NATIONAL ENERGY TECHNOLOGY LABORATORY

DOE's Technology Policy for RD&D of IGCC and CCS

Gary J. Stiegel
Technology Manager - Gasification

U.S. DEPARTMENT OF ENERGY

Presentation Outline

- U.S. IGCC plants
- CCS impact
- Program funding & budget
- Investment & incentive strategies

"Coal is an abundant resource in the world ... It is imperative that we figure out a way to use coal as cleanly as possible."

Dr. Steven Chu, Secretary of Energy

IGCC Plants in the U.S.

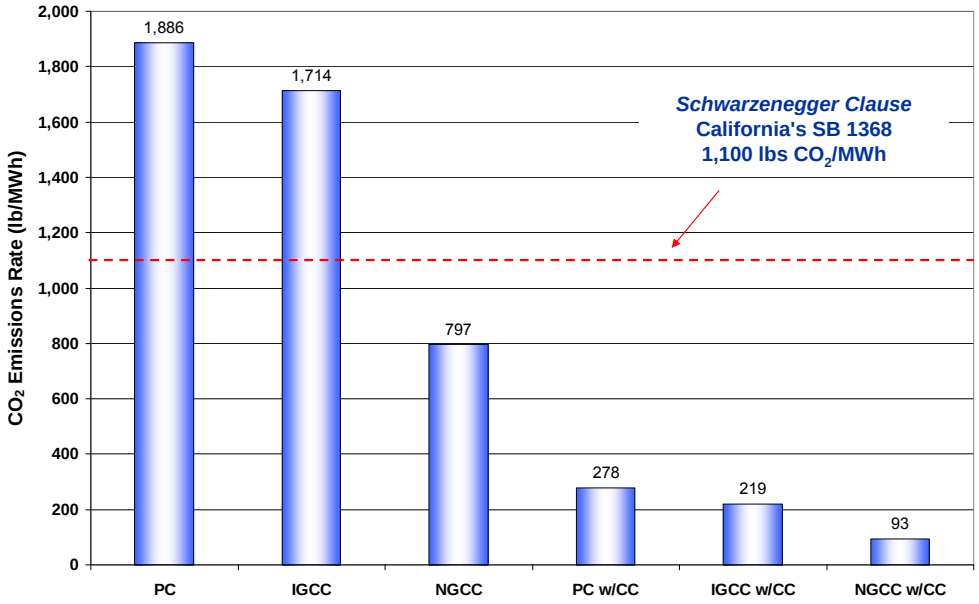
- **Southern California Edison's Cool Water Coal Gasification Plant**
  - 100 MWe – coal (1984-1988**)**
- **Dow Chemical's Louisiana Gasification Technology Inc (LGTI) Project**
  - 160 MWe – coal (1987-1995)
- **Wabash River Coal Gasification Repowering Project**
  - 262 MWe – coal/petcoke (1995 - present)
- **Tampa Electric Polk Power Station**
  - 250 MWe – coal/petcoke (1996 - present)
- **Valero Delaware City Refinery's Delaware Clean Energy Cogeneration Project**
  - 160 MWe & steam – petcoke (2002 – present)
- **Duke Energy's Edwardsport Integrated Gasification Combined Cycle Station**
  - 630 MWe – coal (2012 start up)

Active IGCC Projects – *North America*

Active Projects	*Location*	*Feedstock*	*MWe*	*Gasifier Vendor*	*CO_2 Capture*	*Date In Service*
Edwardsport IGCC Project	Indiana	coal	630	GE	STUDY	2012
Kemper County IGCC Project	Mississippi	coal	600	KBR	50% EOR	2013
Mesaba Energy Project	Minnesota	coal	600	E-Gas	READY	
Taylorville Energy Center	Illinois	coal	630	GE	YES	2014
Hydrogen Energy California project (HECA)**	California	petcoke	390	GE	2 MTY	2014
Cash Creek Generation*	Kentucky	coal	630	GE	EOR	2012
Summit Power IGCC - Penwell	Texas	coal	600	Siemens	60% EOR	
Sweeny E-Gas™ Project (IGCC or SNG)	Texas	petcoke		ConocoPhillips	YES	
Southern California Edison H_2 for Power**	Utah	coal	500		to meet CA standard	
Future Power PA	Pennsylvania	coal	150			2011
Ohio River Clean Fuels, LLC***	Ohio	coal/biomass	250	Shell	YES	2012
Somerset Gasification Retrofit	Massachusetts	coal/biomass	120	WPC		2011
Genesee IGCC Project	Alberta	coal	270	Siemens	1.25 MTY EOR	2011
Great Lakes Energy and Research Park ***	Michigan	coal	250	ConocoPhillips	EOR	2012
Hyperion Energy Center (HEC) refinery and IGCC power plant**	South Dakota	petcoke			READY 90%	2014
Hunton Energy Freeport Plant SNG* & IGCC (formerly Lockwood)	Texas	petcoke	400	GE or CoP	100% EOR	2015
Henderson Luminant IGCC Commercial Demonstration	Texas	coal	630		YES	
Morgan 3&4 - Colorado City Luminant IGCC Commercial Demonstration	Texas	coal	630		YES	

*also *SNG project, **H2 project, ***CTL project*

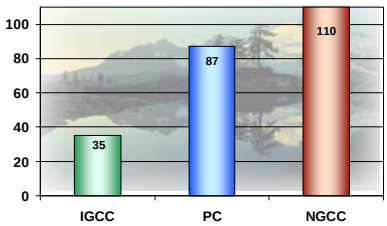
CO_2 Emissions



Current CO_2 Capture Technology Expensive

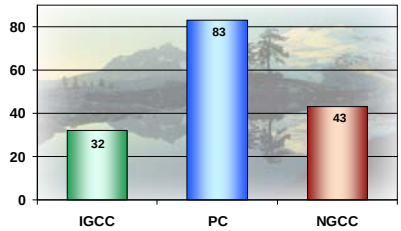
- 5–30% parasitic energy loss
- 35–110% increase in capital cost
- 30–80% increase in cost of electricity

Effect of CO_2 Capture on Capital Cost
(% Increase Resulting From CO_2 Capture)



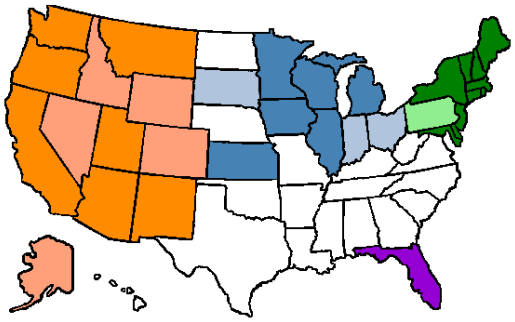
Note: CO_2 capture costs based on use of Selexol process for IGCC and MEA for PC and NGCC.

Effect of CO_2 Capture on Cost of Electricity
(% Increase Resulting From CO_2 Capture)



Source: *Cost and Performance Baseline for Fossil Energy Power Plants study, Volume 1: Bituminous Coal and Natural Gas to Electricity; NETL, May 2007.*

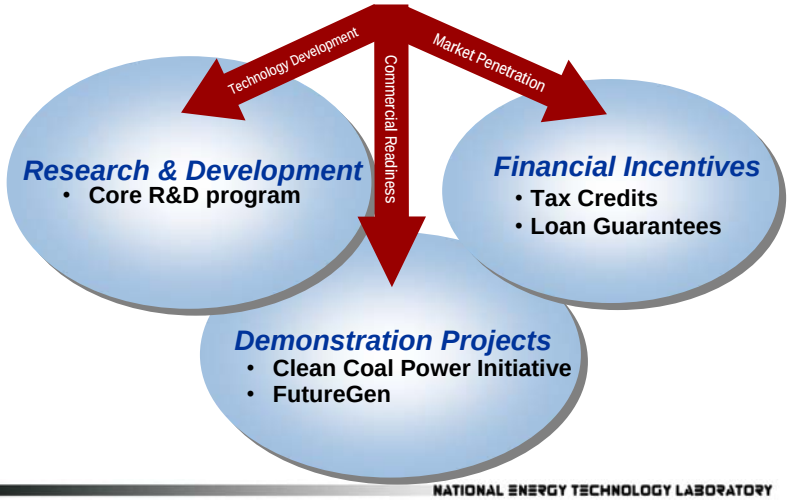
Map of North American Cap-and-Trade Initiatives



- Regional Greenhouse Gas Initiative RGGI
- RGGI Observer
- Midwest GHG Reduction Accord
- MGGRA Observer
- Western Climate Initiative
- Western Climate Initiative Observer
- Individual State Cap-and-Trade Program

Source: Pew Center on Global Climate Change
http://www.pewclimate.org/what_s_being_done/in_the_states/regional_initiatives.cfm

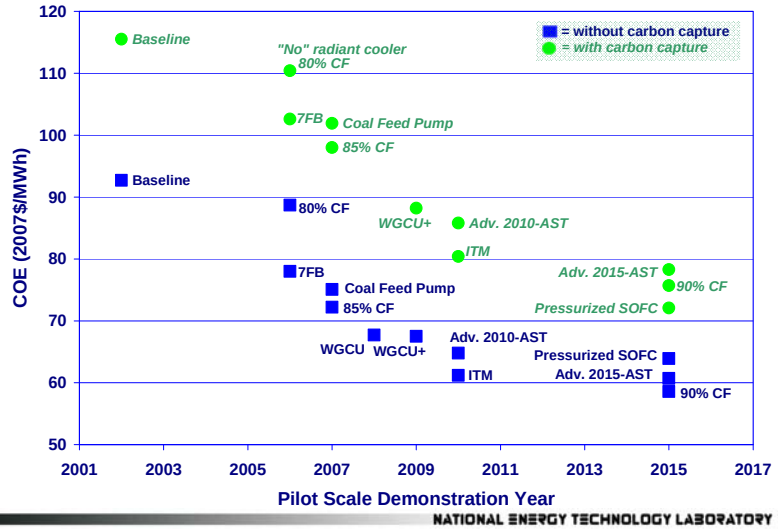
U.S. Government's Coal R&D Investment Strategy



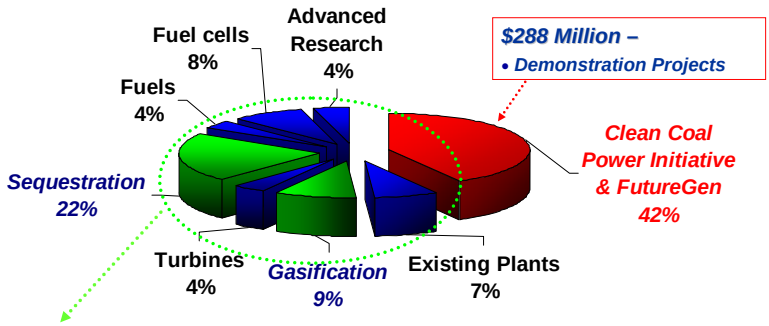
Advanced Power Systems Goal

- **2010:**
  - **45-50% Efficiency (HHV)**
  - **99% SO_2 removal**
  - **NOx< 0.01 lb/MM Btu**
  - **90% Hg removal**
- **2012:**
  - ***90% CO_2 capture***
  - ***<10% increase in cost of electricity (COE) with carbon sequestration***
- **2015:**
  - **Multi-product capability (e.g, power + H_2)**
  - **60% efficiency (measured without carbon capture)**

COE Timeline



FY 2009 Coal Program Budget



$288 Million –
- ***Demonstration Projects***

$404 Million –
***Coal Research includes*:**
- **Development of more efficient gasification, turbine and fuel cells technologies**
- **Innovations for existing coal power plants**
- **Large-scale CCS injection tests**

FY09 Budget - $692 Million

Clean Coal Power Initiative (CCPI)

- *10 year - $2 billion demonstration program*
- *Industry cost share of at least 50%*
- *Government-industry partnership*
- *Anticipate five rounds of solicitations*

Round 1- CCPI Active Projects
Increasing Power Plant Efficiency: Lignite Fuel Enhancement
TOXECON Retrofit for Mercury and Multi-Pollutant Control on Three 90-MW Coal-Fired Boilers
Round 2 - CCPI Active Projects
Demonstration of a 285 MW Coal-Based Transport Gasifier, Southern Company Services
Mercury Specie and Multi-Pollutant Control, Pegasus Technologies, Inc.
Mesaba Energy Project

Round 3 underway

Goals: Demonstrate at commercial scale & setting technologies that:

- Operate at 90% carbon dioxide capture efficiency
- Limit increase in COE < 10% for gasification < 35% for combustion & oxycombustion
- Sequester ≥ 50% of plant CO_2 output at a scale sufficient to evaluate impact on plant operations, economics, and performance
- Capture and sequester or put to beneficial reuse ≥ 300,000 TPY of CO_2

Status

- Proposals currently under review - due to DOE 1/20/09
- DOE to award multiple cooperative agreements

FutureGen – *Under Review*

Primary Goal

- **Demonstrate carbon capture and storage technology at multiple clean coal power plants**

Focus

- **Carbon dioxide separation for Carbon Capture and Storage (CCS)**

DOE's Approach

✓ ***Request for information issued January 31, 2008***
- **Costs and feasibility for building clean coal facilities that achieve FutureGen goals**
- **Industry input due by March 3, 2008**

✓ ***Issued Funding Opportunity Announcement*** **June 24, 2008**
- **Financial assistance to equip IGCC commercial power plants with CCS technology**
- **Was due to DOE by October 8, 2008**

Result

✓ ***Commercial operation of IGCC* power plants equipped with CCS technology to begin as soon as plants are commissioned, between 2015 and 2016***

* *Or any Clean Coal Power Technology*

Federal Investment Tax Credits - *EPAct 2005*

- **$1 billion initially allocated 2006-2007**

  Round 1 awards included:
  - Duke Energy's Edwardsport IGCC project $133.5 M
  - Mississippi Power's Kemper County IGCC project $133 M
- **$650 million available for Round 2 (2007-2008)**

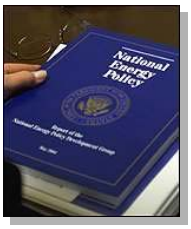
  Round 2 awards included:
  - Excelsior Energy's Mesaba project $133.5 M
- **$392 million remaining for Round 3 (2008-2009)**

  Round 3 to be awarded
  - IGCC – 2 projects
    - Sub-bituminous - $133.5 million (1 project)
    - Lignite - $133.5 million (1 project)
  - Advanced Combustion – $125 million (1 project)

  Round 3 status
  - Applications were due to Treasury – March 1, 2009
  - Awards to be made by April 30, 2009

DOE's Loan Guarantee Program

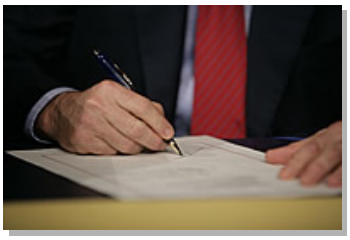
- **Secretary Chu to *accelerate* the loan-guarantee program *… aims to sign first in late April or early May***
- **First solicitation — *16 pre-applicants invited to submit applications - October 2008***
- **Second round has 3 solicitations for $30.5 billion in loan guarantees *renewable energy, nuclear and 'front-end' nuclear power facility projects - June 2008***
- **DOE announces third round solicitation for $8.0 billion in loan guarantees - *targets innovative clean coal ltechnologies***
  - **Issue Date: September 22, 2008**
  - **Application Due: March 23, 2009**



Advanced Fossil Energy Invited Projects
Mesaba Energy Project (MEP–I, LLC): Integrated Gasification Combined Cycle (IGCC) Plant
Mississippi Power Company: IGCC Plant
TX Energy, LLC: Coal to Synthetic Gas IGCC Plant

2008 Economic Stimulus Bill

Additional EPAct 2005 Tax Credits



Additional Sec. 48A Tax Credits

- $1.25 billion for clean coal
- 30% investment tax credit
- Projects must capture 65% of CO_2

Additional Sec. 48B Tax Credits

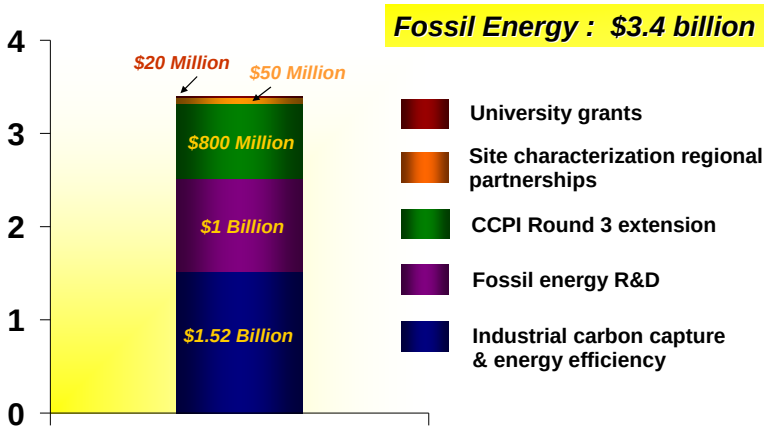
- $250 million for gasification projects
- 30% investment tax credit
- Projects must capture 65% of CO_2
- Projects that manufacture "transportation grade liquid fuels" eligible

New CO_2 Sequestration ***Sec. 48Q Tax Credit***

- Each metric ton of CO_2 captured and stored or used qualifies
  - $20/tonne CO_2 stored in saline formation or unmineable coal seam
  - $10/tonne CO_2 used in enhanced oil or gas recovery
- Project must sequester ≥ 500,000 tonnes of CO_2 during taxable year
- Program limited to 75 million tonnes of CO_2 sequestered

American Recovery and Reinvestment Act

Impact of Stimulus Package on NETL



$10 million - Program administration

… the Benefits

GASIFICATION

- Stable, affordable, high-efficiency energy supply with a minimal environmental impact
- Flexible applications for energy production

CARBON CAPTURE & SEQUESTRATION

- Provides for low cost carbon capture and storage
- Allows continued use of low-cost, abundant, fossil energy resources, by reducing release of carbon emissions

BIG PICTURE

- Energy security -- Maintain coal as a significant component in the energy mix
- A cleaner environment

Visit Our Websites

Gasification

www.netl.doe.gov/technologies/coalpower/gasification

Sequestration

www.netl.doe.gov/technologies/carbon_seq

American Recovery and Reinvestment Act

$3.4 billion - Fossil Energy Research, Development, & Deployment

- **$1.0 billion for fossil energy research and development programs**
- **$800 million for additional amounts for the Clean Coal Power Initiative Round III Funding Opportunity Announcement**
- **$1.52 billion for a competitive solicitation for a range of industrial carbon capture and energy efficiency improvement projects, *including a small allocation for innovative concepts for beneficial reuse of CO_2***
- **$50 million for a competitive solicitation for site characterization activities in geologic formations (in the context of CO_2 sequestration in geologic formations)**
- **$20 million for geologic CO_2 sequestration training and research grants**
- **$10 million for program direction funding**