Global Climate Change —How We Fit

U.S. Department of Energy • Office of Fossil Energy • National Energy Technology Laboratory

When President Bush announced his Global Climate Change Initiative in February 2002, he committed the United States to a new strategy to cut greenhouse gas emissions over the next decade. The initiative calls for an 18 percent reduction in U.S. greenhouse gas intensity—the ratio of greenhouse gas emissions to economic output—by 2012. Focusing on greenhouse gas intensity in the short term enables the sustained economic growth needed to develop new, clean energy technologies for the longer term. The initiative calls for a progress review in 2012, at which time decisions will be made about taking additional measures to mitigate greenhouse gas emissions.

"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."

—President George W. Bush
February 14, 2002

TECo Energy's 250-MW Polk Power Station near Mulberry, Fla., uses an integrated gasification combined-cycle system that reduces emissions of greenhouse gases by increasing efficiency. Developed in partnership with NETL, this power station has received numerous awards, including the 1991 Florida Audubon Society Corporate Award, the 1993 Ecological Society of America Corporate Award, and *Power* magazine's 1997 Powerplant of the Year award. In 2000, the power station was inducted into *Power* magazine's Powerplant Hall of Fame.

The Need for a Federal Research and Development Program

With few legal or market-driven incentives to reduce greenhouse gases, private-sector investment in carbon reduction technologies is limited to those areas that can be justified by other factors, such as efficiency improvements that result in fuel savings. Climate change controls are a classic example of a public good which could have substantial value, but is not accountable within traditional business economics.

Federal investment in climate change mitigation technologies has one overriding benefit: a broad suite of mitigation technologies can expand the menu of future policy choices, both domestically and internationally. Without federal research and development, the choice of future greenhouse-gas-reducing technologies may be limited to those that are either prohibitively expensive or require massive overhauls of the energy infrastructures of this nation and others.

Energy Efficiency—Climate Change Benefits Begin at the Power Plant

Public and private investment has brought about significant improvements in the efficiency of appliances, automobiles, and factories. But efficiency improvements can be just as beneficial at the point where energy is generated, at the power plant. Boosting power plant efficiencies in this country by only 2 percentage points, from 33 to 35 percent, would be the same as—

- Weatherizing 82 million homes.
- Replacing 300 million 100-watt incandescent light bulbs with fluorescent bulbs.
- Installing more than 7 million commercial heat pumps.

The greenhouse gas result is the same; a decrease in fuel consumption leads to a corresponding decrease in greenhouse gas emissions.

The private sector, alone, might be expected to make these small, 1- or 2-percentage point, incremental improvements in power-generating efficiencies. A successful federal research and development program, however, can help push the technology well beyond that—toward efficiency improvements of 10 to 15 percentage points for natural-gas-fueled technologies, and as much as 20 to 30 percentage points for coal-based power technologies.

Boosting front-end fuel efficiencies at power plants could offer one of the most affordable and least disruptive ways to reduce greenhouse gas intensity. Many emerging, high-efficiency technologies also offer other advantages. For example, gasification-based power systems can be configured to transform coal into a pure stream of hydrogen and a concentrated stream of CO_2. Since concentrated CO_2 is much easier and cheaper to capture, these systems are a steppingstone toward carbon sequestration.

Carbon Sequestration—The Ultimate Answer?

The President's Climate Change policies endorse the longer-term goal of stabilizing atmospheric greenhouse gas concentrations, but efficiency improvements alone—either at the power plant or at the point of energy consumption—will not be sufficient to meet this goal. Nor will the development of alternatives to fossil fuels, such as wind and solar power. Even with aggressive deployment of renewable and other non-carbon resources, stabilizing greenhouse gas levels will require carbon sequestration.

The President has singled out carbon sequestration research as a high-priority element of his climate-change strategy. Many options for CO_2 storage have the potential to provide value-added benefits. For example, tree planting, no-till farming, and other terrestrial sequestration options can prevent soil erosion and pollutant runoff into streams and rivers. Injecting CO_2 into oil reservoirs and unmineable coal seams can enhance the recovery of crude oil and natural gas while leaving a portion of the greenhouse gas sequestered. These value-added benefits have propelled near-term action, and they create opportunities for integrated CO_2 capture and storage systems.

Meeting the President's Goals

The National Energy Technology Laboratory (NETL) is implementing a broad research and technology development that expands the options for—

- Meeting the President's near-term goals for greenhouse gas intensity.
- Ensuring the readiness of future technologies for the 2012 reassessment required by the Global Climate Change Initiative.
- Making the longer-term goal of atmospheric stabilization of greenhouse gases more achievable.

NETL's research portfolio includes options for reducing greenhouse gas emissions through efficiency improvements, as well as an extensive carbon sequestration program.

Direct carbon sequestration involves capturing CO_2 from large point sources such as power plants, and injecting it into unmineable coal seams, depleted oil and gas reservoirs, or deep saline formations for long-term storage. Indirect sequestration involves removing CO_2 from the atmosphere by enhancing natural CO_2 sinks. Approaches include forestation, enhanced photosynthesis in algae farms, and no-till farming.

"Technology offers great promise to significantly reduce emissions—especially carbon capture, storage, and sequestration technologies."

—President George W. Bush
June 11, 2001

National Energy Technology Laboratory

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

One West Third Street, Suite 1400
Tulsa, OK 74103-3519

P.O. Box 750172
Fairbanks, AK 99775-0172

Contact:
David J. Anna
412-386-4646

Visit our website at:
www.netl.doe.gov

Customer Service:
1-800-553-7681

U.S. Department of Energy
Office of Fossil Energy

April 2004

How NETL Fits—Sample Projects

- The Intergovernmental Panel on Climate Change estimates that up to 15 percent of fossil fuel CO_2 emissions between 1995 and 2050 could be offset by slowing tropical deforestation, allowing these forests to regrow, and engaging in plantation plantings and other forms of agroforestry. There is great potential for such carbon sequestration projects, but without cost-effective means to accurately assess the amount of carbon sequestered, these approaches may not be recognized as credible ways to reduce greenhouse gases.

  NETL is working with **The Nature Conservancy** to refine the tools and technologies for monitoring long-term carbon storage, and to assess land-use practices that avoid CO_2 emissions. The project uses newly developed aerial and satellite-based technology to study forestry projects in Brazil and Belize to determine their carbon sequestration potential. The project also includes testing of new software models to predict how soil and vegetation store carbon at sites in the United States and abroad.

- To develop confidence that carbon sequestration in depleted oil and gas reservoirs is safe and environmentally acceptable, sound scientific information is needed showing that CO_2 will be stored for geologic time scales. This information will come from monitoring CO_2 storage projects such as the **Weyburn Project**, an international, collaborative effort studying the fate of CO_2 used for enhanced oil recovery at EnCana's Weyburn oilfield in southern Saskatchewan.

  CO_2-enhanced oil recovery is a commercially proven technology that has been used extensively in the United States to increase oil production at diminished wells. In CO_2-enhanced oil recovery, compressed CO_2 is injected into an oil reservoir near the production well site, forcing the oil toward the production well and increasing yield.

  The Weyburn Project uses CO_2 piped through a 200-mile pipeline from Dakota Gasification's Great Plains Synfuels plant in Beulah, N.D. Over the project's 20-year lifetime, some 20 million tonnes of CO_2 will be stored in the Weyburn oilfield—an amount equivalent to the annual emissions generated by the state of Maine. NETL is providing funding to develop and use new reservoir-mapping and predictive tools to better understand CO_2 behavior in a geologic formation.

Additional information on these and other projects addressing the Global Climate Change Initiative can be viewed at ***www.netl.doe.gov***