lifetime (years)
Carbon Dioxide	1	50-200
Methane	21	12 +/- 3
Nitrous Oxide	310	120
Hydrofluorocarbons (HFCs)	140-11,700	1.5-264
Perfluorocarbons (PFCs)	6,500-9,200	3,200-50,000
Sulfur Hexafluoride	23,900	3,200

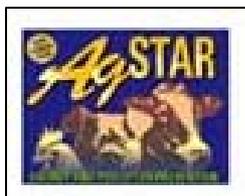
EPA's industrial partners have set significant goals:

- World Semiconductor Council - PFCs 10% below 1995 by 2010
- International Aluminium Institute - PFCs 80% below 1990 by 2010
- International Magnesium Association - Phase-out SF₆ by 2010
- Methane partnerships (Oil and Gas, Coal, Agriculture, and Landfills)
- Mobile Air Conditioning Partnership: Improve energy efficiency of mobile AC units by 30% and reduce refrigerant emissions by 50%.

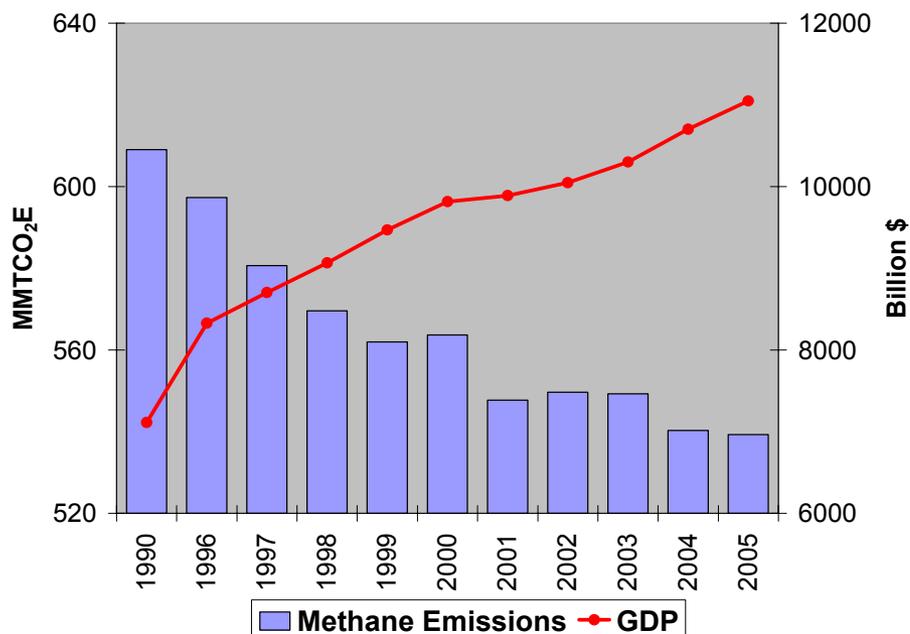


U.S. Methane Success

By deploying cost-effective technologies and best practices for methane management, partnerships in four sectors have contributed to an ~11% reduction in U.S. methane emissions since 1990.



Changes in U.S. Methane Emissions and Economic Growth 1990 - 2005





Near-Term Vehicle Technologies

Report: New Powertrain Technologies and Costs

- Evaluated the fuel economy improvement and costs (from a consumer perspective) of new, fuel efficient vehicle technologies.
- Four technology types evaluated:
 - Packaged gasoline technologies
 - Advanced diesel engines
 - Gasoline-electric hybrids
 - Diesel-electric hybrids
- Technologies can improve fuel economy by 20-70%, and all technology packages pay back to consumers w/in 14 years
 - www.epa.gov/otaq/technology

Hydraulic Hybrids

- Technology (invented and patented at NVFEL) reduces GHGs by 40% and provides 60-70% fuel economy improvement
- Being field tested today in the UPS fleet



Promoting Near-Term Vehicle and Fuel Options

SmartWay Transport Partnership

- Collaboration between EPA and the freight industry to increase energy efficiency and reduce greenhouse gases and air pollution.
- Helps promote advanced vehicle technologies such as:
 - Advanced Powertrain technologies
 - Automatic tire inflation systems
 - Aerodynamics
 - Auxiliary Power Units (APUs)
 - Truck stop electrification
- Component of West Coast Diesel Collaborative

SmartWay Grow & Go

- Add a renewable fuel component to SmartWay
- Promotes the environmental benefits of renewable fuels
- Encourages SmartWay companies to use (and sell) these fuels (including E85 and biodiesel blends)



Long-Term Climate Technologies



Coal Gasification and IGCC

■ Gasification:

- Conversion of carbon-based feed stocks, such as coal, into a synthetic gas (syngas) through partial oxidation
- Syngas mainly contains carbon monoxide and hydrogen; steam injected to increase hydrogen content

■ Integrated Gasified Combined Cycle (IGCC) Plants

- Preliminary IGCC vs. PC (pulverized coal) study results show IGCC has significantly better thermal performance and better environmental performance overall
- IGCC also has the advantage of capturing CO₂ at lower costs

Polk IGCC Plant, Florida



Wabash IGCC Plant, Indiana





FutureGen Overview

What is FutureGen?

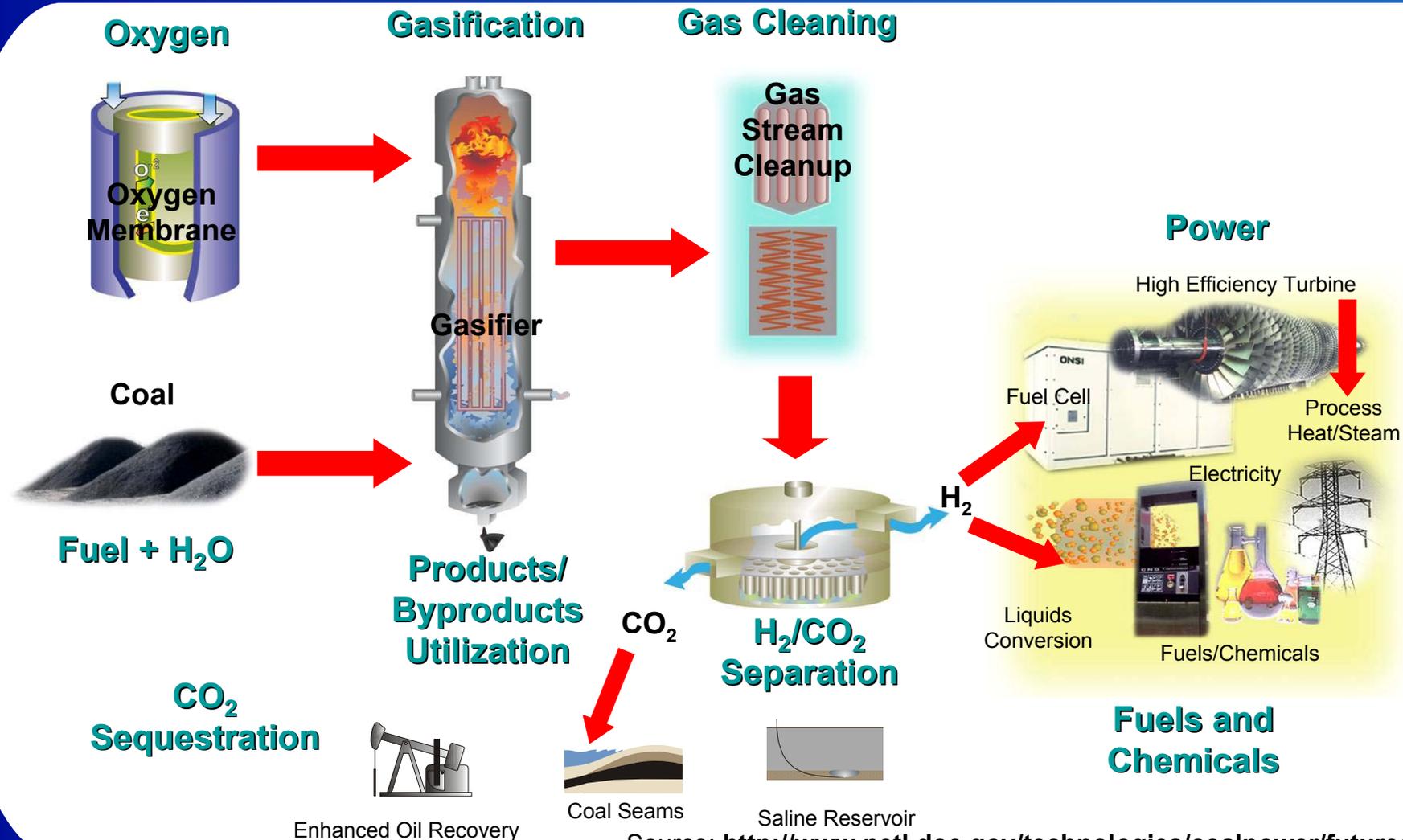
- An initiative to build and operate the world's first coal gasification plant integrated with systems generating electricity, producing hydrogen, and capturing and sequestering carbon dioxide.
- FutureGen was announced by the President in 2003 along with the Carbon Sequestration Leadership Forum. DOE entered into a cooperative agreement with industry to launch the initiative in December 2005. See:
<http://www.netl.doe.gov/technologies/coalpower/futuregen/>

EPA's Role:

- OAR/OW Geologic Sequestration Workgroup actively involved in supporting sequestration initiatives
- OAR/OW/Regions permitting activities, other activities to encourage IGCC



FutureGen – More than an IGCC Plant

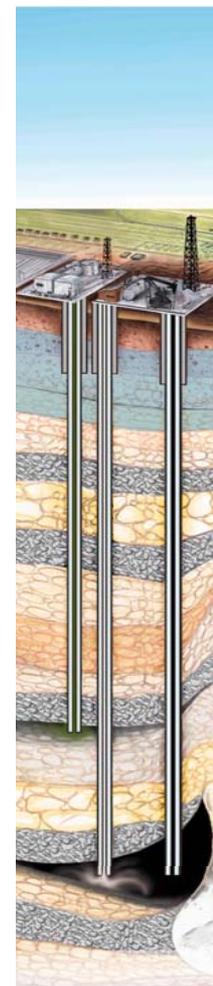
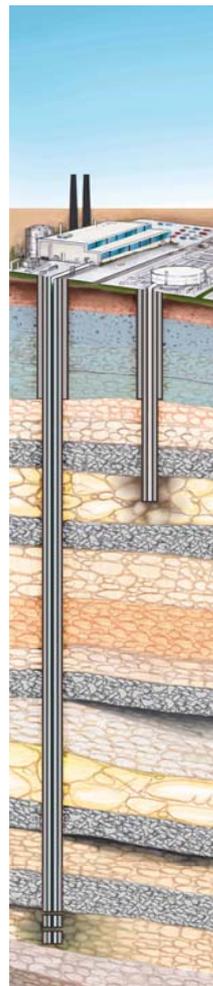


Source: <http://www.netl.doe.gov/technologies/coalpower/futuregen>



Geologic Carbon Sequestration

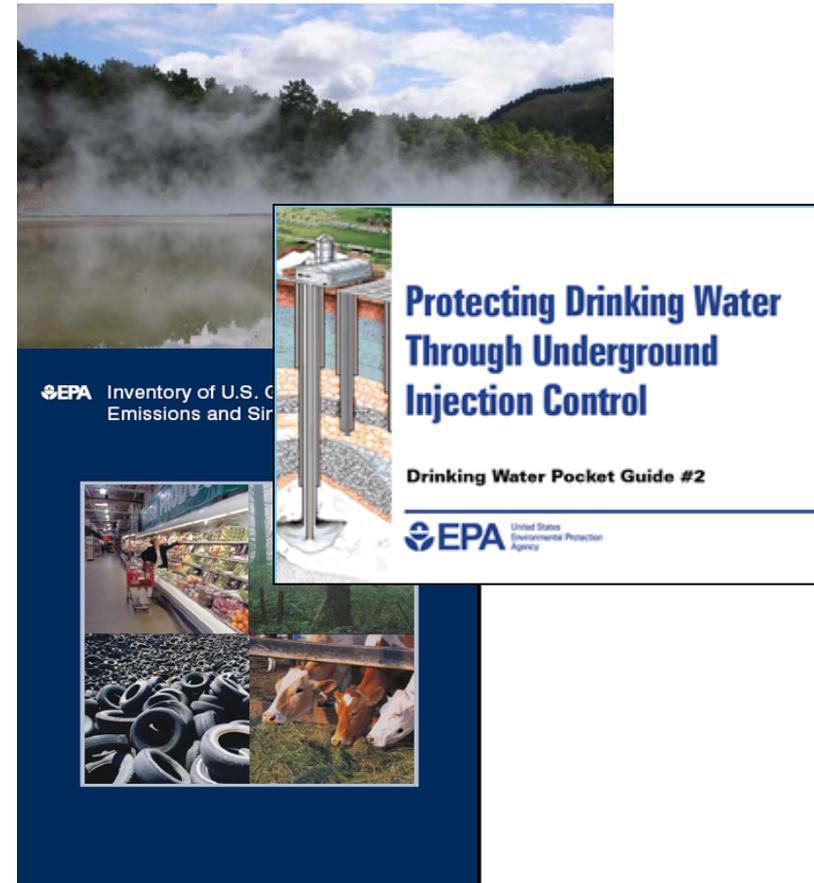
- Carbon dioxide capture and storage (CCS) is an important longer-term climate mitigation technology
 - US has large underground storage reservoirs
 - Successful deployment of technology would enable large GHG reductions with continued use of fossil fuels (especially coal)
- DOE leads U.S. R&D efforts to advance CCS technologies including FutureGen and Regional Sequestration Partnerships
- EPA is working with DOE, with a focus on risk assessment and to ensure R&D supports regulatory development
 - Co-led by Office of Water (Underground Injection Control Program) and Office of Air (Climate Change Division)





CCS and EPA Efforts

- Evaluating risks to human health and the environment
- Developing regulatory guidance for pilot projects and a management framework for permitting large-scale projects under the Safe Drinking Water Act
- Designing inventory and accounting methodologies for CCS



http://www.epa.gov/safewater/uic/wells_sequestration.html (for Guidance)
http://www.epa.gov/climatechange/emissions/co2_geosequest.html



U.S. Regulatory Framework for CCS

- Safe Drinking Water Act (SDWA) provides the framework for carbon storage
 - Underground Injection Control (UIC) Program regulates injection of ALL fluids
- Two Stage Approach:
 - Stage 1: Provide guidance to states and regions to enable timely and effective permitting of pilot R&D wells
 - Stage 2: Develop regulations suitable for large-scale commercialization



Long-Term Vehicle Technologies

Plug-in Hybrid Analysis

- Analyzed the feasibility and possible benefits of plug-in hybrid commercialization.
- The amount of greenhouse gas emissions reduced depends upon the source of the electricity used to charge the vehicle when it is plugged in.
 - For example, plug-in hybrids charged with electricity from coal would be responsible for more GHG emissions than those charged with electricity from a renewable source.
 - Current studies have found that even plug-in hybrids using current electricity generation sources are responsible for fewer GHG emissions than conventional gasoline vehicles.



Long-Term Advances in Fuels

Advanced Renewable Fuels

- EPA will be soliciting proposals for a \$1.5 million grant to investigate a wider range of feedstock sources for production of renewable fuels, e.g. algal oil for biodiesel and citrus peels and other fruit wastes for ethanol.
 - The study will assess the potential of alternative feedstock sources based on their availability to produce fuel, feedstock production efficiency, cost, and resource use (e.g. water, fertilizer, and fossil fuel, etc).
 - In addition, the grant recipients will evaluate the potential of innovative fuel processing technologies specific to these alternative feedstocks and make a comparison of process technologies by fuel production efficiency and cost.



Long-Term Advances in Fuels

Lifecycle analysis

- We are also continuing to develop models to analyze the lifecycle GHG impacts of a wide range of advanced fuels
 - Cellulosic ethanol
 - Biobutanol
 - Coal-to-liquids, etc
- Coordinating across federal government, as well as State of California and others



Overview of EPA Climate Programs

- **Office of Atmospheric Programs (OAP)**
 - Climate Change Division: Dina Kruger
 - Climate Protection Partnerships Division: Kathleen Hogan
- **Office of Transportation & Air Quality (OTAQ)**
 - Transportation & Climate Division: Sarah Dunham
- **Office of Air Quality Planning & Standards (OAQPS)**
 - Health & Environmental Impacts Division: Lydia Wegman
- **Office of Research and Development (ORD)**
 - Global Change Research Program: Joel Scheraga
- **Office of Water (OW)**
 - Cross-office participation
- **Region IX**
 - Senior Energy Advisor: Ben Machol



For More Information

The screenshot shows the U.S. EPA Climate Change web page in Microsoft Internet Explorer. The browser's address bar displays <http://www.epa.gov/climatechange/>. The page features the EPA logo, a search bar, and navigation links such as "Climate Change Home", "GHG Emissions Inventory", "ENERGY STAR", and "Clean Energy". A central text box highlights the website's URL: <http://www.epa.gov/climatechange>. The page content includes sections for "Where You Live", "Newsroom", "Related Links Directory", "About the Site", "Glossary", "Climate Change For Kids!", "Recent Climate Change", "Future Climate Change", "State of Knowledge", "Greenhouse Gas Emissions", "Health and Environmental Effects", "Climate Change Technology Program", "Climate Change Science Program", "International Cooperation", "What You Can Do", and "News".