

**CO₂ Capture and Separation in the Quest for Zero Emissions:
The Transformation of Global Energy Begins with FutureGen**

Keynote Remarks

by

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Thank you Carl Bauer, and good morning everyone.

I want to add my personal welcome to those you've received already.

I had planned to begin this morning by stressing my personal belief in the President's commitment to technology development and the purposes of the Carbon Sequestration Leadership Forum.

But the President himself beat me to the punch in his energy-policy speech last week.

Most of what he said didn't make the papers or the broadcast news, except his comments on gasoline prices.

So I'd like to frame the nature of the commitment quickly by quoting excerpts from his remarks.

The President said this nation must:

"...recognize the transformational power of technology...

"...apply technology to increase domestic production from existing energy resources...create entirely new sources of energy...on the doorstep of incredible technological advances...

"...put technology to work so we can harness the power of clean coal..."

"...use our most abundant energy source in a smart way..."

On the international level of the Carbon Sequestration Leadership Forum, he said:

"...[at the] G-8 meeting in July...I'm going to work with...our friends and allies...to help developing nations...like China and India to develop and deploy clean energy technology.

"We need to find practical ways to help these countries take advantage of clean coal technology."

President Bush said much more last Wednesday, but I'm sure the point is made.

The commitment to technology development is strong.

And the commitment to technology deployment is clear.

The President really did beat me to the punch.....But he didn't leave me speechless.

The President's remarks added to a sense of rising momentum around the technologies associated with carbon dioxide capture and sequestration that I'll touch on frequently as we move forward.

A great deal of what will happen over the course of this century depends on what we in this room achieve working together over the next decade or so, beginning this year. And, perhaps, from this point forward.

We here – whatever our professional roles, whatever our organizations, whatever our nationalities – are at the center of a worldwide marshalling of intellectual resources with the intent and distinct probability of transforming the way the world works.

In the U.S., the origins of this effort are in the cluster of comprehensive, integrated and forward-reaching initiatives grouped in the President's climate change and energy policies.

The President's broad domestic and international objectives include:

- A substantial and voluntary moderation in the growth rate of greenhouse gases, especially carbon dioxide – specifically, an 18 percent reduction in greenhouse gas intensity here in the U.S.;
- Then, the use of technology to initiate carbon dioxide's on-going elimination in the evolutionary development of a hydrogen economy with declining levels of greenhouse gas emissions;
- Then, achievement of this transformation while providing energy and energy security on terms that both sustain and invite economic growth;

- And, finally, ensuring that such technologies, such gains and such energy all are available to any nations which require them.

Energy security means making full use of all our considerable resources beginning with conservation and renewable energy and including nuclear energy.

But it also means coming to terms with what a distinguished former chairman of the World Energy Council once called the facts and the physics of energy.

The facts and the physics of energy which shape all reliable forecasts say:

- That alternative sources, including nuclear generation, can't do it all – not now, not in the next 25 years;
- And, that fossil fuels are indispensable to developing and developed nations alike for the foreseeable future.

The International Energy Agency's world outlook of last fall brings forward some very specific notations to the point:

- Economic growth means world energy demand will increase 60 percent through 2030;
- Fossil fuels will be required to satisfy 90 percent of the increase;
- Total carbon dioxide emissions will grow by more than 60 percent;
- And, the majority of CO₂ will come from developing nations shortly after 2020;
- But...the step of adding carbon dioxide capture and sequestration to power generation alone could cut those CO₂ projections by a little more than 20 percent.

We all will have to rely on oil, gas and coal to bridge the gap between present-day conditions and the development of hydrogen economies.

The transition to hydrogen, like all transformations, is a steady work of decades and not one of artificial deadlines.

The facts and the physics of energy are behind the sense of rising momentum associated with carbon dioxide capture and sequestration.

In the U.S. Department of Energy's Office of Fossil Energy, our responsibility within the President's initiatives is to lead in developing technologies that will eliminate pollutants and greenhouse gases, and to support their commercial use.

We rely heavily on industry participation through joint ventures in doing this. We want industry's judgment about the market's practical requirements and its creative insight in developing the immediately useful. And we want our demonstrations to put in place the manufacturing base for wide and rapid commercial deployment.

Our special emphasis is on removing the environmental liabilities and challenges that attach to increased use of coal, this nation's most abundant source of primary energy.

Today, much of our activity, but not all, deals with CO₂ emissions and advancing the technology we call IGCC – integrated-gasification-combined-cycle generation.

We also are developing other applications that will be suitable for use in traditional power production and on other large-scale industrial sources whether they burn oil, coal or natural gas.

The President has committed to investing \$2 billion in research, development and demonstration over 10 years in his Coal Research Initiative, which supports both the climate and energy policies.

We contribute to the Presidential policies through:

- First, the core of research activity to develop low-cost carbon dioxide capture and sequestration – the Carbon Sequestration Program;
- Next, the Regional Carbon Sequestration Partnerships, whose purpose is to establish the regulatory, institutional and other arrangements needed to conduct carbon-dioxide storage;
- Next, the President's \$1 billion Clean Coal Power Initiative – it demonstrates advances in pollution control and advances in adapting IGCC to CO₂ capture and the co-production of value-added by products, motor fuels to displace petroleum imports and hydrogen for uses now in other development;
- Next, the \$950 million FutureGen project to develop a prototype power plant for zero-emissions through the 21st Century – it will integrate the IGCC advances in carbon control and hydrogen production from the Sequestration Program and the Power Initiative.
- And, finally, we provide policy and technical leadership for the international Carbon Sequestration Leadership Forum.

The CSLF brings together developed and developing nations alike, including China and India. Together the members represent most of the world's present and projected energy demand, economic growth and carbon dioxide emissions.

We expect many of these countries to participate in FutureGen.

The FutureGen prototype is at the nexus of climate policy and energy policy. It will be a cost-shared venture among government, industry and other entities with an 8 percent portion reserved for international partners.

Most lines of U.S. technology development and carbon sequestration converge on it, the surest paths toward the transition to hydrogen-based energy services run from it.

IGCC is the core technology of FutureGen.

But IGCC also offers significant benefits in the present and its early deployment is a priority of policy.

We cannot build on this technology until it is in commercial use, and its existence in multiple stages of development has been a source of great misunderstanding.

Today's IGCC is deployment ready – IGCC is IGCC.

It provides many environmental benefits, including the kind of efficiency increases that markedly reduce greenhouse gas intensity. The manufacturing base is organizing itself to offer turnkey packages with appropriate guarantees, and interest is on the rise in the U.S.

Sequestration-ready IGCC is another technology, which is in development.

And FutureGen IGCC, for all practical purposes, is a third technology.

The FutureGen prototype will incorporate the appropriate technology advances to offer in one plant, for the first time, the capability to produce electricity and hydrogen from coal while capturing and sequestering carbon dioxide. Its purpose is to establish the technical and economic feasibility of doing those things at commercial scale.

Follow-on plants of the FutureGen class will offer developing and developed nations alike benefits that include:

- Low cost electric power from coal with low and, ultimately, zero emissions of all pollutants and CO₂;
- A range of liquid fuel co-products that can serve to help moderate petroleum demand;
- Where appropriate, a means of using carbon dioxide sequestration to expand oil supply and extend the life of reserves through enhanced oil recovery;
- Where appropriate, expansion of the domestic natural gas supply through sequestration in deep, unmineable coal seams;
- And, early commercial production of the carbon-free energy source hydrogen.

Early access to commercial hydrogen at gasoline-competitive prices will support the activities of a companion initiative – the International Partnership for a Hydrogen Economy.

The hydrogen coalition's goals include displacement of the internal combustion engine in transportation which leads to:

- Falling demand for imported petroleum products;

- And, elimination of their companion CO₂ emissions.

FutureGen is a critical keystone for the bridge between now and the era of ultimate de-carbonization later in the century.

FutureGen will enable the world to begin coming to terms with the facts and the physics of energy and its concerns about the greenhouse gas carbon dioxide.

In the world of man-made CO₂ emissions, industrial activities are the largest source, transportation the fastest growing source.

FutureGen will enable us to address both.

Let me momentarily sum up and outline the U.S. leadership role in carbon capture and sequestration from the perspective of the Office of Fossil Energy.

First, the Bush Administration has expanded the core effort, the Carbon Sequestration Program. Appropriations grew by a factor of five to \$45 million a year during the Bush years, and we're asking for \$67 million in FY '06.

Today we're actively pursuing more than 80 specific projects at laboratory, pilot or field scale that include:

- Pre- and post-combustion capture of carbon dioxide;
- Sequestration in all its forms, especially geologic and terrestrial;
- Reliable and accurate measurement, monitoring and verification to ensure safe, long-term storage of sequestered carbon;
- Basic research at the National Energy Technology Laboratory;
- And, potential breakthrough concepts.

Next, the Regional Carbon Sequestration Partnerships have just completed a highly successful Phase One, and we recently issued a call for Phase Two activities to run through 2010.

Among the Phase One achievements is establishing a national database on industrial-scale CO₂ emissions by source and location and which also shows their relationship to probable geologic reservoirs and sources of terrestrial up-take.

Phase Two plans include numerous field tests to further define our storage capacity and additional work on the concepts and institutional arrangements of permitting, regulation and achieving public acceptance.

The Partnership effort continues to grow. It now spans most of the North American land mass. It just added the Canadian provinces of Alberta and British Columbia and now covers 40 states, four provinces, three Indian Nations and more than 230 organizations, including some of our most prestigious research institutions and universities.

Next, the President has highlighted the importance of FutureGen in other comments, and we are moving the project forward as rapidly as possible.

Our tentative schedule is site selection in fiscal year 2007, initial construction activity in FY 2008, final detailed design in FY 2009 and full-scale operation in FY 2012. Site selection will be based on competitive solicitations and criteria to be determined by our joint-venture partners of the Industry Alliance.

And finally, the Bush Administration is committed to the success of the Carbon Sequestration Leadership Forum.

The goal is to foster the worldwide deployment of carbon dioxide capture and sequestration technologies through bi-lateral and multi-lateral cooperation.

We want these technology choices to be available to developing nations as they proceed toward 2020.

Activities like these are among the reasons former Secretary of Energy Schlesinger could write in an essay for The Los Angeles Times:

"The U.S. is doing more than any other nation to address the climate issue."

In critical area of capture technology, we continue to examine many cost-lowering applications of great promise.

Four of these are:

- A clathrate – or molecular – application that separates synthesis gas to deliver a concentrated stream of CO₂ for sequestration and a concentrated stream of hydrogen for zero-emissions use;
- Advanced scrubbing;
- Chemical looping;
- And advanced membrane separation.

In critical area of sequestration, the Mountaineer project in Mason County, West Virginia, near America Electric Power's station of same name, has given us a successful start on characterizing the saline reservoir potential with respect to the region of our heaviest coal use, the Ohio Valley.

This 9,000-foot test well has identified several deep reservoirs of potential, and our efforts now include making use of data from drilling by others in the area.

We are actively moving forward other projects as well, including these directly related to FutureGen's potential:

- The Frio Project in Texas – it is tracking the behavior of a small amount of CO₂ in a deep saline formation;
- A West Virginia project to explore the sequestration potential and the methane recovery potential of unmineable coal seams;

- Norway's Sleipner Project in the North Sea – it is sequestering one million tons a year in a deep saline formation and developing improved technologies for monitoring, measuring and verification;
- And, Canada's Weyburn Project – it now requires almost two million tons of CO₂ a year for enhanced oil recovery and also is developing improved verification technologies.

Coupling sequestration with enhanced oil recovery at Weyburn is proving safe and long term. As concerns rise about oil prices, oil supplies and oil reserves, this application will be of increasing interest.

Recent studies for the Office of Fossil Energy determined that the application of CO₂-based recovery to depleted and declining oil fields in six regions of the U.S. could produce an additional 43 billion barrels of oil.

At present, our total domestic reserve of proven recoverable oil is only 22.7 billion barrels.

Technology advances also can transform resource accessibility and reserve estimates.

Weyburn has a flip-side that is often overlooked.

It also has enabled the CO₂ supplier – the Dakota Gasification Company – to make deep cuts in its emissions while adding another profitable item to a line of profitable by-products. The company uses the low-rank coal lignite to produce pipeline gas.

The Weyburn Project is a double success.

Weyburn and Sleipner were approved as CSFL projects last fall.

The Forum's ministerial meeting in Melbourne last fall also made a significant contribution to the momentum.

We added three nations – Germany, France and South Africa. Now two other additions are pending – the Netherlands and Denmark.

The Ministers approved a total of 10 projects.

They included Phase Two of the CO₂ Capture Project and the Castor Project.

Phase One of the CO₂ Capture Project produced more than 100 detailed studies and assessments that identified capture-cost reductions ranging up to 60 percent and pioneered a risk-based approach to proving sequestration safe, measurable and verifiable.

Phase Two will follow up on this start with strong emphasis on capture technologies that are applicable to all fossil fuels in all industrial sectors and on further reductions in costs.

The Castor Project may be the most ambitious in scope. It is aimed at capturing 30 percent of Europe's large industrial emissions and storing them in four reservoirs located around the sub-continent.

This fall in Berlin the CSLF Policy and Technical Groups will consider recommending an additional five demonstration projects for the next year's ministerial meeting.

Two of these will be in developing nations – a coalbed methane project in China and a natural-gas project in Mexico.

There can be no real progress against the rise in CO₂ emissions or the rise in global energy problems unless – or until – the developed nations find constructive ways to engage the developing nations on energy.

To borrow the President's words again:

"...practical ways to help these countries take advantage of clean coal technology."

Cooperation, collaboration and voluntary activity within the CSLF are leading the world in a constructive direction.

CSLF members have begun to express interest in FutureGen participation, notably Australia and China.

This may be the year that capture and sequestration wins international acceptance as an effective method of dealing with greenhouse gases.

Last month the European Commission's new Energy Commissioner, at a conference much like this one, entered the following points into their discussions:

- Europe will be 80 percent dependent on imported natural gas and 90 percent dependent on imported oil by 2030;
- Coal for electric generation is important to Europe's energy mix in terms of security and diversity of supply;
- Carbon dioxide storage can extend the productive life of oil and gas fields in the North Sea.

He also listed in order of importance the Commission's seven priorities for energy R&D from 2007 through 2013.

The first three were:

- CO₂ capture and storage technologies for zero-emissions power generation;
- Clean coal technologies;
- And, finally, hydrogen and fuel cells.

The sum of these developments is behind the sense of building momentum.

Coal gasification and carbon dioxide capture and separation are not panaceas for concerns about greenhouse gases and climate.

We'll need all the alternatives available to bring on the hydrogen era. We'll need conservation, renewables and nuclear power.

But the gap between present-day conditions and the future we all seek cannot be bridged without the keystones of coal gasification and capture and separation.

Neither will we be able to sustain the global economy on terms that invite growth nor resolve our growing problems with energy.

Thank you for your attention, and for your participation in the activities of capture and sequestration.