Cost/Benefits of Regulation

- EPA estimates that:
  - If the full regulatory costs of Subtitle C were passed on from utility companies to consumers, electricity prices nationwide could increase by 0.8%, on average.
  - For Subtitle D, the potential full cost pass-thru nationwide increase in electricity prices would be 0.2%, on average.

Costs/Benefits of Regulation

EPA has estimated regulatory costs and regulatory benefits *(groundwater protection avoided cancer cases, avoided future cleanup costs, increased beneficial use)* for the next 50 years.

- Subtitle C (assuming no reduction in beneficial uses):
  - Cost: up to $1.5 billion/year
  - Benefit: up to $7.4 billion/year
- Subtitle D (assuming no reduction in beneficial uses):
  - Cost: up to $587 million/year*
  - Benefit: up to $3 billion/year

* Lower cost based on lower compliance rate: "states that do not currently regulate units would not change their practices simply because EPA issued national rules."

Seeking Comments

2. Beneficial Uses:

Information on:

- New beneficial uses
- The best means for estimating future quantities and changes in the beneficial use of CCRs
- Beneficial uses that may present a risk to human health and the environment
- Specific incentives that EPA could provide to increase beneficial use
- Documenting, mitigating and estimating impacts of the stigma effect presumably associated with regulating CCRs under Subtitle C.

Seeking Comments

1. On all aspects of proposed regulatory options:

- Subtitle C vs. Subtitle D, other alternative regulatory approaches
- The specific elements of each alternative.

Public Outreach

- Eight public hearings held:
  - Arlington, VA; Denver, CO; Dallas, TX; Charlotte, NC; Chicago, IL; Pittsburgh, PA; Louisville, KY; Knoxville, TN
  - Of the 2,328 total attendees, about 54% provided testimony
- For transcripts: http://www.epa.gov/osw/nonhaz/industrial/special/fossil/ccr-rule/ccr-hearing.htm
- Three Webinars

Seeking Comments

3. EPA's supporting analyses:

- Extent of existing damage cases
- Extent of risks posed by mismanagement of CCRs
- Adequacy of state programs to ensure proper management of CCRs
- Risk and economic analyses.

Questions?

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Telephone: 703-308-7251

Public Comments/Next Steps

- Five-months comment period (including one extension) yielded > 400,000 comments on the CCR proposal
- Most comments are mass mailings campaigns; we estimate there are between 600-1000 substantive comments
- Embarking on comments sorting and analysis; complimentary studies
- Early Guidance/Option Selection; revised RIA and Risk Assessment; OMB review.

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EPA

www.epa.gov/ord/nrmrl

ENERGY & CLIMATE ASSESSMENT TEAM
National Risk Management Research Laboratory

Modeling emission implications of scenarios of the future using MARKAL

Dan Loughlin, Ph.D.

35th Annual EPA-A&WMA Information Exchange
Research Triangle Park, NC
December 7th and 8th, 2010

Outline

- Background
  - Energy and the environment
  - Modeling energy system scenarios with MARKAL
- Illustrative application
  - Air pollutant emission response to a hypothetical greenhouse gas policy
    - National
    - Regional
  - Sensitivity of response to mitigation pathway
- Other recent or ongoing applications
- Collaborations

Objective of presentation

Illustrate how the MARKAL energy system model can be used to explore the nexus of energy and emissions

Disclaimer:
The views expressed in this presentation are those of the author and do not necessarily reflect the views or policies of the U.S. EPA.

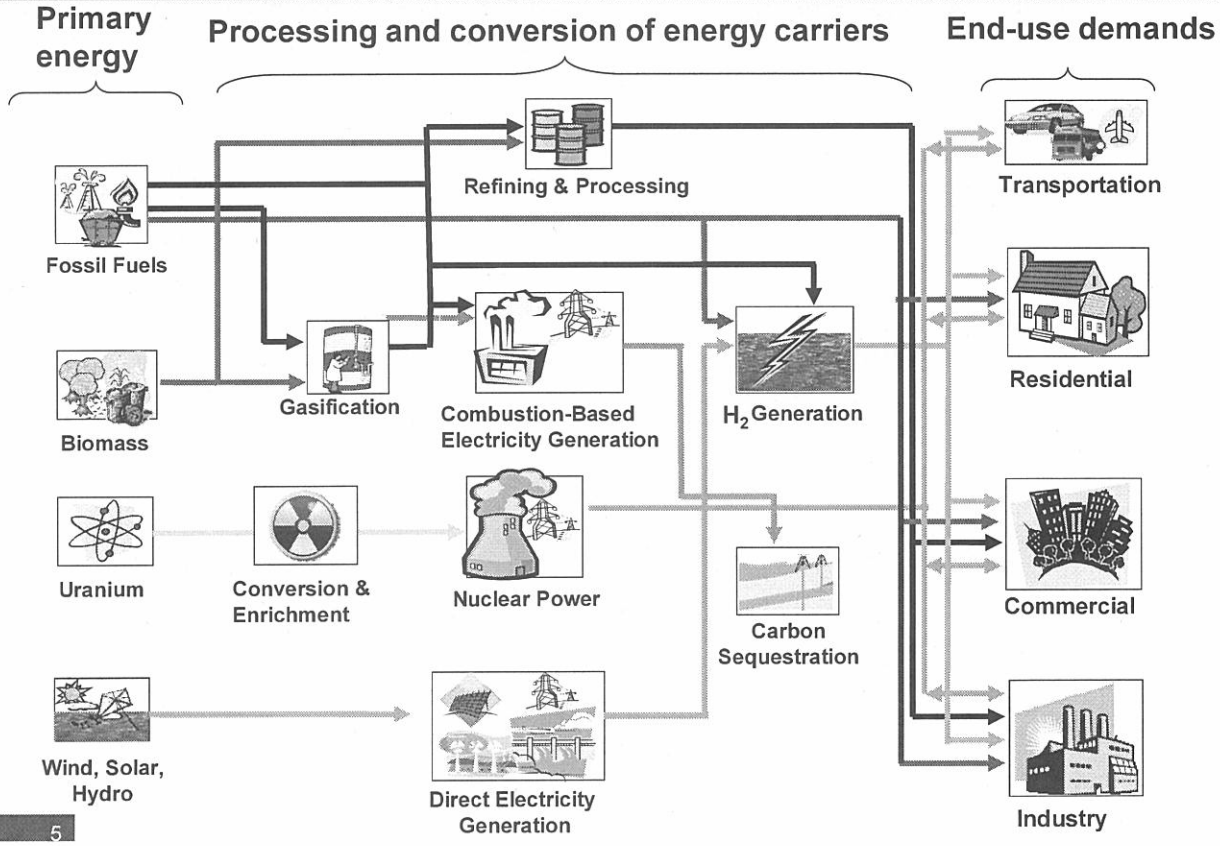
Modeling results are preliminary and are provided to demonstrate capabilities only. Please do not cite results.

Why energy and the environment?

In 2000:

- Air quality
  - Contributions to U.S. anthropogenic emissions
    - *NOx – 95%*
    - *SO_2 – 89%*
    - *CO – 95%*
    - *Hg – 87%*
- Climate change
  - Contributes 94% of U.S. anthropogenic CO_2 emissions
- Water supply and quality
  - 89% of U.S. electricity production uses water for steam or cooling
    - *39% of U.S. water withdrawals (agriculture ~ 41%; domestic ~ 12%)*
    - *132 trillion gallons of water per day is required*
    - *2 gallons/kWh evaporates from thermoelectric plants*
    - *18 gallons/kWh evaporates from hydroelectric plants*
  - One gallon of ethanol may require many gallons of water
  - There are water quality concerns related to new hydraulic fracturing approaches for extracting shale gas

The energy system



Factors driving energy system evolution

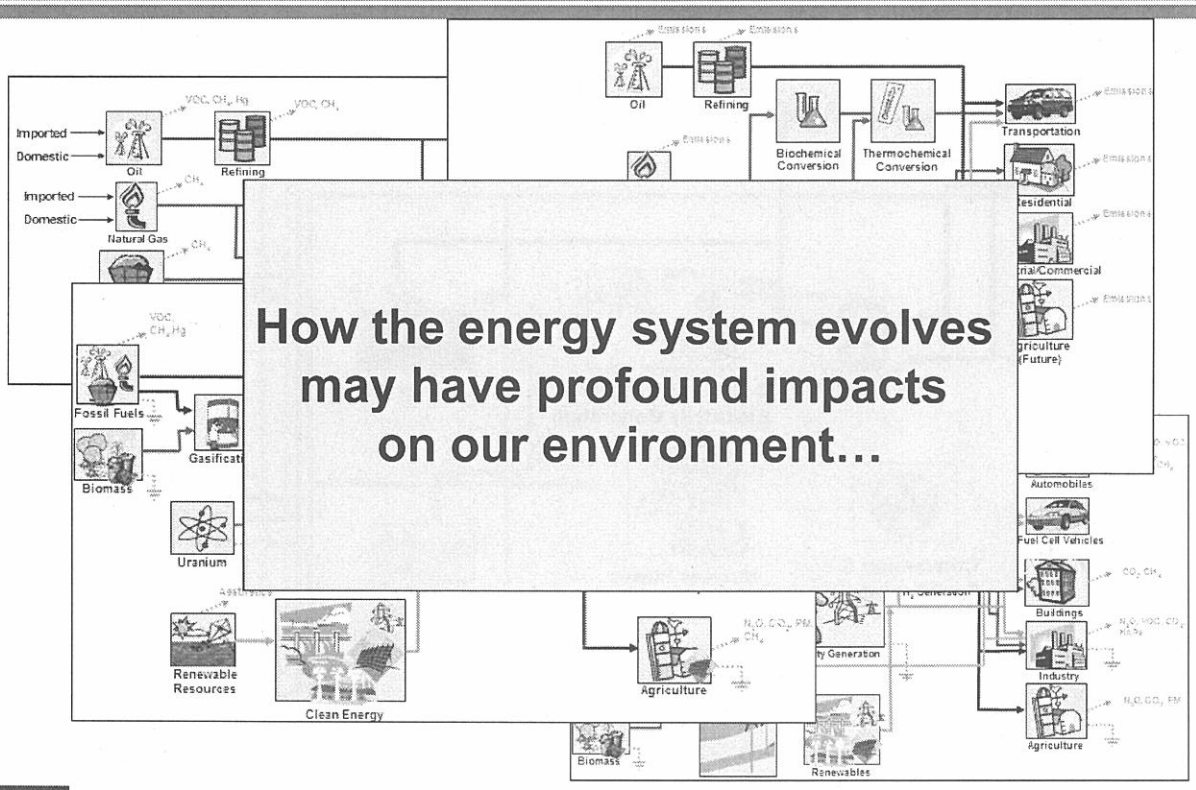
- **Population** growth and migration
- **Economic** growth and transformation
- **Land use** change
- **Technology** innovation
- **Climate change** impacts on energy use and production
- Availability and cost of **energy resources**
- Consumer and firm **behavior**

Policy
- *Climate*
- *Energy security*
- *Environmental*
- *Other*
  - *R&D*
  - *Trade*
  - *Smart growth*

Policy can be proactive or reactive

Many uncertainties when projecting to future

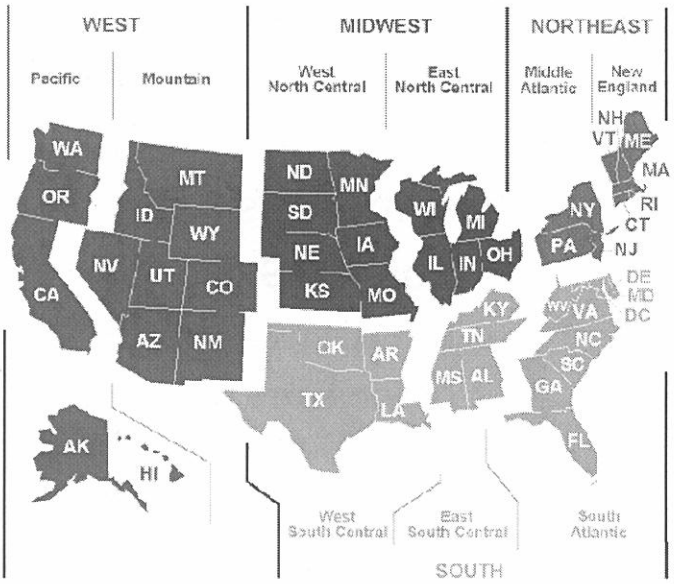
Energy and the environment in the future?



How the energy system evolves may have profound impacts on our environment…

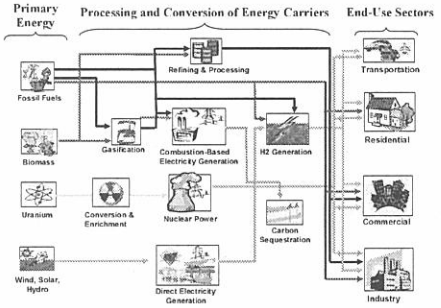
EPA MARKAL databases

- EPA MARKAL databases allow optimization from 2000-2050 horizon in 5-yr steps
- National database:
  - Released to public in 2006
  - 1-8 minute runtime
- Regional database:
  - Improves resource supply characterization
  - External peer review complete
  - Current database calibrated to AEO2008
  - New database, calibrated to AEO2010, is being finalized
  - Runtime: 25 to 45 min on a desktop computer



MARKAL energy system optimization model

- Selects the **least cost mix of technologies and fuels** over a time horizon by minimizing the net present value of energy system capital and O&M costs
- Subject to:
  - Projections of energy service demands
  - Resource supply costs and competition for fuel across sectors
  - Resource supply constraints
  - Inter-regional trade costs and constraints
  - Emission limits
  - Other constraints (e.g., policies)



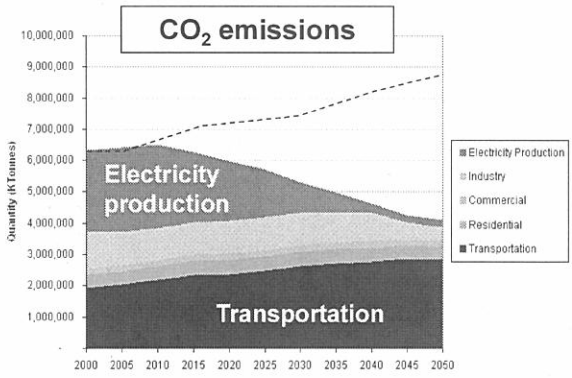
Illustrative application of scenario analysis

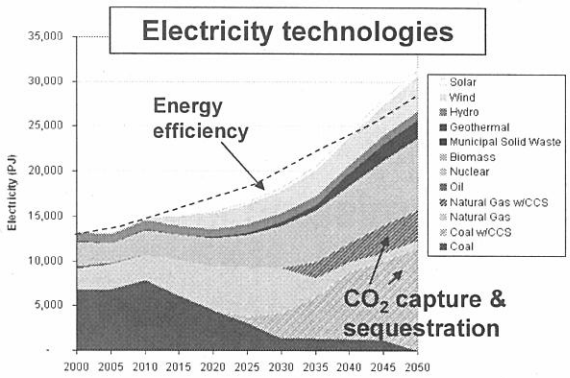
- Approach
  - Compare MARKAL results for scenarios with and without a hypothetical GHG policy
- Assumptions
  - Non-GHG case:
    - Calibrated to AEO2008 through 2030
    - Includes CAIR, light- and heavy-duty engine regulations
  - GHG policy case:
    - Incorporates an energy system-wide limit on CO_2 emissions, reducing CO_2 emissions by ~40% relative to 2005 levels

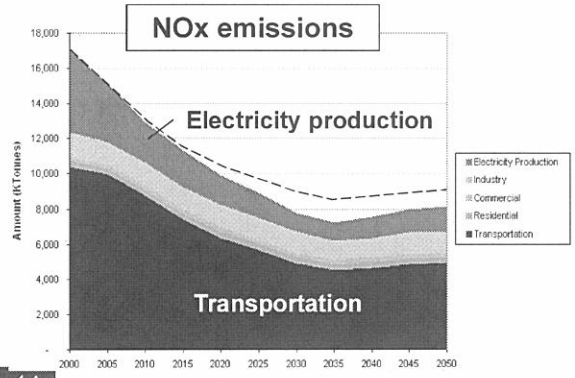
Illustrative application

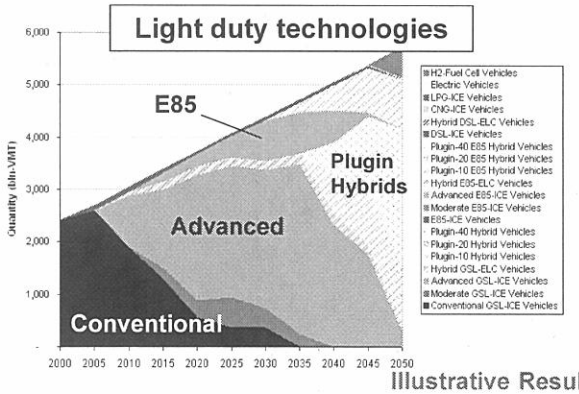
Q: How could a greenhouse gas (GHG) policy impact air pollutant emissions?

An energy system with a GHG policy



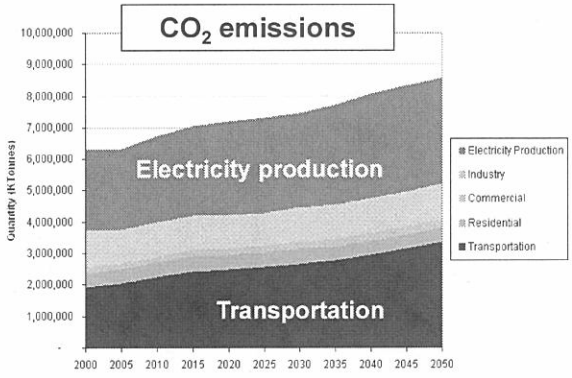


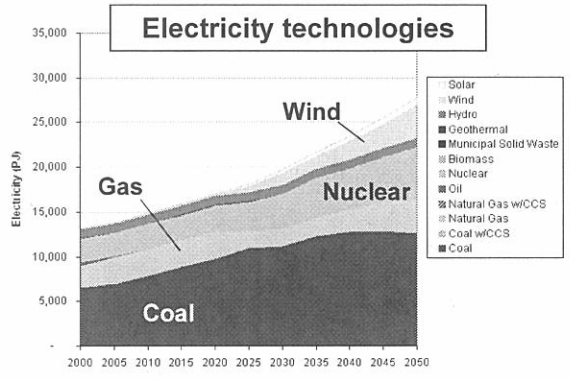


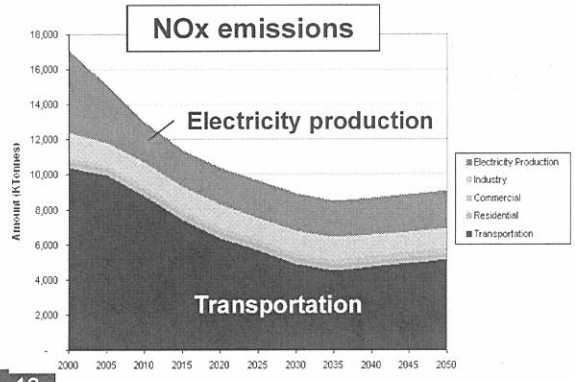


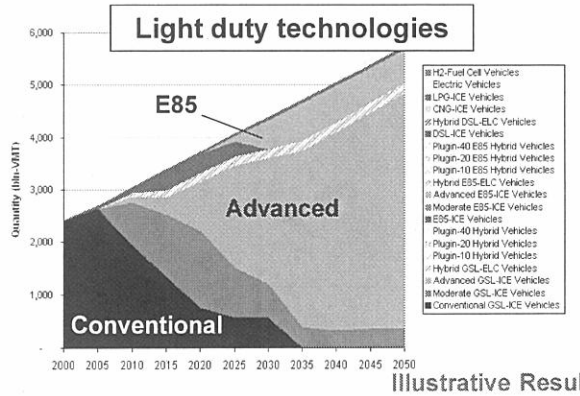
Illustrative Results

An energy system future without a GHG policy







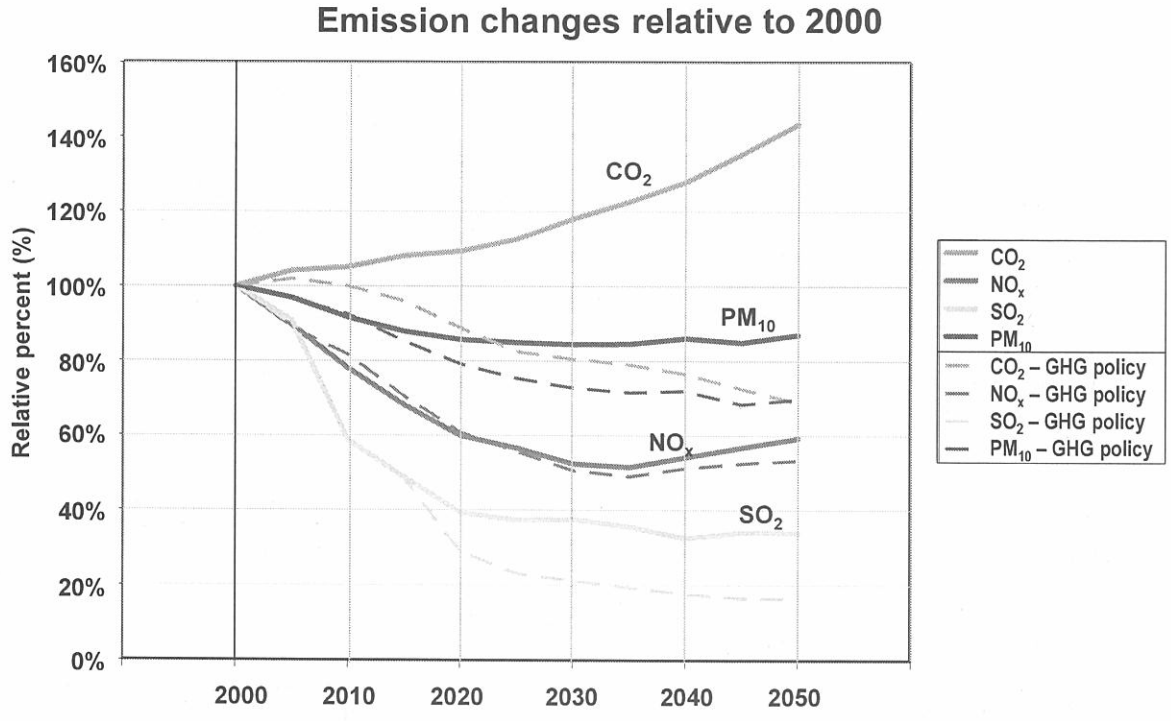


Illustrative Results

Illustrative application

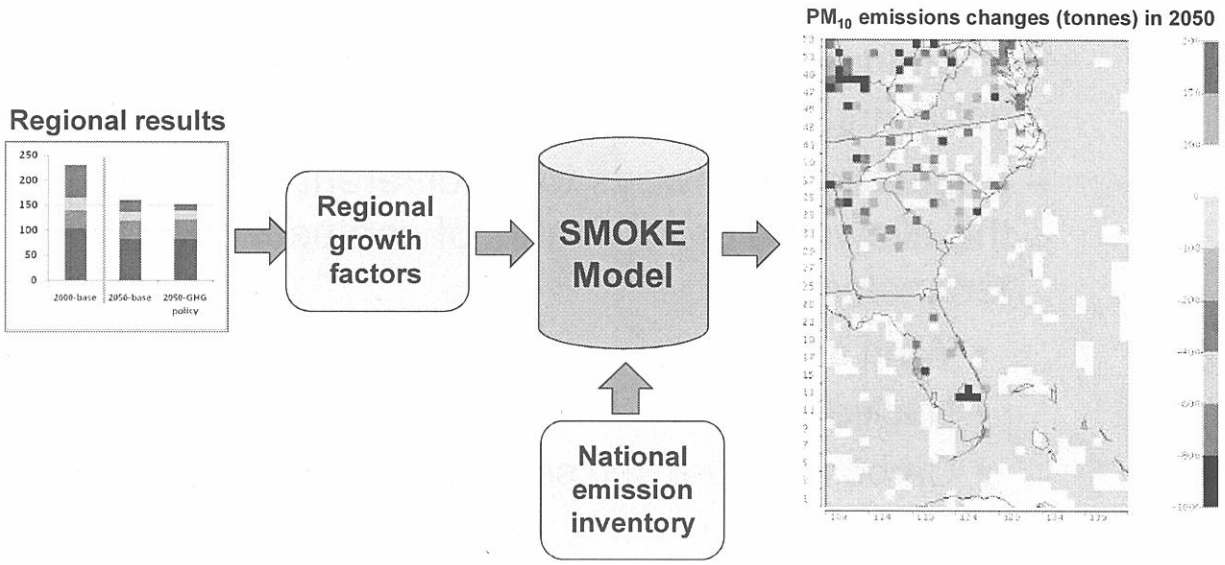
Q: Are there regional differences in air pollutant emission impacts?

Impact of the GHG policy on emissions



Spatial allocation using the SMOKE model

Illustrative Results



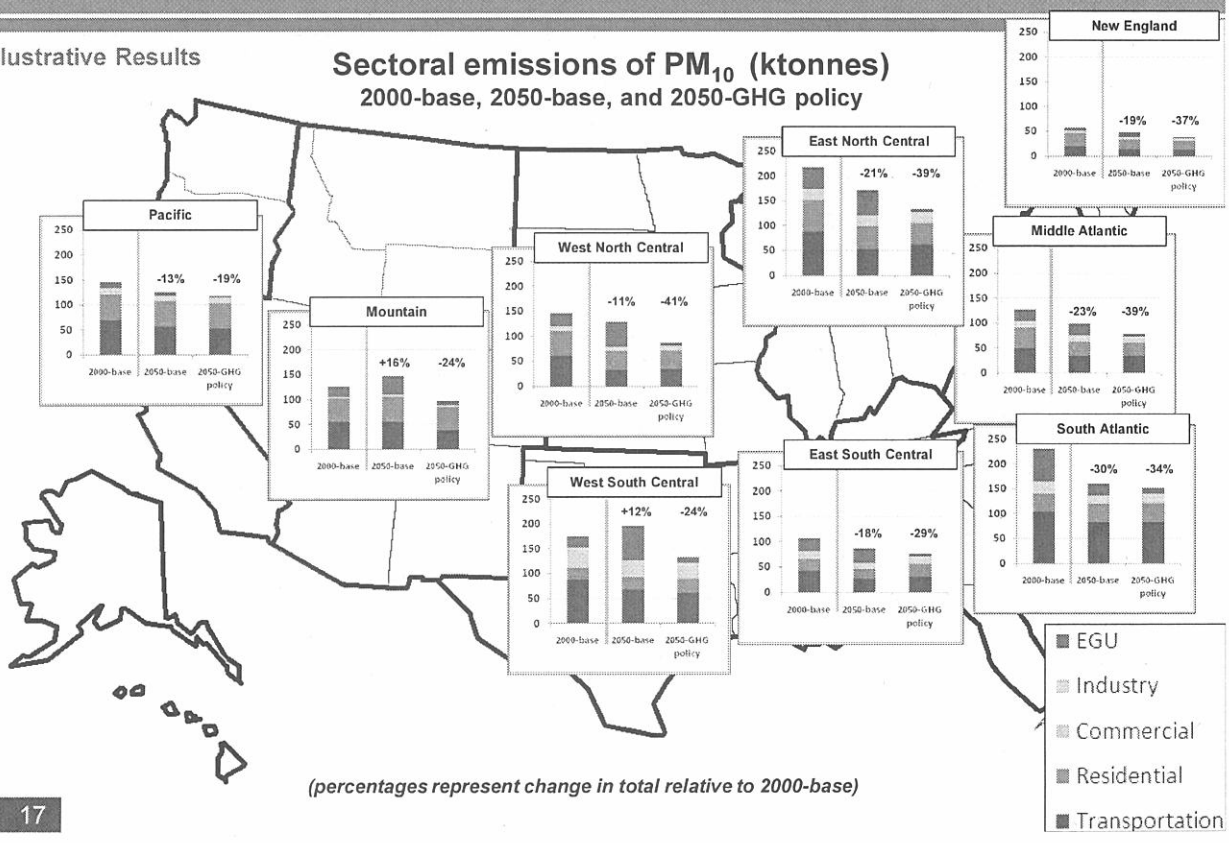
Loughlin, D. H., Benjey, W. G., and Nolte, C. G.: Modeling framework for exploring emission impacts of alternative future scenarios, Geosci. Model Dev. Discuss., 3, 2021-2050, doi:10.5194/gmdd-3-2021-2010, 2010.

Regional differences in GHG policy impacts

Illustrative Results

Sectoral emissions of PM_{10} (ktonnes)

2000-base, 2050-base, and 2050-GHG policy



(percentages represent change in total relative to 2000-base)

Illustrative application of sensitivity analysis

- Approach
  - Examine alternative technology pathways for achieving the hypothetical GHG policy
  - Encourage pathways to be different by varying the allowable growth rates of competing technology
    - Wind and solar
    - Nuclear
    - Carbon capture and sequestration (CCS)
- Assumptions
  - Alternative growth trajectories developed from sensitivity cases reported in the literature

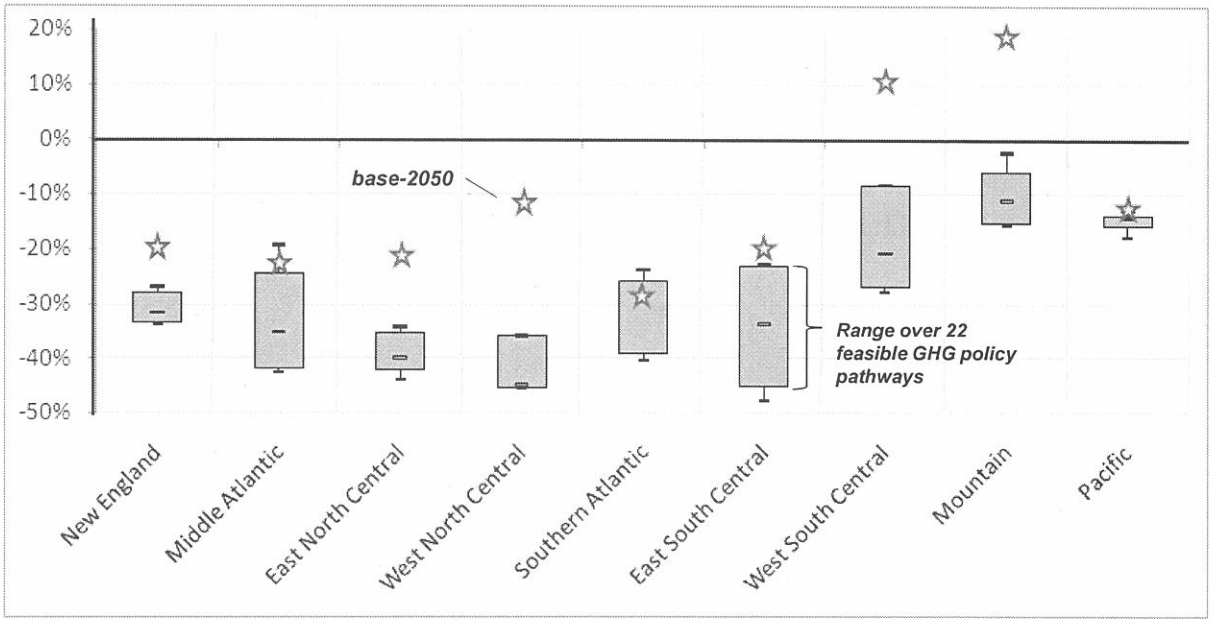
Illustrative application

Q: How could the technology strategy for mitigation impact regional results?

Sensitivity of regional emissions response

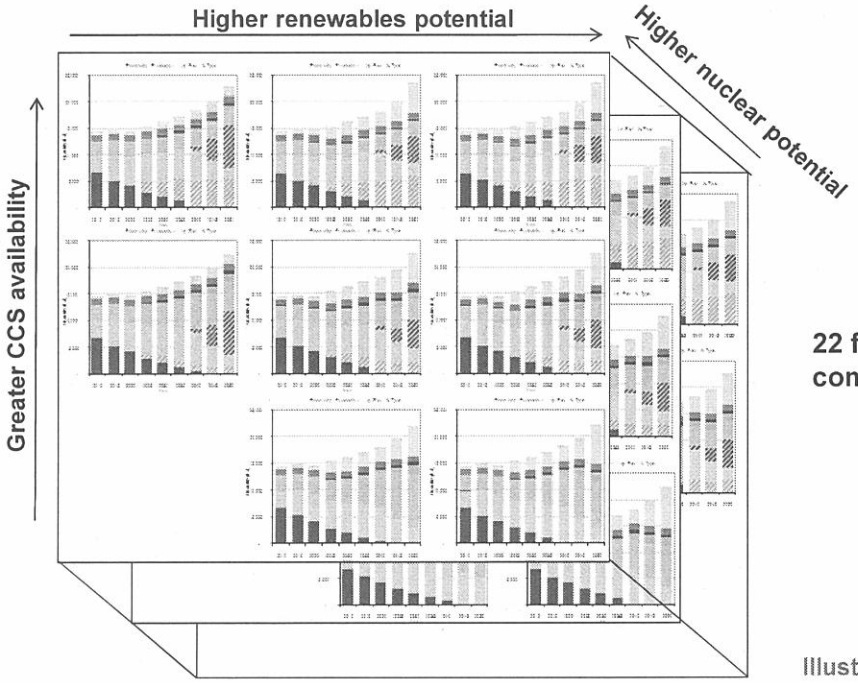
PM_{10} emission reductions by U.S. Census division:

Percent change in emissions from 2000 to 2050



Alternative pathways for EGU GHG reductions

27 pathways were examined, differing in their assumptions about the achievable expansion of renewables, nuclear and CCS



22 feasible combinations

For more information…

About the EPA MARKAL databases:

- Carol Lenox (lenox.carol@epa.gov)

This analysis:

- Dan Loughlin (loughlin.dan@epa.gov)

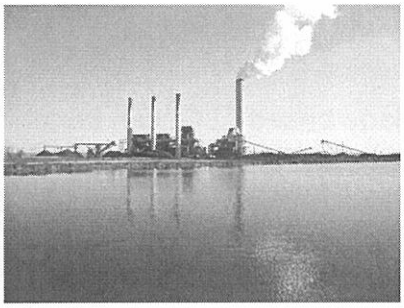
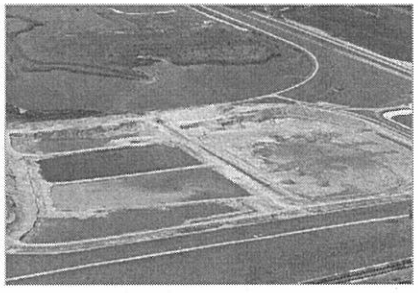
Preliminary observations

- A GHG mitigation strategy can yield air pollutant emission reductions
- These emission reductions will differ regionally as a function of:
  - Stringency of existing regulations
  - Projected growth in energy demands
    - Population growth and migration
    - Economic growth and transformation
    - Climate change
  - The existing energy infrastructure
  - The regional availability of low-polluting renewable energy resources (e.g., wind and solar)

Two CWA Rules in Development

- Steam Electric Effluent Limitations Guideline (ELG)
  - Revision of 1982 rule
- §316(b) Cooling Water Intake Structures Regulation for Existing Facilities
  - Rule responding to court decisions

Clean Water Act Regulations Affecting Electric Utilities

35th Annual EPA-A&WMA Information Exchange
December 8, 2010

Background -- Steam Electric Industry ELG

- Steam electric point source category
  - Approx. 1200 facilities
    - 500 coal-fired
    - 700 gas, oil and nuclear
  - Includes fossil (coal, oil, gas) and nuclear-fueled power plants, but not fuels such as biomass, tires, etc.
  - Excludes generating units operated by industrial sites
- Steam electric ELGs were last revised in 1982
  - 1982 ELG set limitations for TSS, oil & grease, copper and iron from metal cleaning, chlorine from cooling water
  - Review of ELG in 2006 showed high toxic loadings, relative to other industry sectors
  - Detailed study of industry showed current regulations are outdated

Background -- Effluent Limitation Guidelines

- The Clean Water Act provides that point sources cannot discharge wastewater into waters of the US unless covered by a permit.
- Permits contain discharge limitations which can be numeric limits and/or best management practices.
- Permit limitations
  - Floor is the technology-based ELG; can be more stringent if needed to meet water quality standards
  - If no ELG, technology limitations are case-by-case based on best professional judgment
- Several levels of technology-based ELGs (BPT, BCT, BAT, NSPS).
  - For example, best available treatment technology requires EPA to establish limitations based on the best technology available and affordable, non-water quality environmental (including energy requirements), and such factors as the EPA Administrator deems appropriate.

Environmental Impacts & Concerns

- Surface water discharges
  - Bioaccumulation in aquatic life & birds; contamination of benthic sediments
  - Mortality, reproductive, population & other impacts
  - Fish advisories/prohibitions
  - Water quality criteria exceedances
  - Highly diluted discharges mask the large mass loadings of bioaccumulative metals
  - Aggregate nitrogen loads to watershed
- Surface impoundments
  - Harm to wildlife attracted to treatment ponds and constructed wetlands
  - Ground water contamination
    - Contaminated public & private drinking wells
    - Several sites placed on National Priorities List
    - Contaminated ground water from leaking ponds & landfills migrates away from site, degrading surface water & wetlands

Findings from the Detailed Study

- Most toxic pollutants are released by flue gas desulfurization (FGD) wastewater & ash ponds
- Rapid growth in use of FGD systems. Unregulated pollutants present in ash ponds, FGD wastewater, & landfill leachate
  - Metals
    - Mercury, selenium & arsenic are of most concern
    - Bioaccumulative
  - Nutrients, especially nitrogen (nitrates, ammonia)
  - Total dissolved solids, chlorides
- Announced start of rule in Sept 2009
- Coal-fired plants are main focus of the rule, but also need to investigate oil, gas, & nuclear
  - New rule will look at pollutants from FGD, ash ponds, leachate from landfills and ash ponds, emerging wastes (mercury controls, coal gasification, carbon capture), metal cleaning, nuclear waste

Timing of Rule -- Consent Decree

- Notice of intent to sue
  - Alleged failure to carry out mandatory duty to review and revise effluent guidelines within one year
  - Filed by Earthjustice and Environmental Integrity Project, on behalf of Sierra Club and Defenders of Wildlife
- Status of consent decree
  - Signed by DOJ and filed with Court
    - Proposed rule by July 23, 2012
    - Final rule by January 31, 2014
  - Utility Water Act Group (UWAG) filed to intervene; pending with Court

Rulemaking Activities

- Information Collection Request (ICR)
  - Extensive survey of industry to collect information on technologies, discharges, costs and financials. All coal-fired plants surveyed; sample of others.
- Wastewater sampling
  - EPA performance sampling of seven facilities will be used to set numeric limits; also facilities will be performing longer-term sampling
  - Facility sampling of leachate
- Analysis of industry costs and economic impacts of various regulatory options; benefits; other impacts

Rulemaking and Litigation History

- 316b of CWA requires the "best technology available for minimizing adverse environmental impacts" (BTA). Prior to a series of court cases, used ELG/BAT approach
- Lots of rulemaking and litigation involving
  - Three rules addressing
    - Phase I - new facilities – requires closed-cycle cooling
    - Phase II - large existing power plants – impingement and entrainment controls short of closed-cycle; depends on waterbody type
    - Phase III – new offshore oil and gas; small existing power plants and all existing manufacturing facilities – closed cycle for o&g; no national rule for existing facilities but case-by-case BPJ
  - Litigation on all three phases
    - Phase I rule upheld except for restoration
    - Phase II rule – significant portions not upheld, EPA stay of rule; certain aspects appealed to US Supreme Court; 2009 USSC decision gives EPA discretion to balance costs and benefits, and consider other factors
    - Phase III – o&g upheld; EPA requested remand of existing facility portion

Background on 316b

- Facilities withdraw 226 billion gallons of water per day for cooling; represents 49% of all water withdrawals from US waters
  - Larger fish unable to swim away are **impinged** against screens and usually die (40% of issue).
  - Smaller organisms that pass through the screens are **entrained** in the cooling system and also die (60% of issue).
- Most facilities employ **once thru cooling** which uses water only once as it passes through a condenser to absorb heat and is then discharged
  - Technologies exist to effectively address
- **Closed cycle cooling** reuses water by recycling it through recirculating systems or towers; most protective of aquatic organisms, reducing both impingement and entrainment by 95-98%
  - Also addresses thermal impacts of once thru cooling
  - Some evaporative losses with wet cooling; none with dry cooling
  - Expensive technology with some energy and air impacts

Timing of Rule – Settlement Agreement

- Long litigation history, including a consent decree dictating the schedules for the original three rulemaking phases, and a mandatory duty suit associated with Phase III
- Settlement agreement with Riverkeeper to dismiss original consent decree issue and Phase III mandatory duty suit
- Timeline under settlement agreement
  - Proposed rule by March 14, 2011
  - Final rule by July 27, 2012

Current 316b Rulemaking

- Revising requirements for existing facilities of Phases II and III (all existing power plants and manufacturing facilities)
- Collecting new data
  - Dozens of site visits
  - New impingement and entrainment studies
  - Updating costs and effectiveness of technologies
  - Updating impacts on industries
  - Updating benefits
    - Stated preference study to monetize non-use values of rulemaking

EPA Regulations Affecting the Power Sector

- Tailoring Rule
  - Beginning in 2011, power plant projects that will increase greenhouse gas (GHG) emissions substantially will require an air permit
    - Finalized in May 2010
- Transport Rule (Clean Air Interstate Rule (CAIR) Remand Response)
  - Will reduce SO_2 and NO_X emissions from existing power plants in 31 states/Washington DC
  - Proposed in July 2010; expected to be finalized in late Spring 2011
- New Source Performance Standards (NSPS) for coal- and oil-fired electric utility steam generating units (EGUs)
  - Will regulate SO_2, NO_X, and PM emissions from new EGUs
  - Proposal anticipated in March 2011; expected to be finalized in November 2011
- Effluent Guidelines for steam electric power generating (wastewater, ash handling, wastewater treatment, surface impoundment and landfill operations, etc.)
  - Consent decree requires proposal in July 2012; final action in January 2014
- Solid waste regulations for EGU coal ash (coal combustion residuals)
  - Proposed in June 2010
- National Emission Standards for Hazardous Air Pollutants (NESHAP) for coal- and oil-fired EGUs (Utility NESHAP)
  - Will regulate hazardous air pollutant (HAP) emissions from new/existing EGUs

OAQPS

OAQPS

Office of Air Quality Planning and Standards

35th Annual EPA-A&WMA Information Exchange

December 8, 2010

Effect of Vacatur

- Coal- and oil-fired EGUs remain a listed source category for which EPA must issue emission standards under CAA section 112(d).
- EPA will address all HAP that are emitted from coal- and oil-fired EGUs – not just mercury.
- Operating under a Consent Decree negotiated with litigants (American Nurses Assn., et al.; represented by Earthjustice)
  - No later than March 16, 2011, EPA shall sign a notice of proposed rulemaking
  - No later than November 16, 2011, EPA shall sign a notice of final rulemaking

OAQPS

Project History

- In December 2000, EPA determined that it was "appropriate and necessary" to regulate emissions of hazardous air pollutants (HAP) from coal- and oil-fired electric utility steam generating units (EGUs) and added such units to the CAA section 112(c) list of sources to be regulated under CAA section 112.
- In March 2005, EPA found it was neither "appropriate *nor* necessary" to regulate HAP emissions from EGUs and removed those units from the CAA section 112(c) source category list.
- In May 2005, EPA issued the Clean Air Mercury Rule (CAMR), which regulated mercury from EGUs through a cap and trade program under CAA section 111.
- In February 2008, the Court vacated EPA's action that removed EGUs from the section 112(c) source category list and vacated CAMR.

OAQPS

Overview of Section 112

- Section 112 of CAA mandates that EPA develop standards for hazardous air pollutants (HAP) for both major and area sources listed under section 112(c).
  - The section 112 definition of EGU does not distinguish between area and major sources.
  - Major sources of HAP are those that have the potential to emit 10 tons per year (tpy) or more of any one HAP or 25 tpy or more of any combination of HAP.
- Section 112(d)(2) states that major source standards must be based on the maximum achievable control technology (MACT).
- Section 112(d)(3) sets minimum stringency criteria (MACT Floor) – costs may not be considered
  - For existing sources:
    - "The average emission limitation achieved by the best performing 12 percent of existing sources.."
  - For new sources, the MACT floor is:
    - "The emission control achieved in practice by the best controlled similar source

OAQPS

Definition of EGU

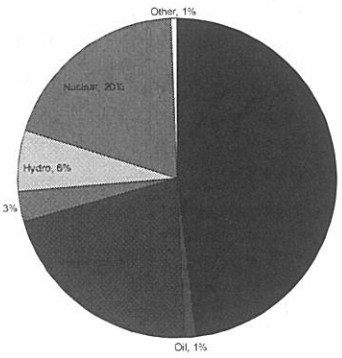
- The "electric utility steam generating unit" source category includes those units that combust coal or oil for the purpose of generating electricity for sale and distribution through the national electric grid to the public.

- Section 112(a)(8) defines an "electric utility steam generating unit" as:
  - Any fossil fuel-fired combustion unit of more than 25 megawatts electric (Mwe) that serves a generator that produces electricity for sale. A unit that cogenerates steam and electricity and supplies more than one-third of its potential electric output capacity and more than 25 Mwe output to any utility power distribution system for sale is also considered ann electric utility steam generating unit.

OAQPS

Affected Facilities

- **Approximately 1,350 EGUs at 525 facilities**
- **Approximately 1,100 coal-fired boilers at approximately 450 facilities in 44 States and Puerto Rico**
  - Many units are "base-load" with generally high capacity factors.
    - Base-load units are large units used to meet the electricity demand that is relatively constant.
    - Approximately 48 percent of nationwide net generation
      - Bituminous coal ~ 50% of coal generation
      - Subbituminous ~45% of coal generation
      - Lignite ~ 5% of coal generation
- **Approximately 150 oil-fired boilers at approximately 75 facilities, mostly in Northeast, Midwest, Florida, Hawaii, Guam, and Puerto Rico**
  - Many units are peaking units with low capacity factor utilization over the past 3 – 5 years.
  - Many co-fire with natural gas or use natural gas preferentially but must have oil capability for use during periods of natural gas curtailments to industry.
  - Approximately 1 percent of nationwide net generation
- **Industry includes investor-owned, publicly-owned, and rural cooperatives.**
- **Natural gas was not listed in the December 2000 regulatory determination.**
  - Approximately 21 percent of nationwide net generation



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Overview of Section 112 (cont.)

- EPA may regulate "beyond the floor" where justified – costs and other issues must be considered
- MACT may differ for new and existing sources.
- Section 112(d)(1) provides EPA with authority to distinguish among classes, types, and sizes of sources.
- Section 112(d)(4) provides EPA with discretionary authority to establish health-based emission standards for HAP for which a health threshold has been established.
- Section 112(h) allows the use of work practice standards instead of emission standards if enforcement of an emission standard is "not feasible", as that term is defined in that section.

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Data Needs

- Have limited current data for all HAP from coal- and oil-fired units
  - EPA must address all HAP emitted from EGUs so data on the HAP emitted is required to establish standards.
  - There have been changes in emissions control equipment since 2005 that result from implementation of CAIR and State-based mercury regulations.
- Completing a major information collection request (ICR) to obtain the necessary data from coal- and oil-fired units
  - 1,332 units to provide updated facility information on boiler, fuels, controls, etc. and all available data from past 5 years
  - Requires emission testing of ~800 units
  - Approximately 95% of data collection is complete; analyses are ongoing
  - "Air Toxics Standards for Utilities" web page can be found at: http://www.epa.gov/ttn/atw/utility/utilitypg.html
    - Data files of emissions data (Microsoft Access format)
    - Extracted data worksheets (Microsoft Excel format)
- Data necessary for development of legally supportable regulation
  - Need sufficient representative data for MACT floor determinations
  - Need data on variability
  - Need data on range of fuels
  - Need data to demonstrate that any surrogate standards are reasonable

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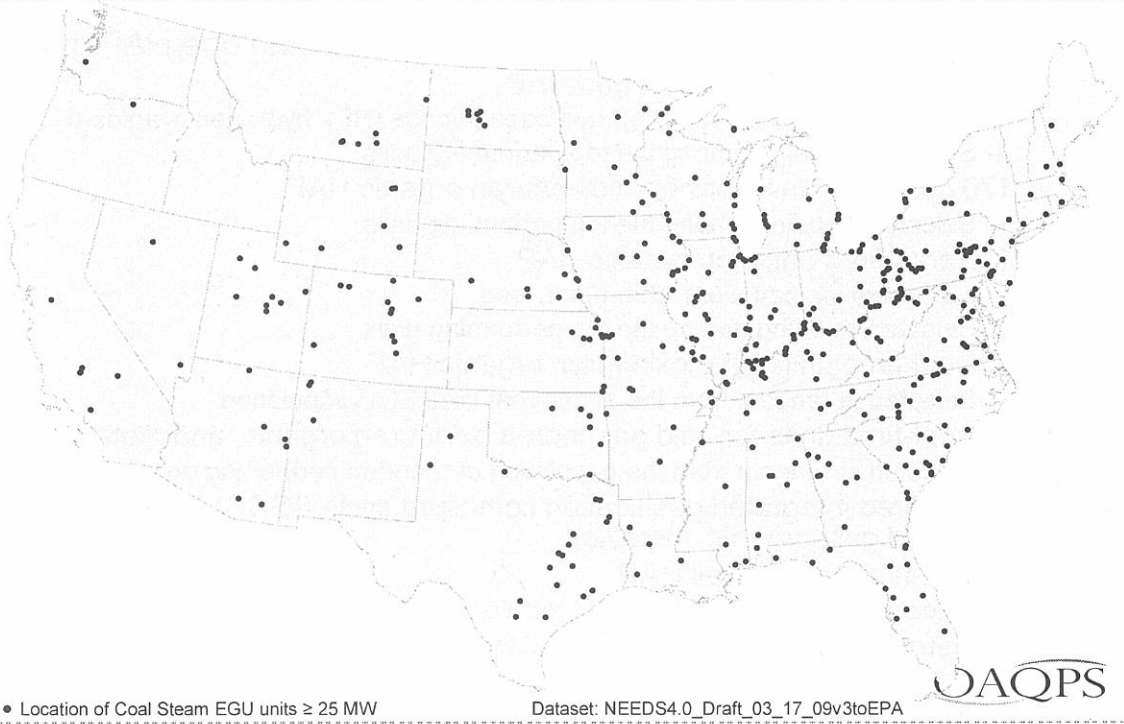
Coal Steam Units ≥25 MW



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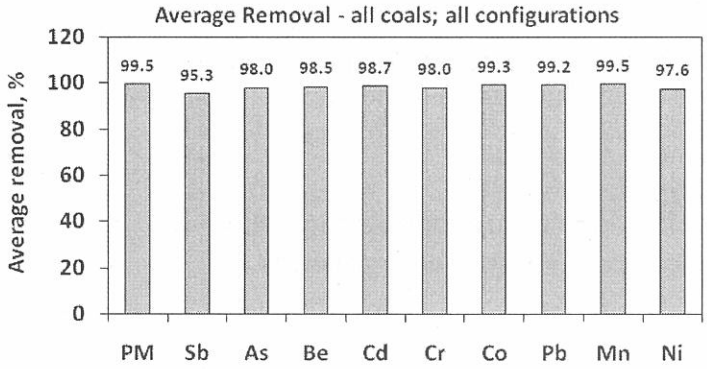
• Location of Coal Steam EGU units ≥ 25 MW Dataset: NEEDS4.0_Draft_03_17_09v3toEPA

Data Needs Example

- Surrogacy Example
  - Bulk particulate matter (PM) removal as a surrogate for non-Hg metal HAP (antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, selenium)
  - Testing conducted in EPA's pilot-scale combustion research facility
  - The level of bulk PM control seems to correlate with control of all non-Hg metal HAP except selenium – regardless of coal type or control configuration.
  - Selenium control appears to be dependent upon fuel-type and configuration.



Selenium control

- **Very variable** for bituminous coal (ESP)
- **89 %** for TX lignite (ESP)
- **99 %** for sub-bituminous coal (ESP)

- **99 %** for bituminous coal (FF)
- **99 %** for TX lignite (FF)
- **99 %** for sub-bituminous coal (FF)

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Utility MACT ICR

- Testing requirements (some units will test more than one HAP group)
  - 170 coal-fired units for acid gas HAP
    - e.g., hydrogen chloride (HCl), hydrogen fluoride (HF), hydrogen cyanide (HCN)
    - Selected as being among the top performing units
  - 170 coal-fired units for non-dioxin/furan organic HAP
    - Selected as being among the top performing units
  - 170 coal-fired units for metallic HAP
    - e.g., mercury, cadmium, chromium, lead
    - Selected as being among the top performing units
  - 50 coal-fired units for dioxin/furan organic HAP
    - Selected at random from the entire coal-fired EGU population
  - 50 coal-fired units for acid gas, non-dioxin/furan organic, and metallic HAP
    - Selected at random from the population of "non-top performing units"
  - 2 coal-fired integrated gasification combined cycle (IGCC) units for all HAP (i.e., acid gas, organic, metallic)
  - 100 oil-fired units for all HAP
    - Selected at random from the oil-fired EGU population
  - 16 petroleum coke-fired units for all HAP

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Floors and Variability

- Must adhere to language of section 112 regarding MACT floors
- Determining variability
  - May not go outside the top performing 12 percent unless EPA can show a demonstrated relationship between the variability of the worst performers and the variability of the best performers.
  - Will look at all applicable variability components
  - Recent regulatory actions (Portland Cement NESHAP and Major Source Boilers NESHAP) have assessed variability based on the 99th percentile upper predictive limit (UPL).
    - Means that for a future test from a best performing source, there is 99 percent confidence that the reported level will fall at or below the UPL value
- Beyond-the-floor options
  - Regulatory options more stringent than the MACT floor must be considered.
  - Can include additional control technologies, process changes, or other means of reducing HAP
  - Costs and other impacts are considered.

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Rulemaking Options under Consideration

- Scope of rulemaking
  - Pollutant-specific limits vs. use of surrogates (e.g., PM)
  - Approach to assess variability
  - Must explore "beyond-the-floor" options
- Subcategorization
  - CAA authorizes subcategorization by class, type and size
  - Will consider and evaluate bases for subcategorization
    - Boiler design (e.g., units designed to burn various ranks of coal vs. units designed to burn oil vs. IGCC)
    - Unit type (e.g., fluidized bed, pulverized coal)
    - Duty cycle (e.g., peaking units vs. base-load units)
- Alternative standards available under CAA section 112
  - Work Practice Standards
  - Health Based Emission Limits
- Oil-fired units
  - Will consider impact on marginal, low-capacity factor, peaking units for which compliance could result in closure

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Questions?

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Project Oversight: **Bob Wayland**
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wayland.robertj@epa.gov

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Control Technologies Potentially Required to Meet Standards

- Mercury and PM (surrogate for non-mercury metal HAP)
  - A new fabric filter installation is likely to be capable of achieving the PM emission limits and will likely assist in achieving the mercury emission limits
  - If a unit already equipped with a fabric filter emits Hg above the emission limit, the incremental Hg removal required to meet the limit can likely be achieved with installation of activated carbon injection (ACI) technology
- SO_2 or HCl (surrogate for acid gas HAP)
  - Either a wet scrubber or dry sorbent injection system is likely to be capable of achieving the SO_2 or HCl emission limit
- CO (surrogate for non-dioxin/furan organic HAP)
  - Organic HAP and CO are likely to be controlled to required levels by improving the combustion efficiency of the unit
- Expect to set limits for 5 pollutants to address all HAP emitted from EGUs
  - Mercury
  - PM (surrogate for non-mercury HAP metals)
  - HCl (surrogate for acid gas HAP)
  - CO (surrogate for non-dioxin/furan organic HAP) vs. other pollutants (e.g., polycyclic aromatic hydrocarbons (PAH) or formaldehyde)
  - Dioxin/furan

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GHG Mitigation Database

Information from literature, vendors, government agencies, states, others

Information on GHG mitigation technologies for *power, generation, transportation, industrial sectors, waste management*

- Policy makers (EPA, other federal agencies, states, foreign governments)
- Technology developers (DOE, academia, industry and vendors)
- Technology evaluators (federal agencies, states, foreign governments, industry, vendors.

The database will help answer the following questions for key technologies:

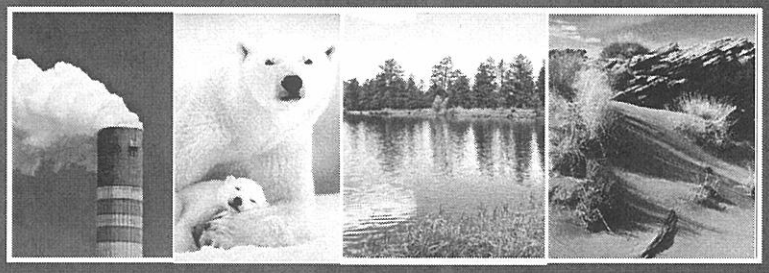
- ***What is the stage of development / demonstration and availability?***
- ***What are the barriers and R,D&D needs relevant to implementation of each technology?***
- ***What are the projected utilization costs?***
- ***What are the ancillary impacts of technology deployment?***
  - ***Water use, parasitic power load, solid waste generation, others***

National Risk Management Research Laboratory
Office of Research and Development

EPA United States Environmental Protection Agency

Greenhouse Gas Mitigation Options Database (G-MOD)

Nick Hutson



December 7, 2010
35th EPA-A&WMA Information Exchange, RTP, NC

Office of Research and Development
Air Pollution Prevention & Control Division, Research Triangle Park, NC

EPA United States Environmental Protection Agency

Database Development

- **Beta Version released for Review – April 2010**
  - Agency reviewers (ORD, OAR, Regional, etc.)
  - Small external group coordinated by CAAAC GHG BACT working group
    - State/local regulators
  - Comments / Suggestions are being addressed now
  - Current URL = http://ghg.ie.unc.edu:8080/GHGMDB/

- **Version 1.0 released – November 2010**
  - Power (Utility) and Cement Sectors only

- **Subsequent versions**
  - Additional industrial sectors (petroleum refineries, pulp & paper, iron & steel, etc.)
  - Transportation / mobile sources
  - Additional or refined information in the Power and Cement sectors

EPA United States Environmental Protection Agency

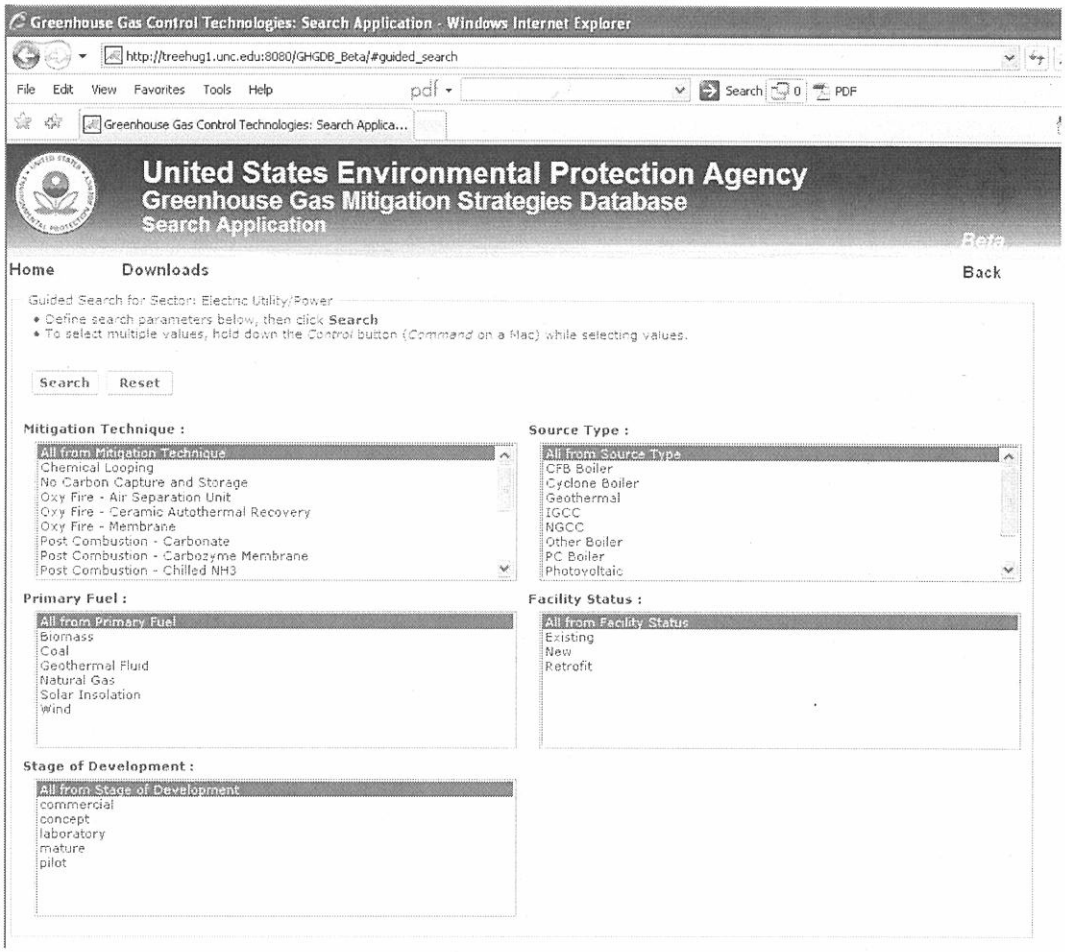
Database Development

- **Stakeholders Workshop – April 2009**
  - Government (federal, state, local) – incl. EPA, DOE, USDA, etc.
  - Technology providers / technology users
  - Energy Efficiency experts
  - Sector-specific experts
  - etc.

- **Power (Utility) Specific Workshop – November 2009**
  - Government (federal, state, local) – incl. EPA, DOE, GAO, etc.
  - Technology providers / technology users
  - Industry experts and advocacy groups
  - NGOs, etc.

- **Database Development Team**
  - Eastern Research Group (ERG) / Andover Technology Partners
  - University of North Carolina Institute for the Environment (UNC-IE)
  - EPA ORD (with input from OAR/OAQPS)

National Risk Management Research Laboratory
Office of Research and Development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Guided Search for Sector: Electric Utility/Power
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• To select multiple values, hold down the Control button (Command on a Mac) while selecting values.
Search
Reset
Mitigation Technique :
All from Mitigation Technique
Chemical Looping
No Carbon Capture and Storage
Oxy Fire - Air Separation Unit
Oxy Fire - Ceramic Autothermal Recovery
Oxy Fire - Membrane
Post Combustion - Carbonate
Post Combustion - Carbozyme Membrane
Post Combustion - Chilled NH3
Source Type :
All from Source Type
CFB Boiler
Cyclone Boiler
Geothermal
IGCC
NGCC
Other Boiler
PC Boiler
Photovoltaic
Primary Fuel :
All from Primary Fuel
Biomass
Coal
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Natural Gas
Solar Insolation
Wind
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Retrofit
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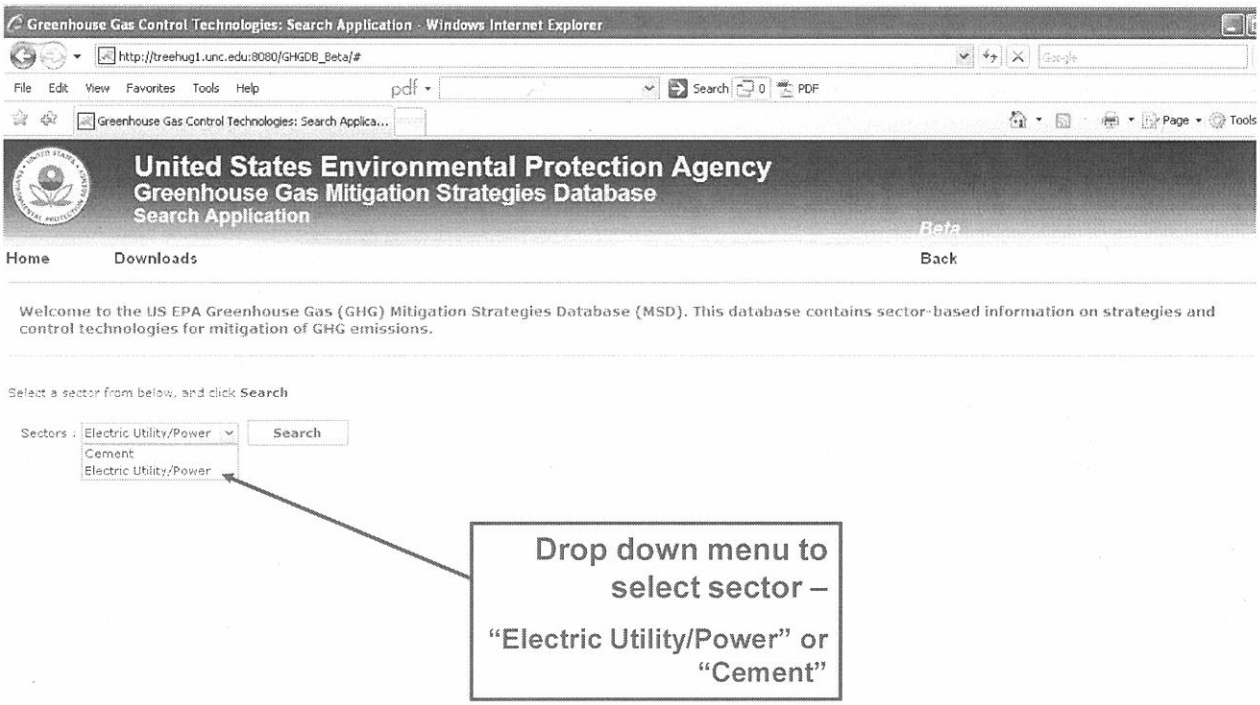
pilot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Welcome to the US EPA Greenhouse Gas (GHG) Mitigation Strategies Database (MSD). This database contains sector-based information on strategies and control technologies for mitigation of GHG emissions.
Select a sector from below, and click Search
Sectors : Electric Utility/Power
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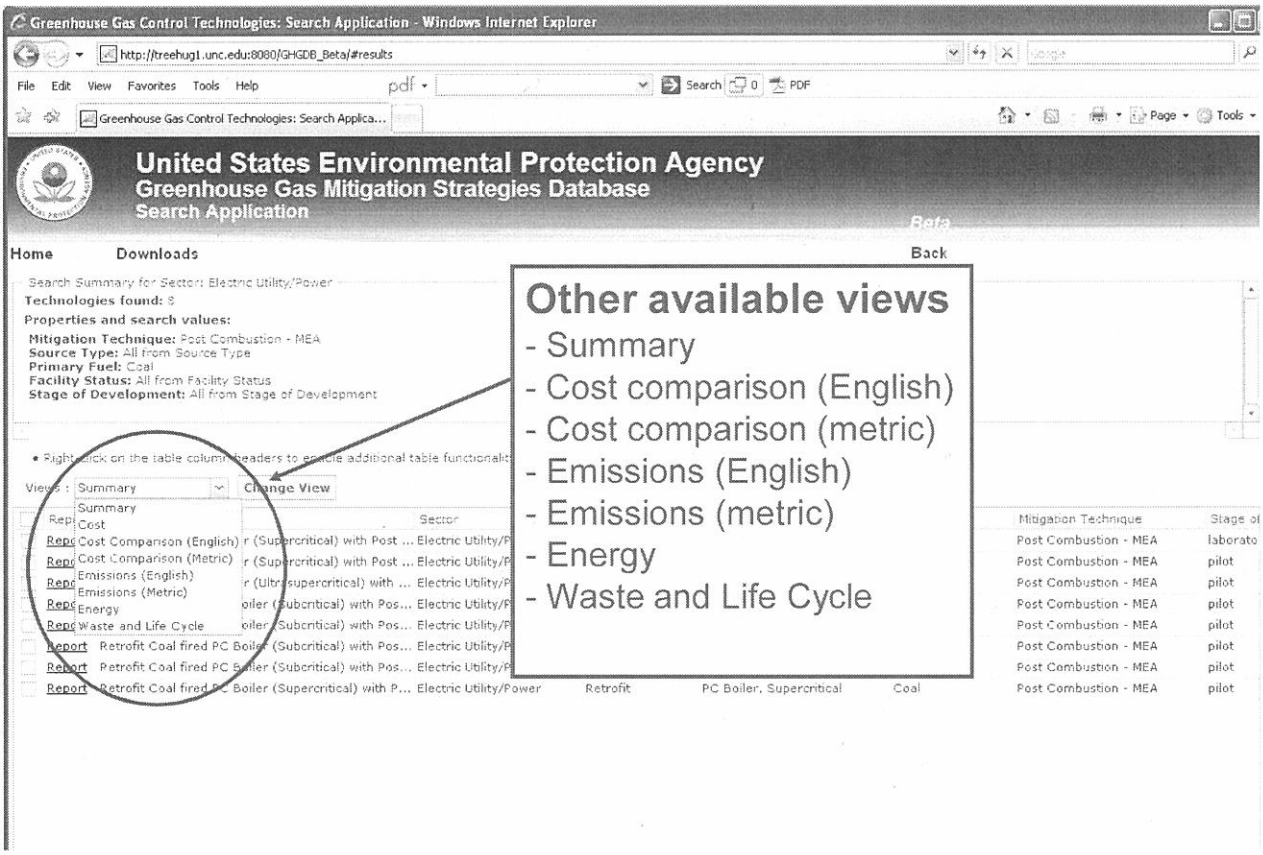
Cement
Electric Utility/Power
Drop down menu to select sector –
"Electric Utility/Power" or "Cement"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Technologies found: 8
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Source Type: All from Source Type
Primary Fuel: Coal
Facility Status: All from Facility Status
Stage of Development: All from Stage of Development
Views : Summary
Change View
Summary
Cost
Cost Comparison (English)
Cost Comparison (Metric)
Emissions (English)
Emissions (Metric)
Energy
Waste and Life Cycle
Other available views
- Summary
- Cost comparison (English)
- Cost comparison (metric)
- Emissions (English)
- Emissions (metric)
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- Waste and Life Cycle
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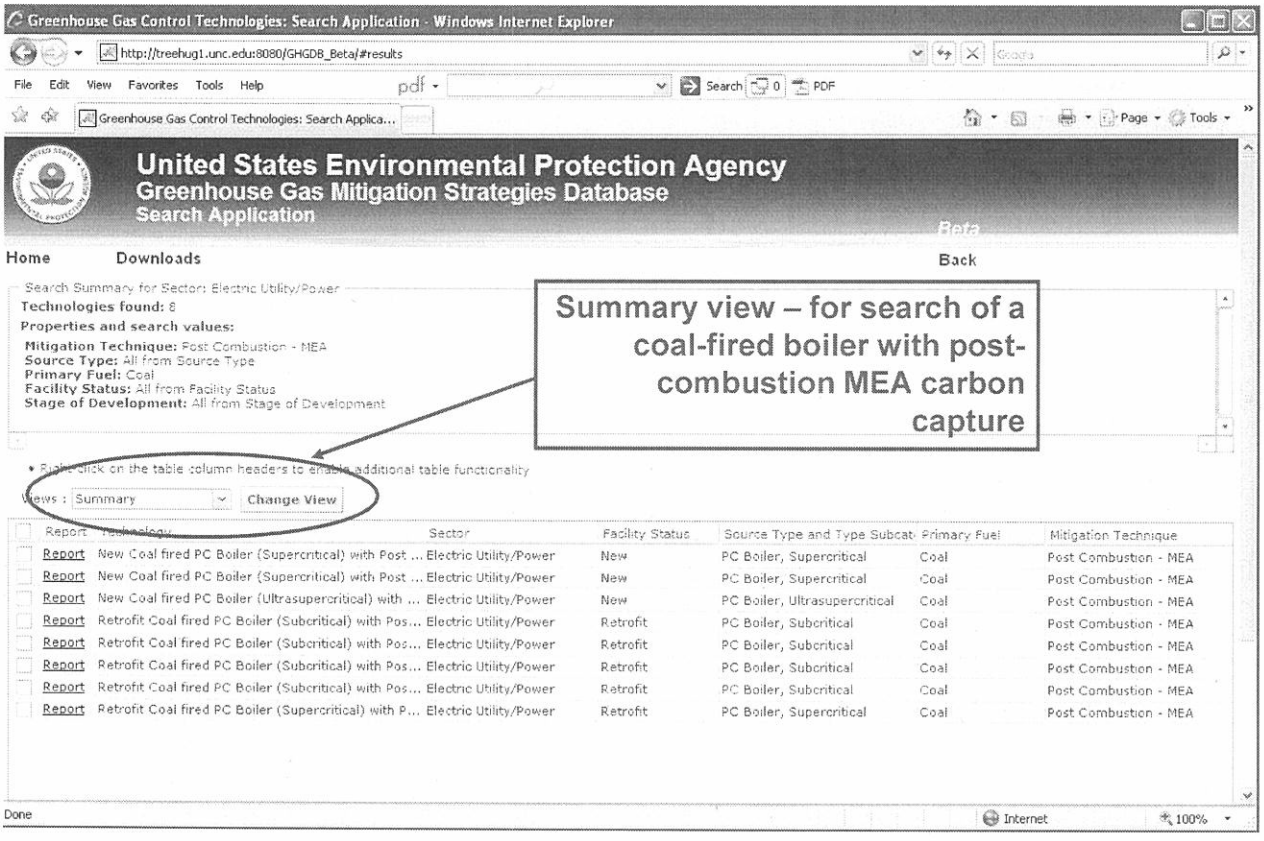
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Search Summary for Sector: Electric Utility/Power
Technologies found: 8
Properties and search values:
Mitigation Technique: Post Combustion - MEA
Source Type: All from Source Type
Primary Fuel: Coal
Facility Status: All from Facility Status
Stage of Development: All from Stage of Development
Summary view – for search of a coal-fired boiler with post-combustion MEA carbon capture
Views : Summary
Change View
Report Technology Sector Facility Status Source Type and Type Subcat Primary Fuel Mitigation Technique
Report New Coal fired PC Boiler (Supercritical) with Post ... Electric Utility/Power New PC Boiler, Supercritical Coal Post Combustion - MEA
Report New Coal fired PC Boiler (Supercritical) with Post ... Electric Utility/Power New PC Boiler, Supercritical Coal Post Combustion - MEA
Report New Coal fired PC Boiler (Ultrasupercritical) with ... Electric Utility/Power New PC Boiler, Ultrasupercritical Coal Post Combustion - MEA
Report Retrofit Coal fired PC Boiler (Subcritical) with Pos... Electric Utility/Power Retrofit PC Boiler, Subcritical Coal Post Combustion - MEA
Report Retrofit Coal fired PC Boiler (Subcritical) with Pos... Electric Utility/Power Retrofit PC Boiler, Subcritical Coal Post Combustion - MEA
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