

Clean Coal: Skills Requirements and Funding for Training

Indiana Center for Coal Technology Research

**CCTR Advisory Panel Meeting
Vincennes University
September 10, 2009**

J.W. (Jim) Wheeler

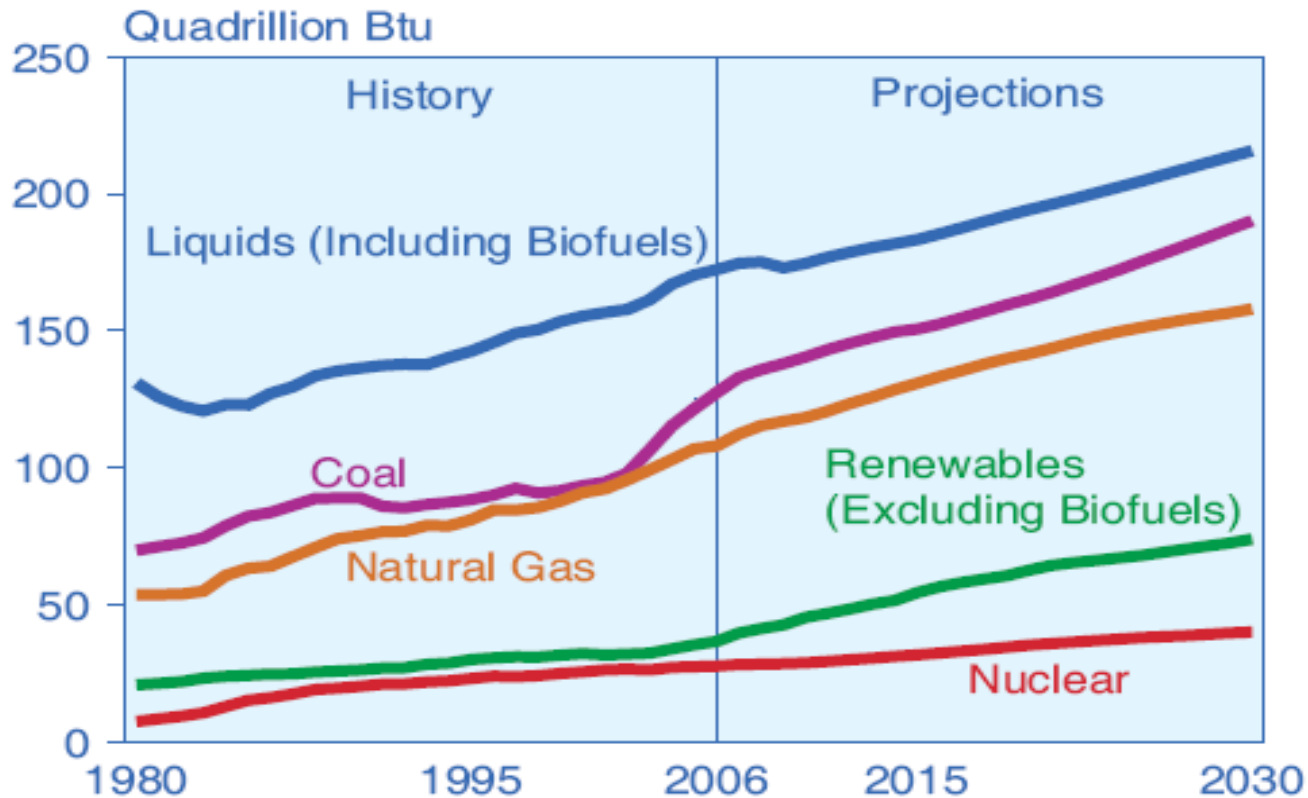


Coal Will be a Major Energy Source for the Foreseeable Future



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World Marketed Energy Use by Fuel Type, 1980-2030



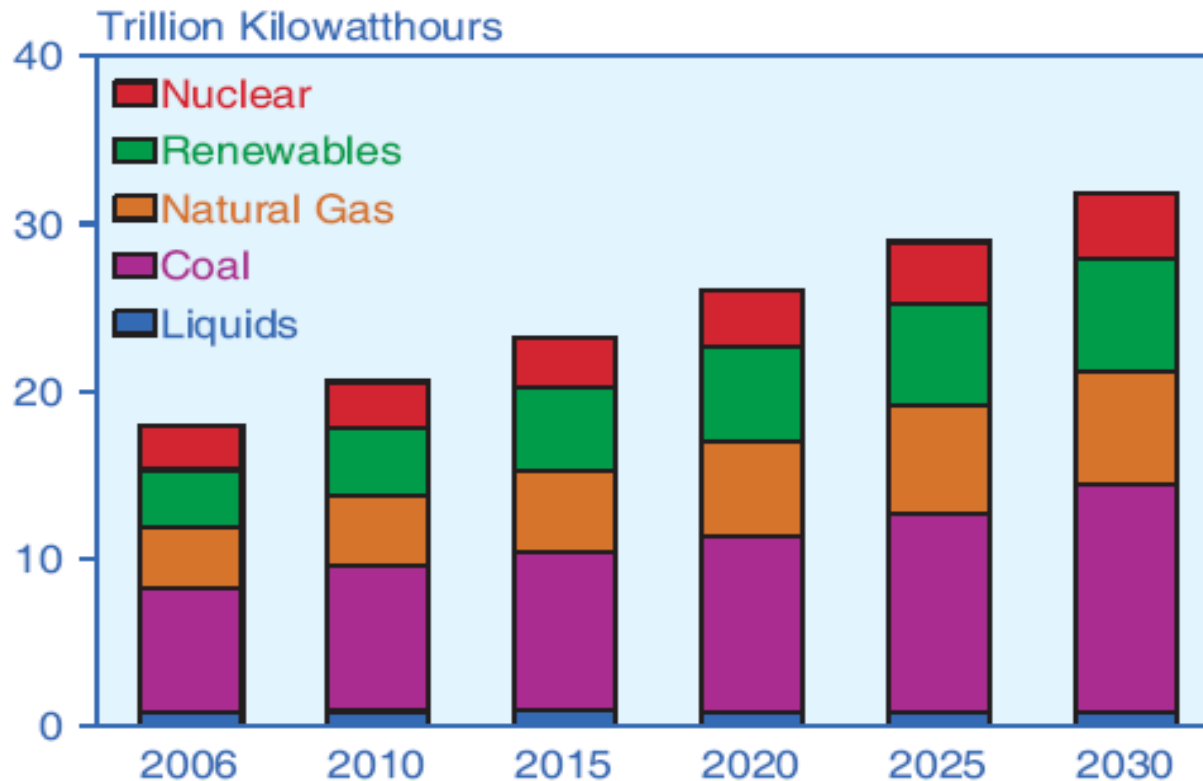
Sources: 2006: Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. Projections: EIA, *World Energy Projections Plus* (2009).

Coal Will Remain the Primary Fuel for Electricity Generation



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World Electricity Generation by Fuel, 2006-2030



Sources: 2006: Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. Projections: EIA, *World Energy Projections Plus* (2009).



Coal: Energy Asset / Environmental Challenge

- Coal reserves are abundant in the United States and in many areas of the world,
 - The largest US energy Asset
 - Attractive option from the standpoint of affordability and supply reliability.
- Coal's energy potential is accompanied by significant challenges related to its effects on the environment and human health
 - NO_x, SO_x, Particulate Matter, Mercury
 - Water (Fossil-fueled power plants account for approximately 39 percent of the water used in the United States – mostly for cooling)
 - Ash & Slag
 - Now CO₂



Clean Coal Technologies (CCTs)

Technologies that enhance both the efficiency and the environmental acceptability of coal extraction, preparation and use

- Reduce regulated emissions and waste
- Increase the amount of energy gained from each ton of coal
- Can reduce greenhouse gas emissions from any industrial or mining process involving coal,
 - but the international priority is reducing carbon dioxide emissions from coal-based electricity generation.

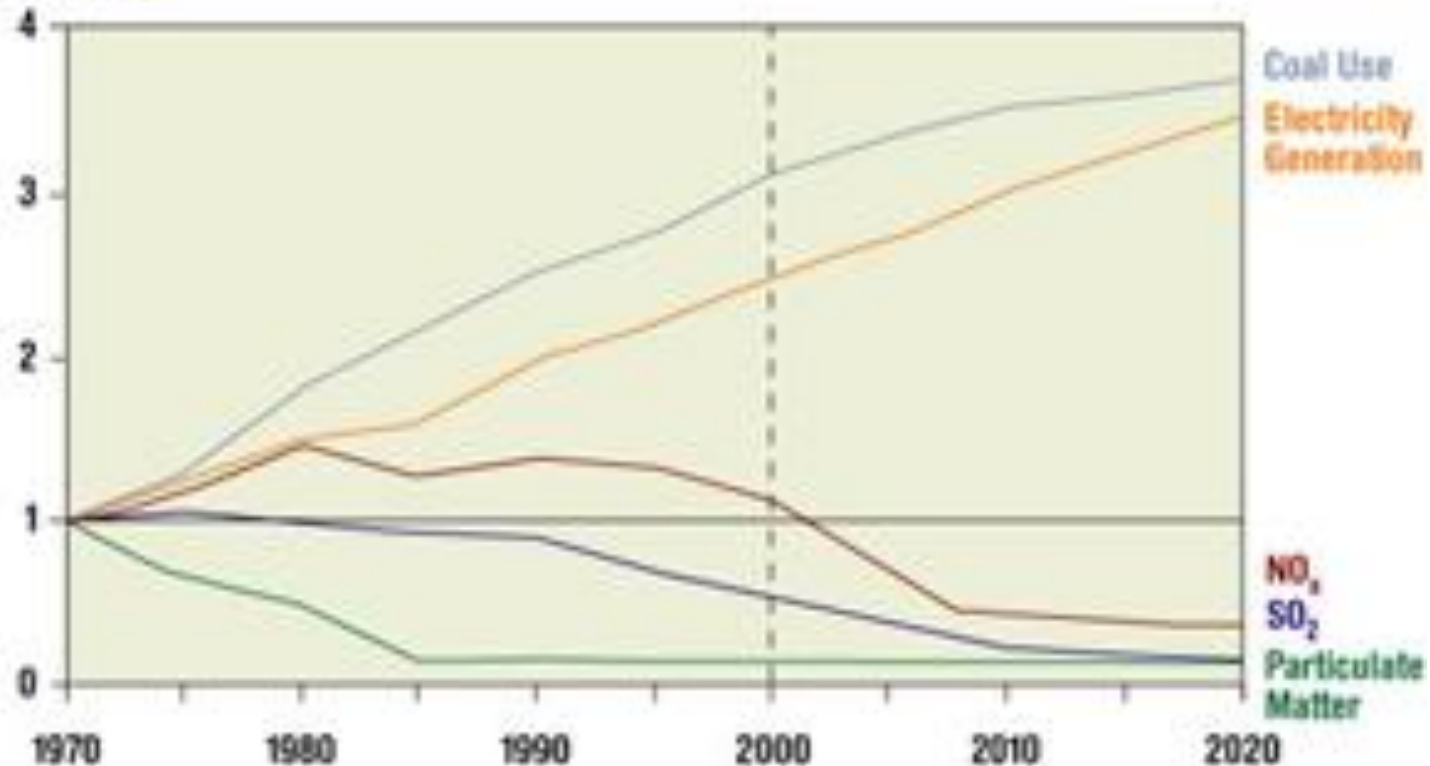
Even w/ Growing Coal Demand Criteria Pollutants' Emissions at lowest levels ever



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National Trends in Air Quality Criteria Emissions

Index: 1970 = 1



Source: EPA, National Air Quality and Criteria Trends Report, 1999 (March 2001); DOE, EIA Annual Energy Review: Projections for NO_x and SO₂; Clear Skies Initiative

Technologies with New/Changing Staffing Rqmts



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- Coal Pre-treatment
 - Coal de-watering technologies (esp. for low rank coals) to improve calorific quality and burning efficiency & reduce emissions (up to 50%)
 - Chemically washing minerals and impurities from the coal
- Advanced Pollution Control Technologies
- Advanced Power Generation Systems
 - Supercritical pulverized coal combustion(PCC)
 - Fluidized bed boilers
- Advanced and Zero Emission Coal Technologies
 - Carbon Offset, Capture & Storage
 - Biomass co-firing
 - Post combustion
 - Oxyfuel
 - Pre Combustion
 - CO2 Compression and economic use or sequestration
 - Coal to ???
 - IGCC, CTL, CT-SNG & Underground gasification



Clean Coal Deployment

- R&D over the past 20 years resulted in new, lower-cost, more efficient and environmentally compatible technologies for coal using electric utilities, steel mills, cement plants and other industries.
 - New products and systems entering the market
 - Political pressures accelerating deployment cycles
- Workers must be ready to design, build, install, operate, maintain and repair these new products and systems

Workforce Development

Policy Issues



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- ❑ Occupations associated w/ Clean coal technologies tend to require modest to high competency in chemical and environmental knowledge and processes
 - Even IGCC plant operations require different technical skills than for power-generating utilities
 - Other gasification and clean coal require more chemical plant than power plant knowledge & skills
- ❑ To date, in Indiana, most clean coal related training largely incorporated in internal and vendor provided training
 - E.g., bagging, scrubbers, water mgmt
- ❑ Future, will need growing engagement w/ education and training system
- ❑ State (Department of Workforce Development) has committed to supporting Clean Coal and Gasification as a state economic priority
 - USDOL Grant due October 20

Elements of an Indiana Clean Coal Workforce Strategy: Near Term



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- Work w/ ed/training orgs to support clean coal investments that increase use of Indiana coals & moderate increases in electricity rates
- Expand clean coal content in recently launched Power curriculum developed by Ivy Tech and “the Consortium” to meet looming retirement profile
- Work w/Duke re rqmts for Edwardsport IGCC staff upgrading & replacement (direct staff < 100)
 - Launch will rely primarily on internal recruiting and skill upgrade training developed in consultation with vendors
- Work with Indiana Gasification LLC on recruiting, skill upgrades, and training pipeline for planned Rockport Coal-SNG plant (direct staff ≈ 200)

Elements of an Indiana Clean Coal Workforce Strategy: Medium –Longer Term



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- Three prong approach under consideration
 - Basic chemical/environmental pgm to support traditional coal users as they adapt to changing regulatory rqmts
 - applicable to other carbon based fuels
 - Basic & advanced gasification program to support coal-to-whatever technology deployment
 - basic pgm applies to all refining/chemical processes incl. biofuels
 - Incorporation of CCS education/training as required
 - DOE selected Univ. partners for development of CCS skills pgm



Curricula Observations

- Most training similar to existing commercial technologies, can be adapted, not newly created
 - Combined cycle power
 - ASU
 - Gasification
 - Gas clean-up
 - Syngas/natural gas conversion to hydrogen, chemicals, liquid fuels, fertilizers
- New rqmts are more
 - Integration
 - Regulatory compliance
 - Scale-up/adoption of technologies developed/commercialized offshore
 - Associated with CCS (see attached info on DOE pgm)



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BACKGROUND INFORMATION



Major Regulatory Drivers

- ❑ Title IV acid rain program, established through the 1990 Clean Air Act Amendments (CAAA)
- ❑ Title I National Ambient Air Quality Standards (NAAQS) for ozone that led to EPA's NO_x SIP (state implementation plan) Call Rule in 1998
- ❑ Clean Air Interstate Rule (CAIR) Clean Air finalized in May 2005
- ❑ 2005 Clean Air Mercury Rule (CAMR)
- ❑ Potential CO₂ controls
- ❑ Clean Water Act, Safe Water Drinking Act, and Resource Recovery and Conservation Act



DOE CCS Training Program: I

- Training activities will focus on the applied engineering and science of carbon capture and storage for
 - site developers, geologists, engineers, and technicians
- Targeted CCS skills and competencies in
 - geology, geophysics, geomechanics, geochemistry and reservoir engineering disciplines.



DOE CCS Training Program: II

- Five activity areas:
 - **Implement an Organized Sponsorship Development Program** – *development of a self-sustained long term technology program, without federal government support*
 - **Short Courses on CCS Technologies** – *work with experts in the field to identify and develop training materials for professionals*
 - **Regional Training—Outreach and Networking** – *conduct training of carbon capture and storage technologies*
 - **Perform Regional/Basin Technology Transfer Services** – *transfer technology with various outreach materials and coordination of regional/basin efforts*
 - **Plan and Manage the Recipient's Regional Program**



DOE CCS Training Program: III

- ❑ **Board of Trustees of the University of Illinois (Champaign, IL)**— Create the Midwest Geological Sequestration Consortium Sequestration Technology Training Center
- ❑ **Environmental Outreach and Stewardship (EOS) Alliance(Seattle, WA)** —Facilitate development of a carbon capture and sequestration workforce through regional CO2 sequestration technology training in the northwest
- ❑ **New Mexico Institute of Mining and Technology (Socorro, NM)** — Develop the Southwestern U.S. Geologic CO2 Sequestration Training Center
- ❑ **Petroleum Technology Transfer Council (Tulsa, OK)**—PTTC Regional Technology Training Program
- ❑ **Southern States Energy Board (SSEB) (Norcross, GA)**—The Southeast Regional CO2 Sequestration Technology Training Program
- ❑ **The University of Texas at Austin (Austin, TX)**—Create an alliance for Sequestration Training, Outreach, Research and Education (STORE), as part of the Gulf Coast Carbon Center
- ❑ **University of Wyoming (Laramie, WY)** — Develop the Wyoming CCS Technology Institute (WCTI)