Crisis or Renaissance;
The State of America's Energy
Sioux Falls, SD
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# Coal: a national perspective

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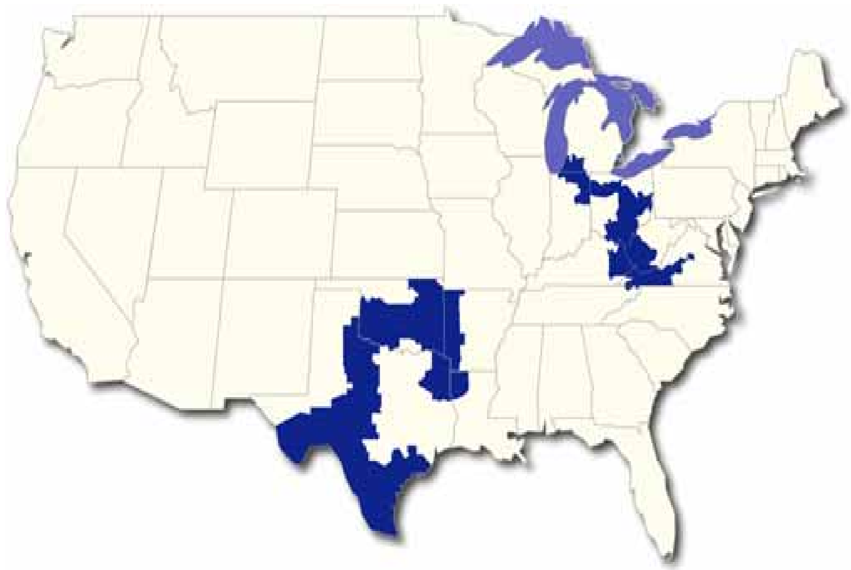
# Key Points

- No silver bullet – Portfolio mix of resources will be required to satisfy future energy needs
- Expected federal environmental policy will require further emissions reductions from existing and future coal and natural gas fired power plants
- Carbon capture and storage and enhanced oil and natural gas recovery are critically needed technologies for baseload generation to comply with anticipated federal $CO_2$ emissions reduction requirements
- States need to help shape national $CO_2$ emissions reduction policies to assure emissions are reduced at affordable costs

# An Introduction of Who We Are

- 5.2 million customers in 11 states
- +21,000 employees
- One of largest U.S. electricity generators (38,000 MW capacity)
  - 75 MW Southwest Mesa PPA
  - 150 MW Trent Wind Farm)
  - 160 MW Desert Sky Wind Farm
- 76 million tons coal/year
- Coal & transportation assets
  - Control 8,400 railcars
  - Own & operate +2,600 hopper barges & 52 towboats
  - Operate 1 active coal handling terminal with 20 million tons of capacity
- 39,000 miles of transmission lines
  - Includes 2,116 miles of 765kV lines
- 212,700 miles of distribution lines



| AEP Generation Capacity Portfolio | | | |
|---|---|---|---|
| Coal/Lignite | Gas/ Oil | Nuclear | Other - (hydro, wind, etc.) |
| 69% | 20% | 6% | 5% |

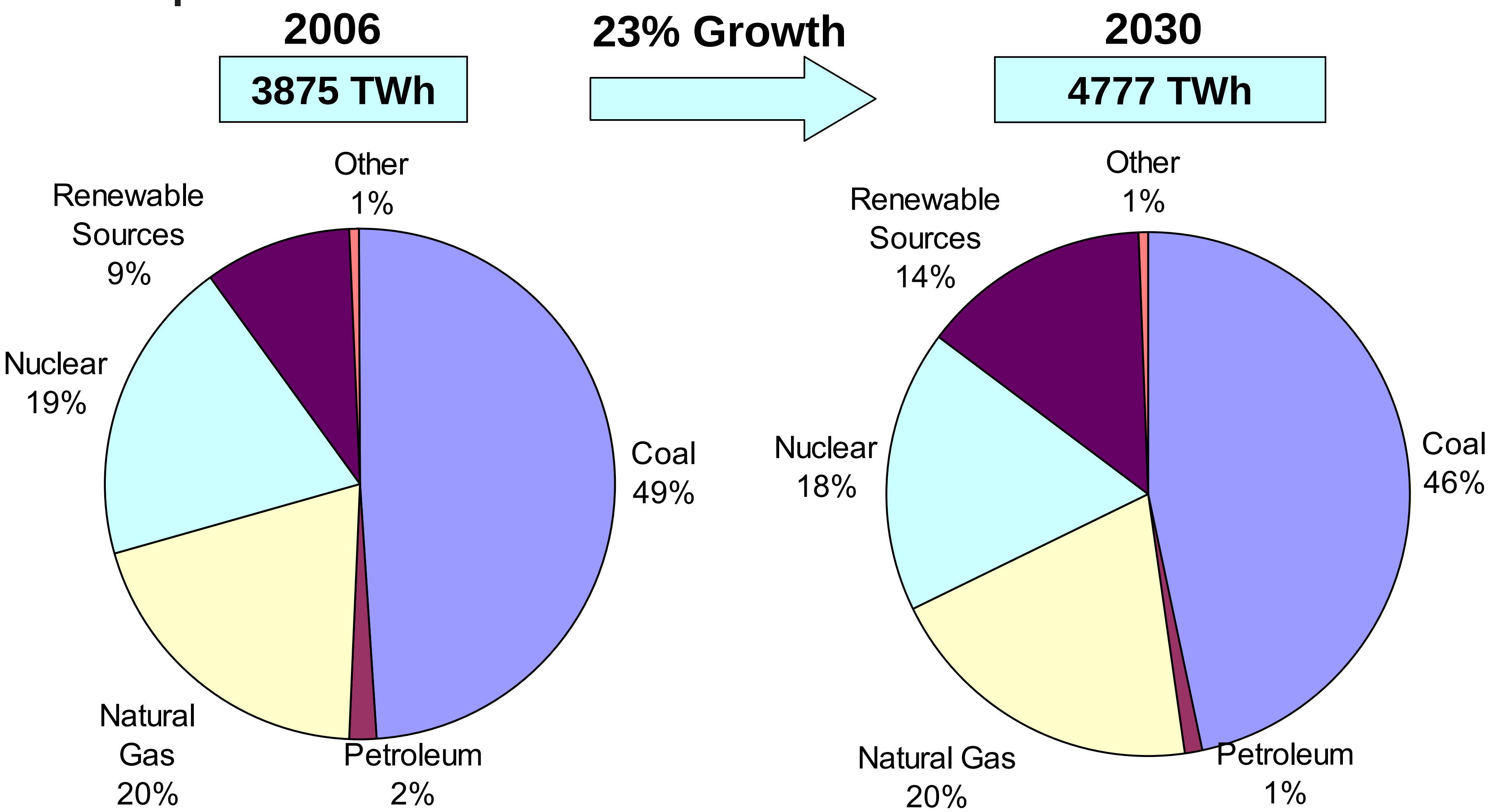
# Current State Policymaker Goals

- Ensuring electricity remains affordable, reliable and secure from domestic sources
- Addressing rising electricity demand
- Moderating electricity price increases
- Sustaining the engine of economic growth
- Increasing environmental protection
- Technology deployment critical
- Example: Plan endorsed by 12 states in Midwest Governor Association

# What do businesses and shareholders want?

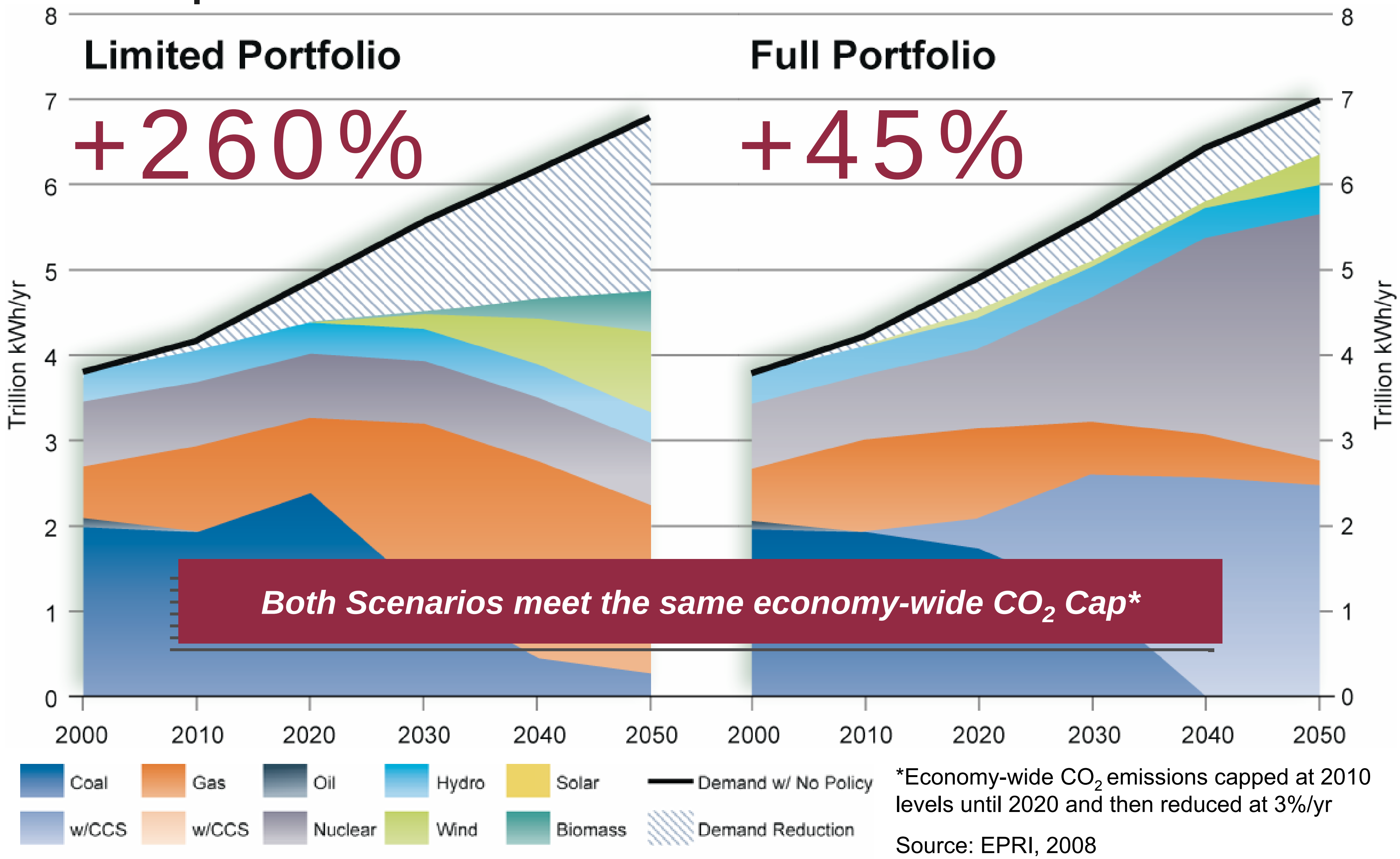
- For Large Commercial & Industrial Customers: Primary Drivers of Overall Satisfaction
  - 22% Handling of Contacts
  - 21% Reliability and Power Quality
  - 20% Price and Cost Control
  - 20% Image (includes economic development and environment)
  - 11% Account Management
  - 7% Energy Efficiency (Assistance, Information)
- What share holders want:
  - Return on investment
  - Well-managed risk

# Electricity Generation: U.S. Government Forecast




*Reference case from EIA "Annual Energy Outlook 2009"*

# Increase in Real Electricity Prices… 2000 to 2050




*Economy-wide $CO_2$ emissions capped at 2010 levels until 2020 and then reduced at 3%/yr

Source: EPRI, 2008

# World advanced integrated gasification combined cycle generation

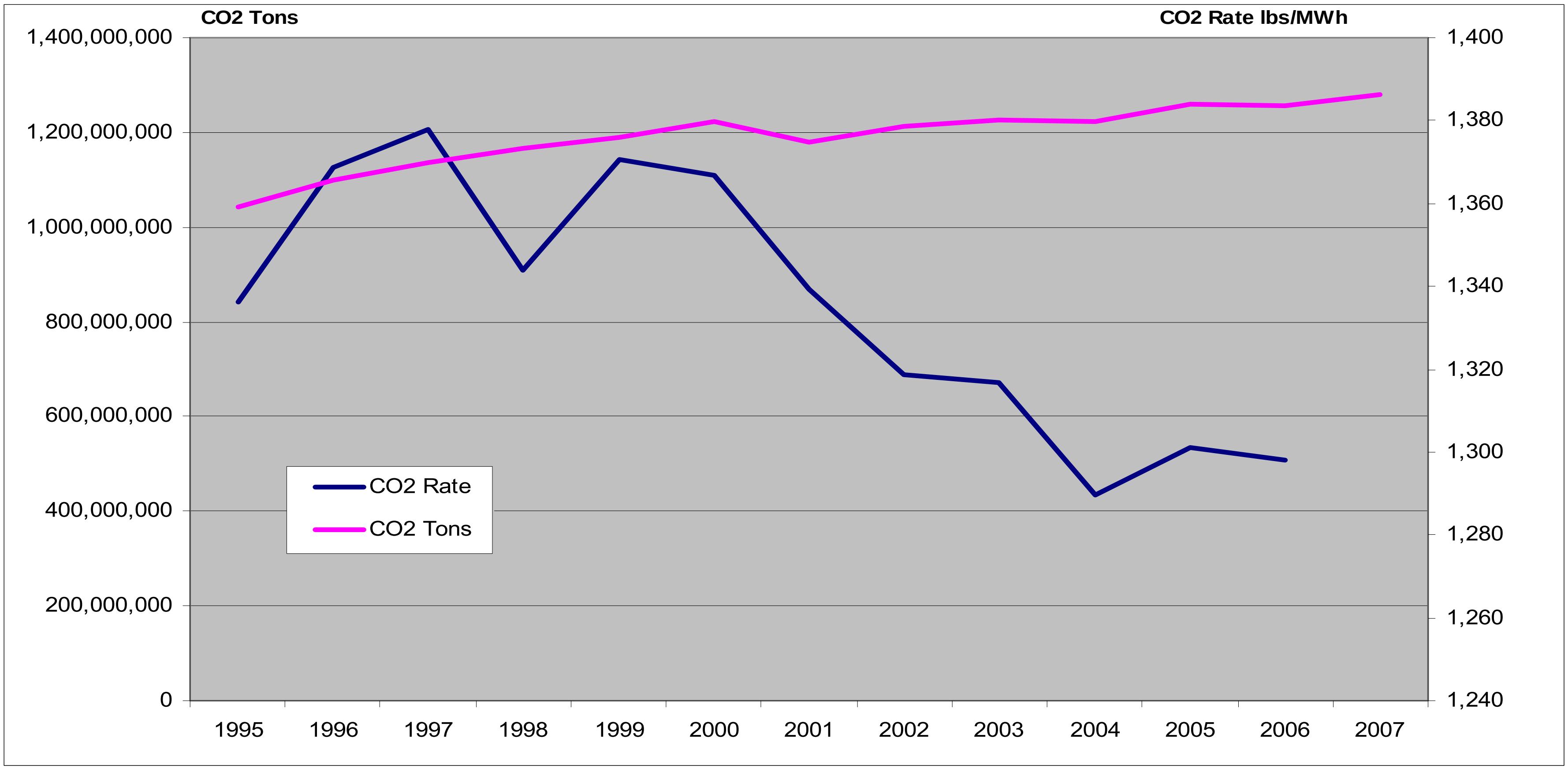
- 4 U.S. plants under construction or in operation
- 12 plants outside the U.S.

Source: Gasification Technology Council, 2009

# World ultra supercritical generation

- Mature commercial technology
- AEP’s Turk Plant (AR) one of the first in the U.S.

# Efficiency improvements of power plants in Southern Governors Association states reduces CO2 emission rates




Source: EPA Title IV State Levels $CO_2$

Source: EIA/DOE State Net Generation

# Federal Climate Change Bill Principles
(June 6, 2008 letter, 10 Democratic U.S. Senators)

- Contain costs and prevent harm to the U.S. economy
- **Invest aggressively in new technologies and deployment of existing technologies**
- Treat states equitably
- Protect America's working families
- Protect U.S. manufacturing jobs and strengthen international competitiveness
- Fully recognize agriculture and forestry's role
- Clarify federal/state authority
- Provide accountability for consumer dollars

# Federal Climate Change Bill Principles
## (Oct 2, 2008 letter, 115 House Representatives)

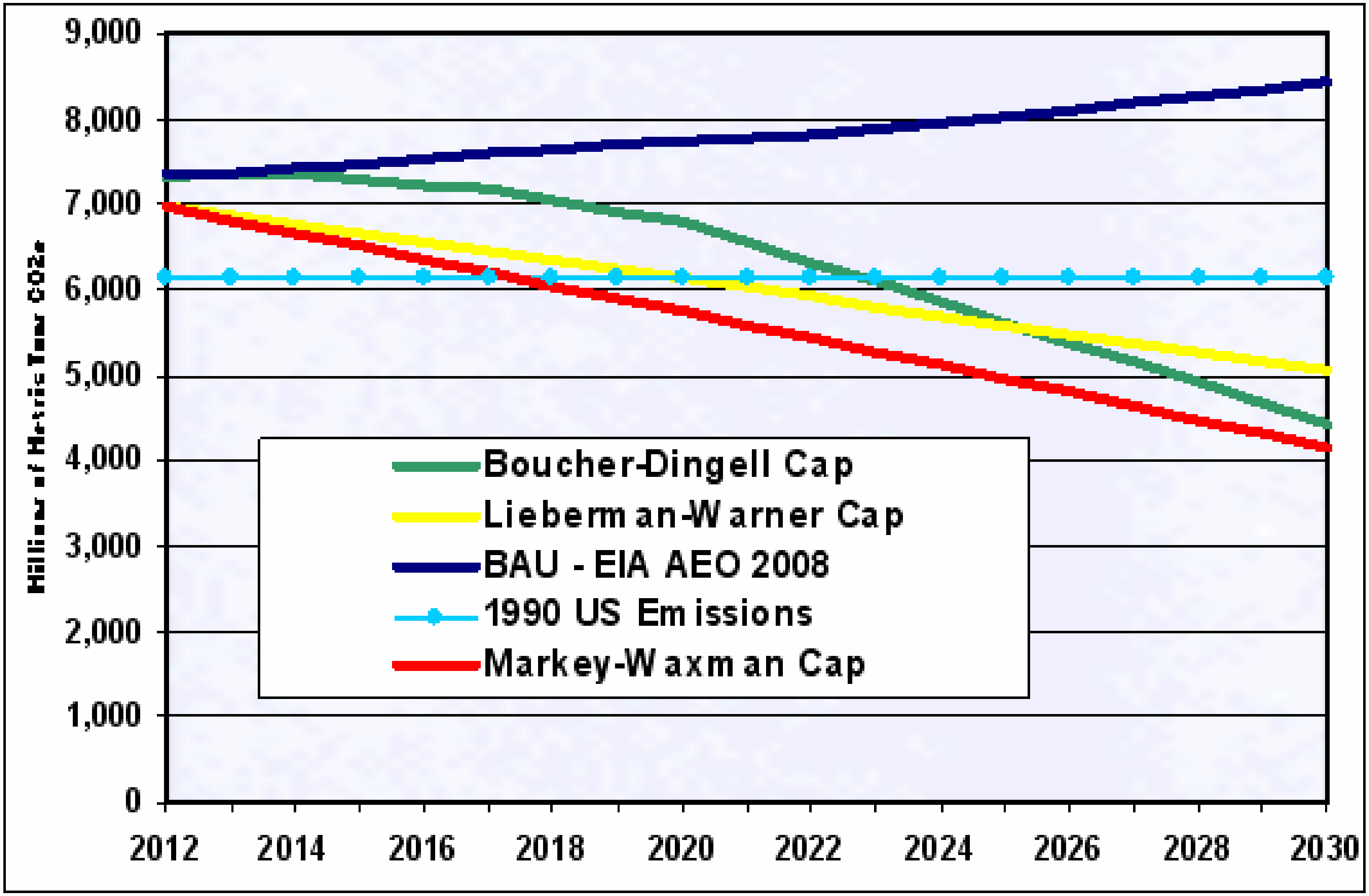
Comprehensive legislation to address global warming must achieve four key goals

- Reduce emissions to avoid dangerous global warming
- Transition America to a clean energy economy
  - **Invest in the best clean energy and efficiency technologies**
- Recognize and minimize any economic impacts from global warming legislation
- Aid communities and ecosystems vulnerable to harm from global warming

# AEP Climate Strategy

- Technologies to reduce or limit GHGs:
  - Nuclear, natural gas, and advanced clean coal plants for baseload
  - Deploy carbon capture and storage technology
  - Retirement of less efficient capacity
  - Emission offsets (e.g., forestry, methane)
  - Renewables (e.g., biomass firing, wind)
  - Supply and demand side efficiency improvements
  - Transmission grid upgrade and expansion
  - Similar to World Business Council for Sustainable Development Technology Plan in “Power to Change”

# Comparison of US Emission Caps



# Policy support to accelerate technology deployment

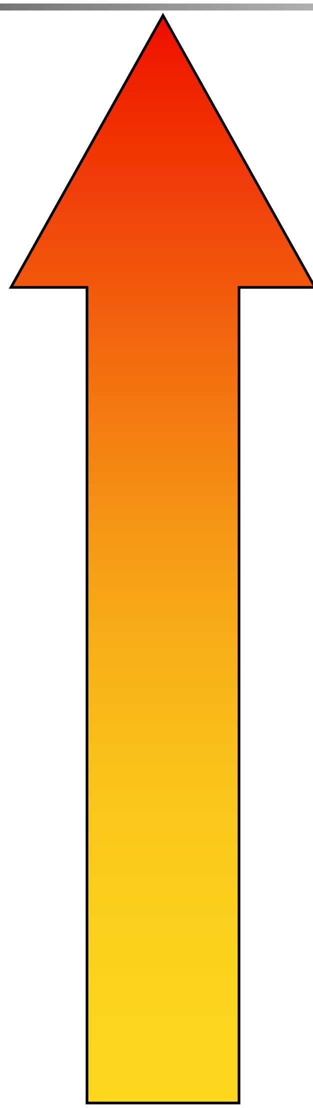
- Keys:
  - New technology deployment, including baseload generation
  - Technology financing policies encouraging investment and reducing costs
  - Policy design that supports technology deployment
    - National cap and trade
    - Reduction targets and timelines that allow commercial technology deployment
    - Carbon credits allocated to emitters, not auctioned
    - Storing CO2 underground
    - Streamlined air quality and siting permitting
    - Funding focused on advanced technology and CCS technology
    - Offsets
  - Understand economic consequences of choices

# Examples of Relative GHG Mitigation Costs for Power Sector

**$50+**

**$/ton $CO_2e$**

**$0**



- Carbon Capture w/ Geologic Sequestration (high capacity factor on coal and NG plants)
- Other renewable, advanced geothermal and/or solar
- Carbon Capture for Enhanced Oil Recovery
- New Biomass Generation
- Dispatch of additional gas vs. inefficient coal
- Biomass Co-firing
- Biological Sequestration (e.g.  Forestry)
- New Wind (low capacity factor)
- Energy Efficiency
- Methane Offsets

# Public Utility Commissions approvals to support clean energy development

- Projects approved as "in the public interest", "reasonable and necessary" and "for economic development" and not least cost test
- Pre-approval of pre-construction and construction investments for generation and transmission
- Enhanced rate of return on investment
- Cash return of construction while in progress (CWIP) at weighted average cost of capital (WACC) and return on and of investment
- No look back for prudency; no post in-service for prudency review

# State Incentives for Technology (June 2008)

| State | Cost Recovery | Financing Assistance | Tax Credits | Regulatory Streamlining | Carbon Sequestration |
|---|---|---|---|---|---|
| **Alaska** | | X | | | X |
| **Arkansas** | X | | | | X |
| **California** | | | | | X |
| **Colorado** | X | | | X | X |
| **Florida** | X | | | | |
| **Georgia** | | | | | X |
| **Idaho** | | | | X | X |
| **Illinois** | | X | X | | |
| **Indiana** | X | X | X | | |
| **Kansas** | | X | X | | X |
| **Kentucky** | X | X | X | X | |
| **Minnesota** | | X | | X | |
| **Mississippi** | | X | | | |
| **Montana** | | | X | | X |

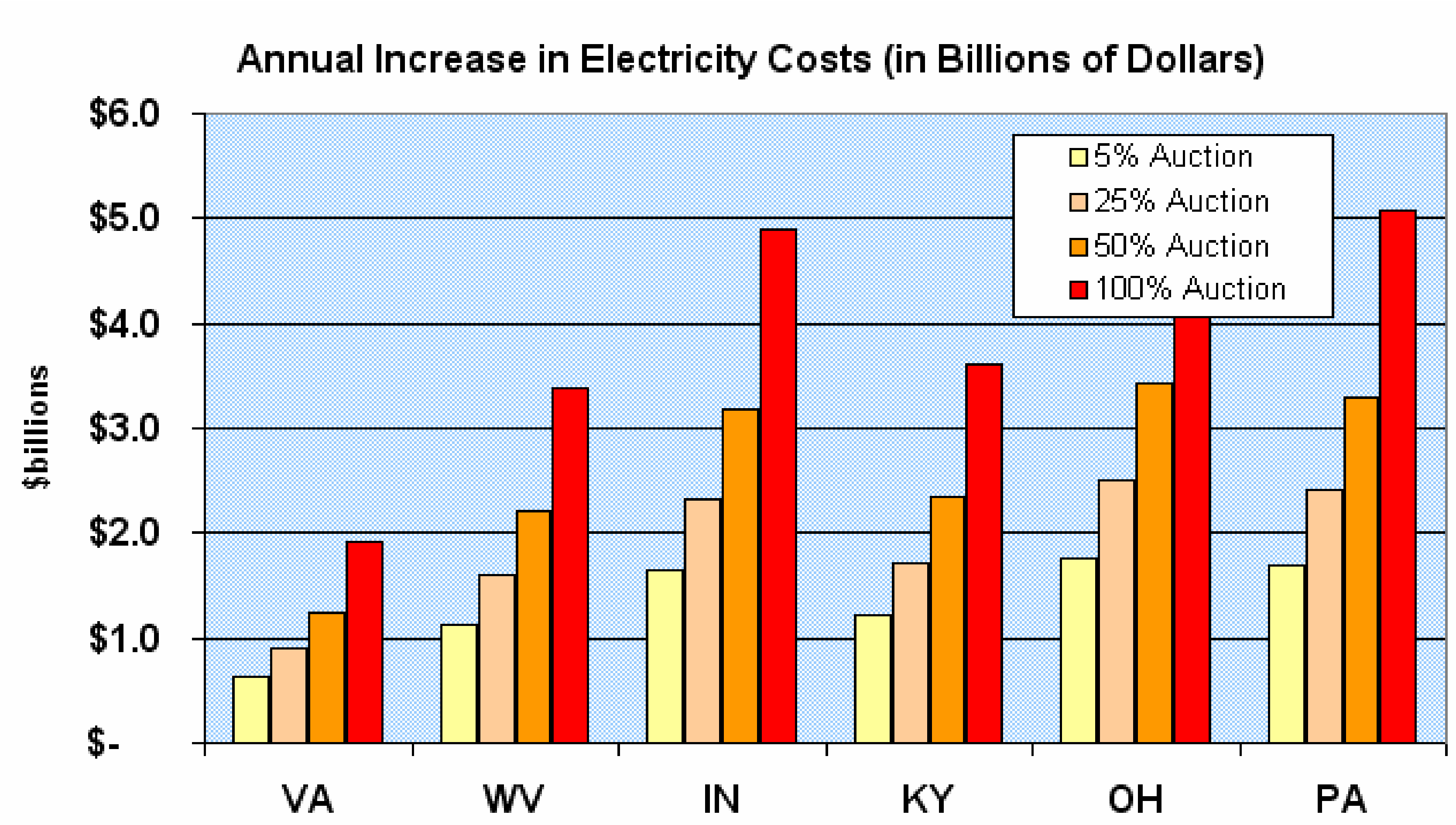
# State Incentives for Technology (June 2008)

| State | Cost Recovery | Financing Assistance | Tax Credits | Regulatory Streamlining | Carbon Sequestration |
|---|---|---|---|---|---|
| **Nebraska** | | | | | X |
| **New Mexico** | X | | X | | |
| **North Dakota** | | X | X | | |
| **Oklahoma** | | | | | X |
| **Oregon** | | | | | X |
| **Pennsylvania** | X | X | | | |
| **Rhode Island** | | | | X | |
| **South Dakota** | X | X | X | X | |
| **Tennessee** | | | X | | |
| **Texas** | | X | X | | X |
| **Virginia** | X | | | | |
| **Washington** | | | | | X |
| **West Virginia** | X | | | | |
| **Wyoming** | | | X | | |

# It Matters How $CO_2$ Emissions Are Regulated

- Many policy design provisions can be chosen, but which ones
  - Are the most effective at the lowest cost
  - Won't divert capital from constructing new facilities to retrofitting the current fleet
- Setting a cap and trading allowances under the cap is most effective and economical traditionally
- Under existing cap and trade programs for $SO_2$, $NO_x$ and mercury, the emitters receive allowances
- Some proposals for $CO_2$ cap and trade policy are for all allowances to be put up for auction, so emitters would be required to buy them
- Cost to reduce emissions will be much higher

# Increase in Customer Electricity Costs/Rates due to Auctions




Approximate Calculation based on a 20% reduction in electric sector GHG emissions with $CO_{2e}$ reductions/allowances costing $20/ton

# AEP Leadership in Technology: Lessons learned

## *NEW ADVANCED GENERATION*

IGCC -- AEP first to announce plans to build two 600+ MW IGCC commercial size facilities in US (OH and WV) by mid next decade. (WV PSC approved; VA disapproved)

FutureGen - First fully integrated IGCC with CCS - Near Zero Emissions Hydrogen/ Electric (coal-fueled IGCC with CCS) - DOE, AEP and Alliance members in FutureGen. (DOE reallocated its financial share to CCS projects)

# World carbon capture and storage projects

- 10 projects in the U.S.
- 22 projects outside of U.S.

Source: MIT 2009

# IOGCC Carbon Capture and Storage Legal and Regulatory Guide

- Property Rights
- Experimental Projects
- Commodity vs. Waste
- Covered Facilities
- Trust Fund
- User Fee
- Cooperative Agreements
- EOR Projects
- Liability Release
- Right of Access
- Permit Transfer
- Permit Requirements

www.iogcc.state.ok.us

# Example of recent state carbon storage laws

## 2009 Enacted Legislation

| State | Bill # | Summary/Status | Link to bills (enacted) |
|---|---|---|---|
| WV | SB 297 passed | Defines pore space ownership. Sets up a work group to develop legislation. | http://www.legis.state.wv.us/Bill_Status/bills_text.cfm?billdoc=SB297%20SUB2.htm&yr=2009&sesstype=RS&i=297 |
| ND | SB 2095 passed | Establishes the regulatory framework for safe, long-term storage in underground geological formations: Authority to the industrial commission, permit requirements and fees, storage operator attains consent from 60% of surface owners pore space, Amalgamating property interests (unitization of pore space area), establishes administration and trust funds, 10 yrs after completion ownership transfers to the state, carbon credits for EOR. | http://www.legis.nd.gov/assembly/61-2009/bill-text/JQTA0300.pdf |

## 2008 Enacted Legislation

| State | Bill # | Summary/Status | Link to bills (enacted) |
|---|---|---|---|
| WY | HB 90 | Establishes DEQ authority, permit requirements | http://legisweb.state.wy.us/2008/Engross/HB0090.pdf |
| | HB 89 | Identifies ownership of subsurface pore space | http://legisweb.state.wy.us/2008/Engross/HB0089.pdf |
| OK | SB 1765 | Set up a work group. | |

# APPENDIX

Background and Reference Materials

# Our Position On Climate Change

**We believe the scientific community, led largely by the Intergovernmental Panel on Climate Change (IPCC), has enough scientific information that human activity has contributed to global warming. We believe AEP should be part of leading the discussion nationally and internationally to reach achievable, reasonable solutions and a federal energy policy that is realistic in timeframe, without causing serious harm to the U.S. economy. It should also support technology development to allow coal to continue to be the important energy resource that it is to the U.S. today.**

## Our policy position on climate change:

- AEP supports a reasonable, achievable approach to carbon controls in the U.S.
- We support a federal cap-and-trade program that includes all sectors and greenhouse gases (GHG)
- We have taken measurable, voluntary actions to reduce GHG emissions
- We support a well-thought out U.S. mandate to achieve additional, economy-wide reductions
- We support input-based allocations, not auctions
- This is a global issue but we believe the U.S. should take the lead in developing an international response
- We must collaborate with others globally, nationally and locally on a roadmap to address climate change
- Regulatory or economic barriers must be understood and addressed
- Recognition for early actions/investments in GHG mitigation
- Inclusion of adjustment provision if largest emitters in developing world do not take action
- A price-based safety valve that sets a ceiling on the cost of C02 allowances, thereby limiting the economic effects placed on an individual company or the economy due to a rapid or large increase in the price of emission allowances. Companies with compliance obligations can buy emission allowances from the Federal Government at the safety valve price.

# AEP's Climate Strategy

- Being proactive and engaged in the development of climate policy
  - IETA. EPRI, Pew Center, GROCC, WBCSD
  - Supports Reasonable Cap-and Trade Legislation-Bingaman-Spector
- Investing in science/technology R&D
  - FutureGen, US DOE, EPRI, MIT, B&W
- Taking voluntary, proactive action now, making real reductions and setting policy precedents thru CCX
  - Chicago Climate Exchange (CCX), EPA Climate Leaders
  - Asia-Pacific Partnership, Business Roundtable, Numerous forestry activities
- Investing in longer term technology solutions--new generation and carbon capture and storage (e.g., IGCC, Ultra-supercritical PC)

# Technology Path Forward

- Advanced coal plants will be built when approved by public utility commissions.
  - IGCC integrates commercially developed technologies ➔ first installation at commercial scale
- Carbon capture and storage (CCS) technologies with first of a kind demonstrations at existing plants, subject to approval by public utility commission
- Gasification carbon capture technology has been commercially proven in chemical plant applications but not IGCC applications.
  - Ability to power CTs with high-$H_2$ must be demonstrated
- Geologic Storage technology requires the most development
  - Monitoring technology and standards need to be developed
  - Geologic Storage feasibility must be demonstrated
  - Regulatory permitting framework must be defined
- CCS technology can be more rapidly deployed when states are willing to accept the risk associated with advancing promising technology that has not been proven at commercial production scale, by providing project developers with assurances that their investments will be contemporaneously recovered.

# $CO_2$ Capture Techniques

- **Post-Combustion Capture**
  - **Conventional or Advanced Amines, Chilled Ammonia**
  - ***Key Points***
    - Amine technologies commercially available in other industrial applications
    - Relatively low $CO_2$ concentration in flue gas – More difficult to capture than other approaches
    - High parasitic demand
      - Conventional Amine ~25-30%, Chilled Ammonia target ~10-15%
    - Amines require **very** clean flue gas

- **Modified-Combustion Capture**
  - **Oxy-coal**
  - ***Key Points***
    - Technology not yet proven at commercial scale
    - Creates stream of very high $CO_2$ concentration
    - High parasitic demand, >25%

- **Pre-Combustion Capture**
  - **IGCC with Water-Gas Shift – FutureGen**
  - ***Key Points***
    - Most of the processes commercially available in other industrial applications
      - Have never been integrated together
    - Turbine modified for $H_2$-based fuel, which has not yet been proven at commercial scale
    - Creates stream of very high $CO_2$ concentration
    - Parasitic demand (~20%) for $CO_2$ capture - lower than amine or oxy-coal options

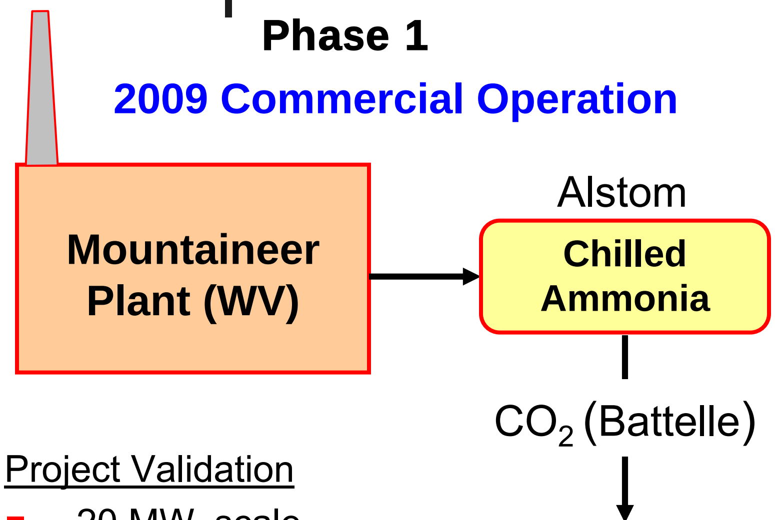
# Additional Provisions States Should Consider Addressing

- A more efficient means of acquiring property rights related to a CCS project
  - Use of eminent domain under the new statute be tied to PSC issuance of a certificate of need
- The siting of pipelines related to CCS projects
  - Address pipeline siting through a new regulatory program or only by allowing the PSC to authorize the use of eminent domain as the result of the issuance of certificate of need
- A more comprehensive liability transfer mechanism
  - Liability transfer extend beyond a transfer of regulatory responsibility and include a transfer of common law and statutory liability

# Chilled Ammonia Technology Program

## Phase 1

**2009 Commercial Operation**



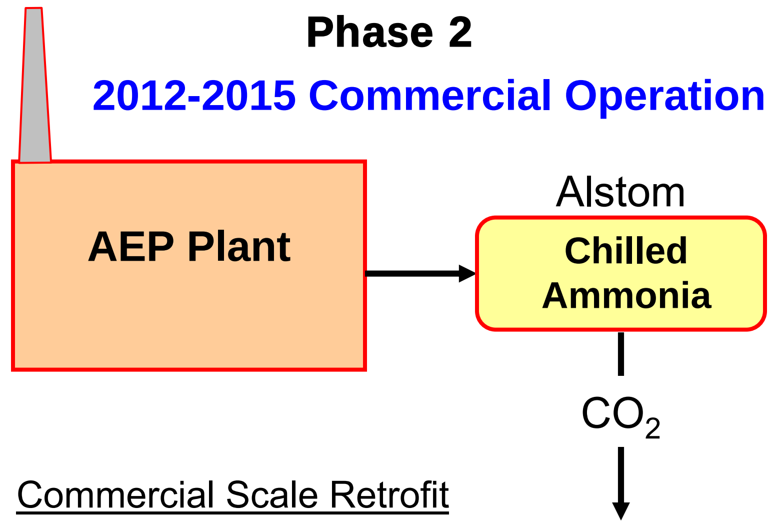

Project Validation

- 20 $MW_e$ scale
  - (Scale-up of Alstom/EPRI 1.7 MW field pilot at WE Energies)
- ~100,000 tons $CO_2$ per year
- In operation 3Q 2009
- Approximate total cost $80 – $100M
- Using Alstom "Chilled Ammonia" Technology
- Located at the AEP Mountaineer Plant in WV
- $CO_2$ for geologic storage

**Phase 1 will capture and sequester 100,000 metric tons of CO2 / year**

## Phase 2

**2012-2015 Commercial Operation**



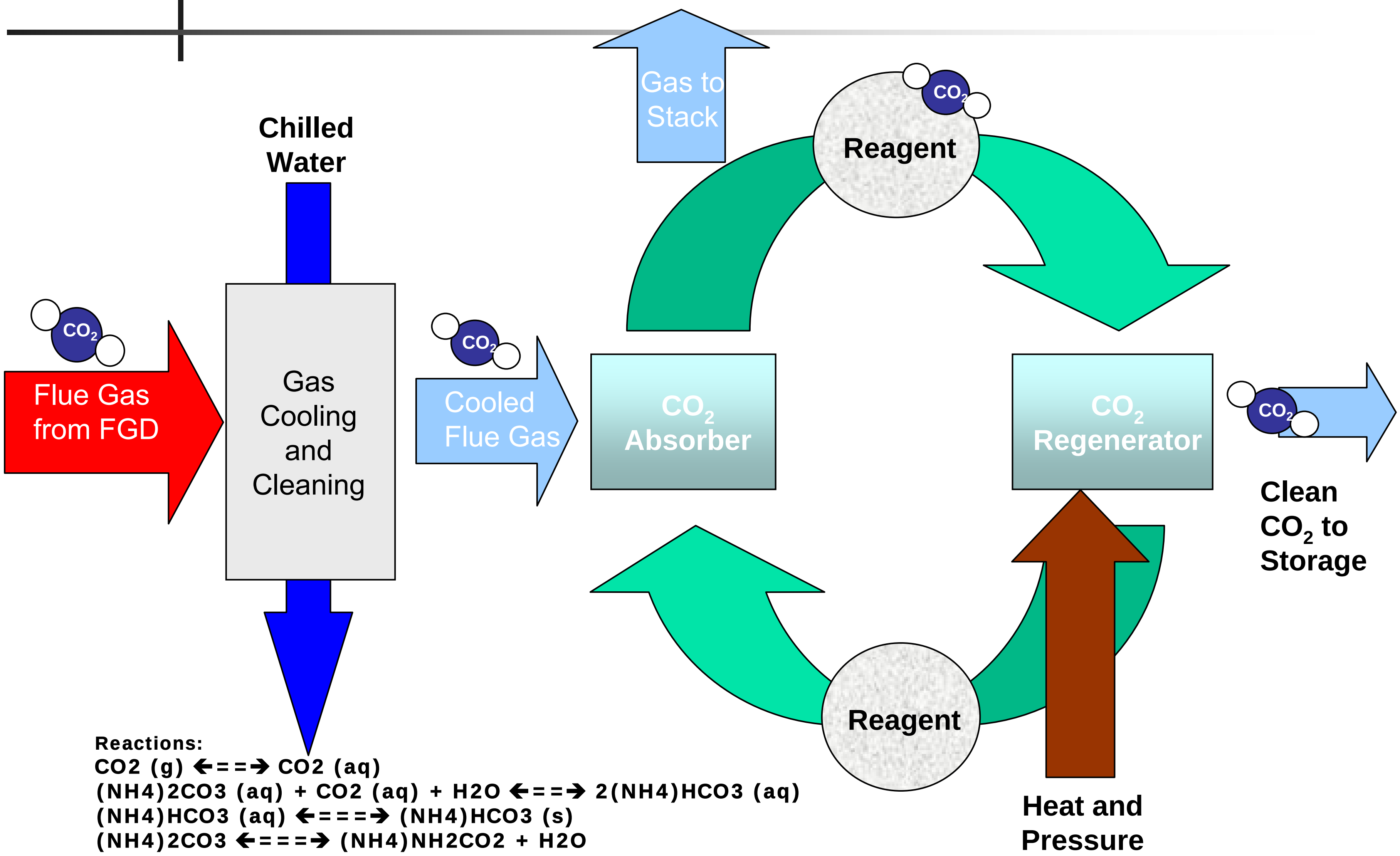

Commercial Scale Retrofit

- ~ 200 $MW_e$ scale
- ~1.5MM tons $CO_2$ per year
- In operation 2012-2015
- Approx. capital >$300M ($CO_2$ capture & compression)
- Energy penalty ~ 35 – 50 MW steam, 25 – 30 MW for $CO_2$ compression
- $CO_2$ for Enhanced Oil Recovery (EOR) or geologic storage

**Phase 2 will capture and sequester 1.5 Million metric tons CO2 / year**

# Alstom's Chilled Ammonia Process

## *Post-Combustion Capture*




**Reactions:**

**CO2 (g) ←==→ CO2 (aq)**

**(NH4)2CO3 (aq) + CO2 (aq) + H2O ←==→ 2(NH4)HCO3 (aq)**

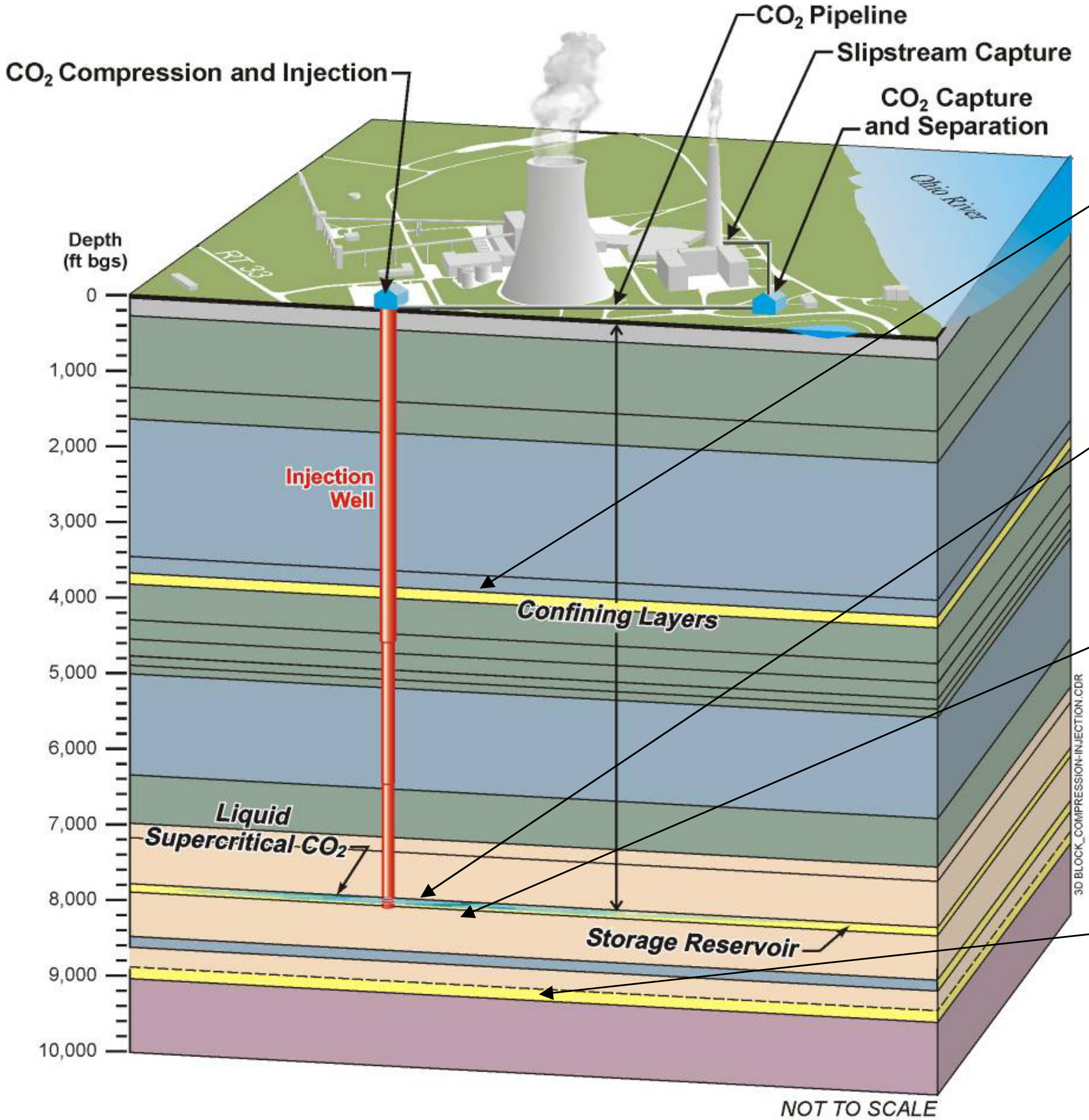
**(NH4)HCO3 (aq) ←===→ (NH4)HCO3 (s)**

**(NH4)2CO3 ←===→ (NH4)NH2CO2 + H2O**

*Graphics curtsey of Alstom Power*

# $CO_2$ Injectivity In the Mountaineer Area

Battelle
The Business of Innovation




$CO_2$ injection should also be possible in shallower sandstone and carbonate layers in the region

Rose Run Sandstone (~7800 feet) is a regional candidate zone in Appalachian Basin

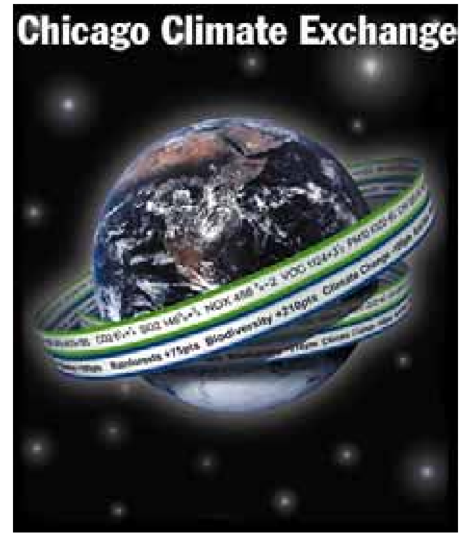
A high permeability zone called the "B zone" within Copper Ridge Dolomite has been identified as a new injection zone in the region

Mount Simon Sandstone/Basal Sand - the most prominent reservoir in most of the Midwest but not desirable beneath Mountaineer site

# AEP Objectives in Participating in CCX

- Opportunity to set public policy precedents (e.g. market “trading” approach with all greenhouse gases and all reduction types counted)
- Central part of overall climate change strategy to meet the President's voluntary plan
- Learning opportunity from market & competitors
- Value as socially-responsible investment
- Opportunity to do so at a relatively low cost
- Incorporates greenhouse gas risks in capital and O&M decisions (through CO2 price), promoting cost-effective reductions (examples in past several years):
  - Plant efficiency improvements
  - Retirements/mothballing old gas steam & coal units
  - Nuclear availability improvements
  - Forest management and forestry projects
  - SF-6 leakage reductions
  - Wind plant development and purchases

# Chicago Climate Exchange Overview




- An unprecedented voluntary greenhouse gas emission reduction and trading pilot program administered by 100+ companies and organizations
- Total member emissions = About 240 MM metric tons $CO_2$ equivalent (~ 4% US $CO_2$ emissions)
- Member commitment to reduce GHG emissions below a “baseline” (average 1998-2001 levels):
  - 1% in 2003
  - 2% in 2004
  - 3% in 2005
  - 4% in 2006
  - 4.25% in 2007*
  - 4.5% in 2008*
  - 5% in 2009*
  - 6% in 2010*

*Extension Period

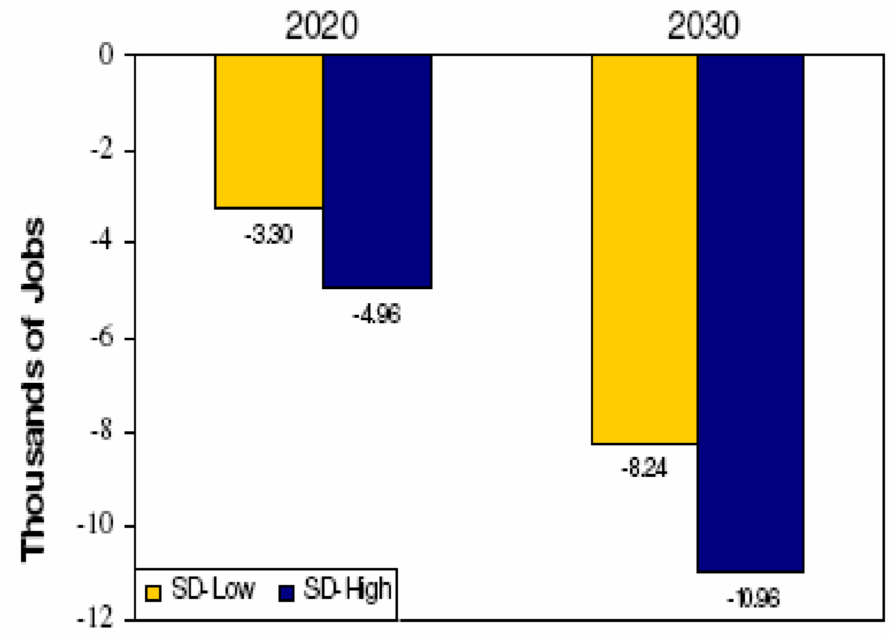
**AEP Info:**
- Current Baseline = 155 MM metric tons (adjusted for divestitures)
- Reduction or offset of about 46 MM metric tons of $CO_2$ during 2003-10
- **2003-05: Reduced 29 MM Tons**
- AEP one of 14 founding members and first to commit to extension period.

# Costs of federal legislative proposals to reduce $CO_2$ emissions (EEI)

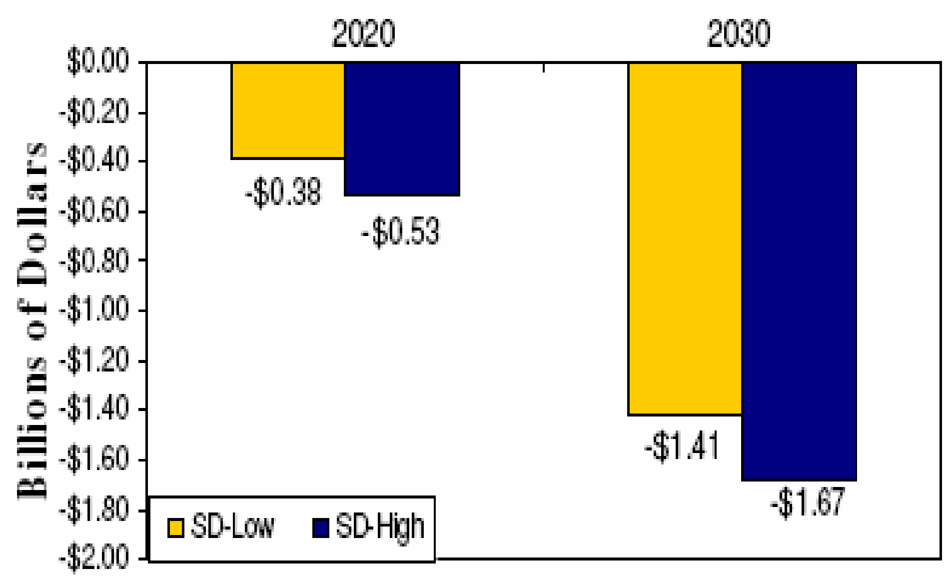
| **Federal Legislation** | Bush Voluntary Program | RGGI | Bingaman-Specter (S. 1766) | Feinstein (S. 317) |
|---|---|---|---|---|
| **Financial Issues – Costs & Recovery** | IGCC depends on state cost recovery | TBD | $12/tCO_2e TAP (increase 5%/yr + infl.) | $42–65 billion? (power sector only) |
| **Federal Legislation** | Carper (S. 1177)[1] | Lieberman-McCain (S. 280)[2] | Lieberman-Warner (S. 2191) | Sanders-Boxer (S. 309)[3] |
| **Financial Issues – Costs & Recovery** | $42–65 billion? (power sector only) | $100 billion (US economy) | $3 trillion in 2050 (US economy) | Tech-index stop price (S); >$279 B (power sector only) |

# Economic Impact on South Dakota from Lieberman-Warner (NAM/ACCF 2008)

Loss of employment relative to baseline




Annual Impact of GSP Relative to Baseline

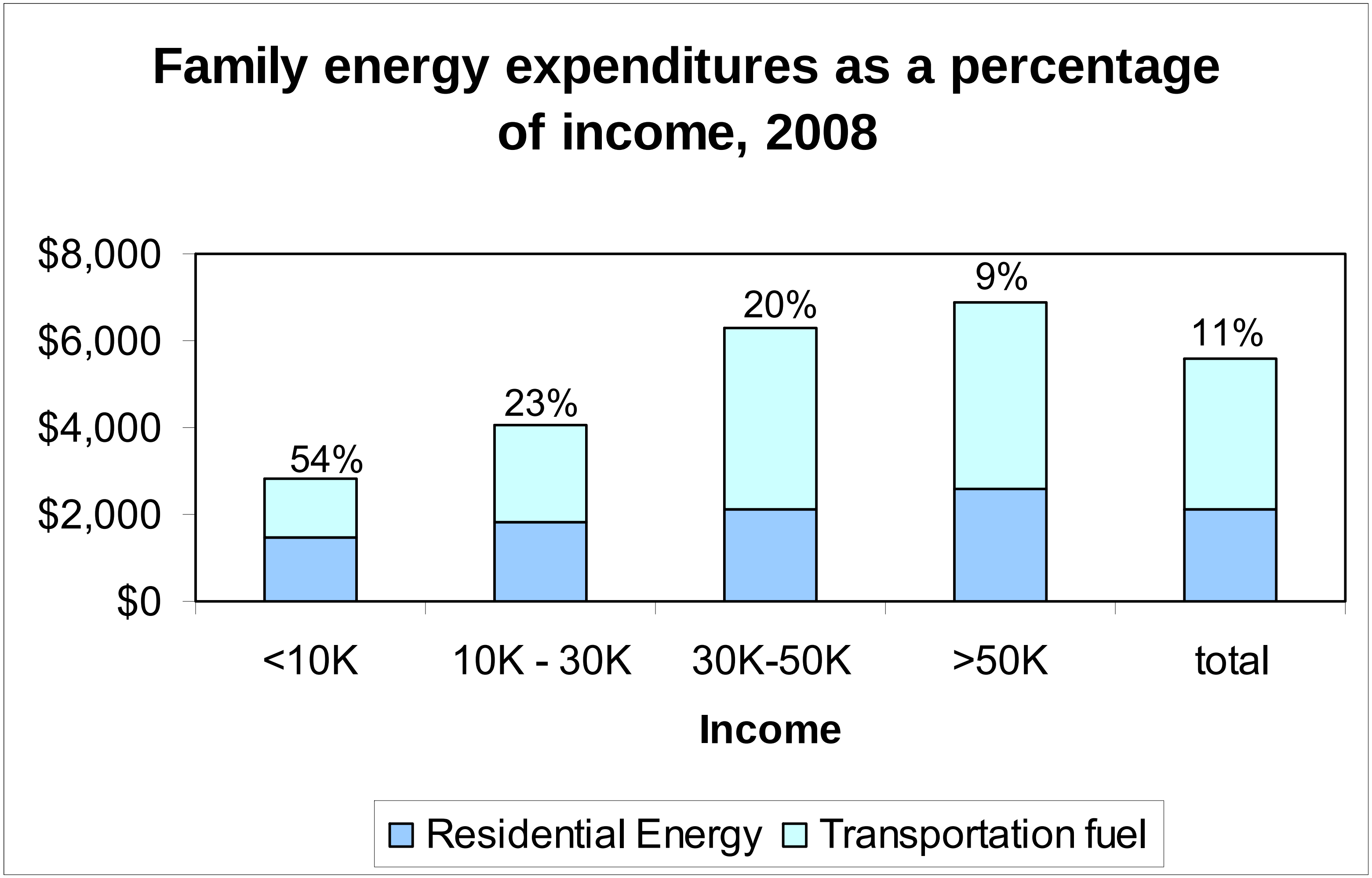


# Economic impact of technology and policy choices – California example

- California has set climate policy goals to reduce greenhouse gas (GHG) emissions by 80 percent by 2050.
- Cumulative real costs to the California economy could range from $100 billion to $511 billion through 2050.
- Policies that combine market-oriented abatement incentives with increased technological innovation are the most cost-effective.
- These policies will entail large costs to the California economy.
- The costs will be reflected as reductions in economic welfare, consumption, and Gross State Product (GSP).
- The average cost of this policy to the California population would be large:
  - The average cost of this policy would be about $31,900 to every California household.
  - Median California household income is about $50,000.
  - Therefore, the long term cost would be the equivalent of nearly 2/3 of one year's median income to every household in California.

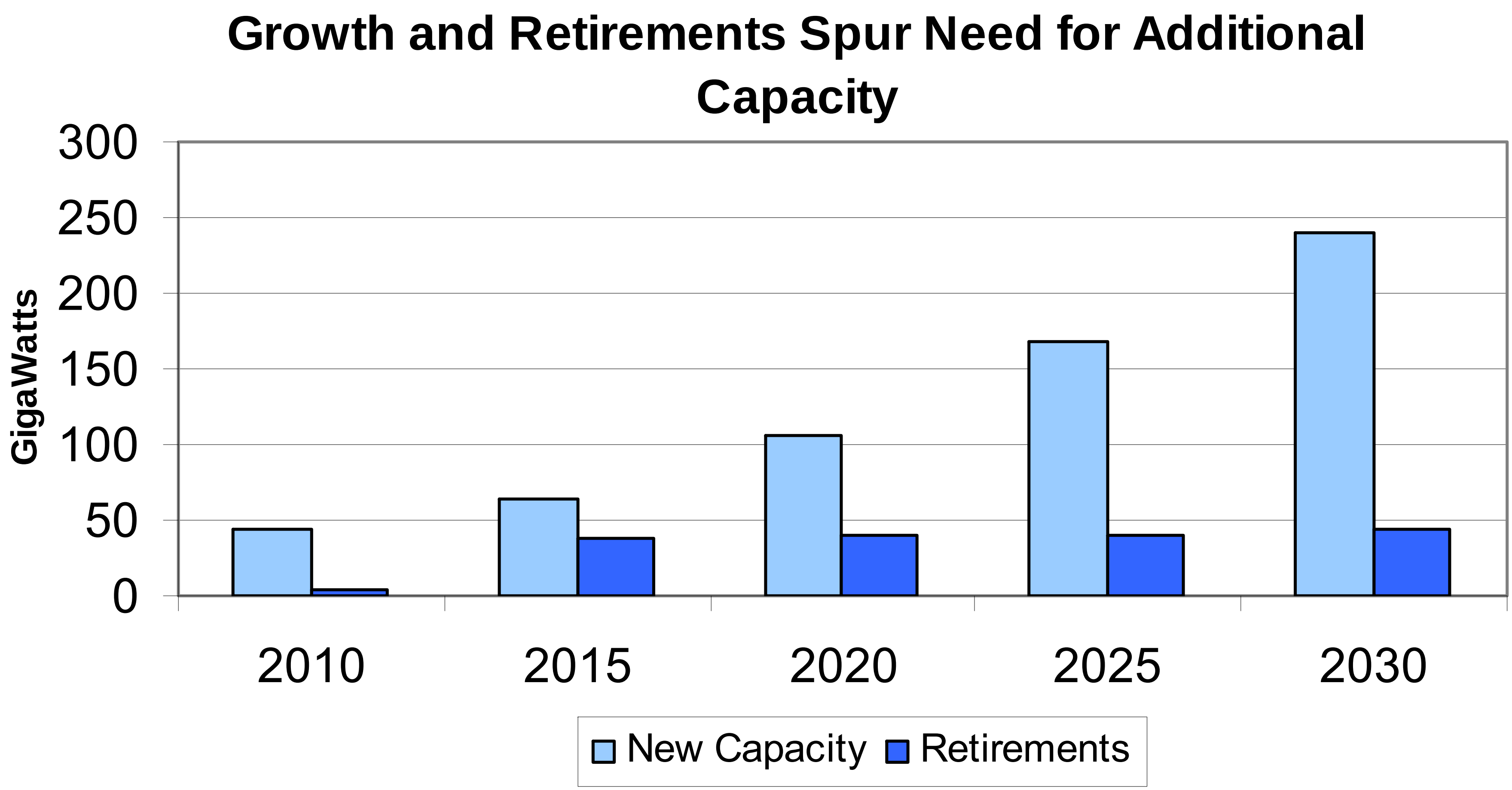
*ECONOMIC ANALYSIS OF CALIFORNIA CLIMATE INITIATIVES: AN INTEGRATED APPROACH.*
EPRI. JUNE 2007

# American Families Pinched by Rising Fuel Costs




ABEC – analysis of EIA and U.S. Bureau of Census data, 2008

# High Increases in Demand Urgently Requires New Generating Capacity




Source: US DOE/EIA '2008 Annual Energy Outlook'

# Allowance Allocations and Auctions: Background Facts

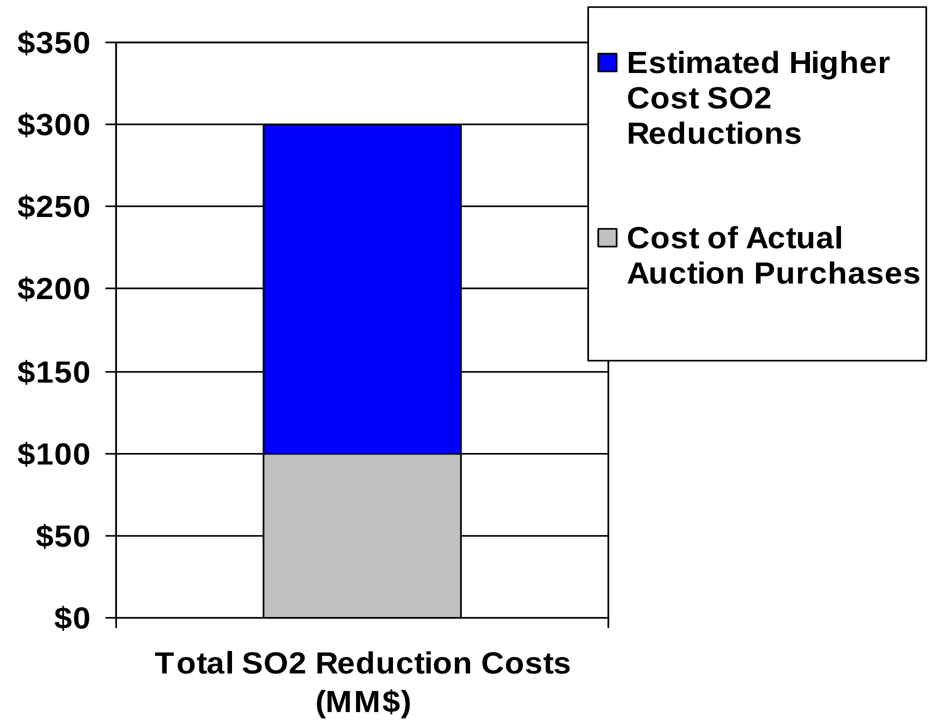
- Most cap-and-trade systems allocate allowances at no cost to generators, primarily based on historic emissions, with little or no auction. **We have little or no experience with large allowance auctions.**
- The EPA Acid Rain program has been hailed as a success because of its affordability due in part to a small (2.8%) auction.
- Allowance allocation to emitters does NOT result in a "windfall". An emissions cap ensures allowances issued less than potential emissions. So reductions must be made at a NET COST.
- **Importantly, whether allowances are allocated at "no cost" or auctioned has NO environmental impact**, it is the overall $CO_2$ cap that determines the amount of reductions.

# Background on Allowance Allocations and Auctions

- **"Allowance" = Right to emit a ton of emissions.** Each year allowances must be surrendered to cover annual emissions of an emitter.
- **Most programs (EPA's SO2 and NOx, CAIR and CAMR, EU CO2 etc.) allocate allowances (at "no cost") to generators.**
- **Emission allowance auctions have been used infrequently in programs.** To the extent they have been employed, they have amounted to 5% or less of total allowance supply.
- **Some have argued that allowances are a net financial asset and could result in windfall profits to generators and other sources and therefore should be auctioned rather than allocated.**
- **New York , Connecticut and others in the RGGI states have proposed large 100% auctions. These will be first of their type, market experiments.**

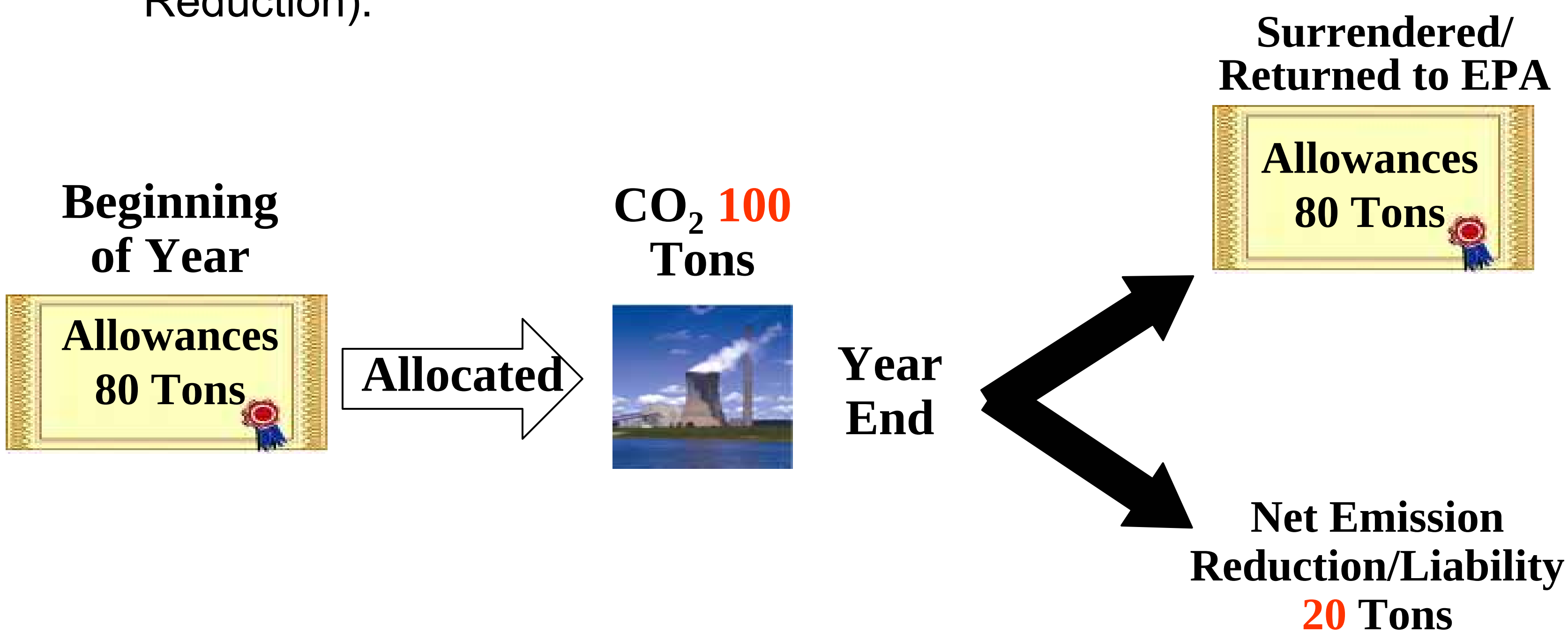
# “Trading” Example: AEP Savings from Auction Purchases

- During 2000-04, AEP bought 0.76 MM allowances @$132 per ton for $100 MM
- Purchased allowances displaced scrubber and fuel switching roughly estimated to cost an average of $400 per ton.
- **Thus, AEP’s 2000-04 auction purchases reduced costs ~ $200 million**



# “Free” Allocation to Emitters Does Not Increase Profits

- Example: Co. Emits 100 Tons, Receives 80 “No-Cost” Allowances (i.e., 20 % Reduction).



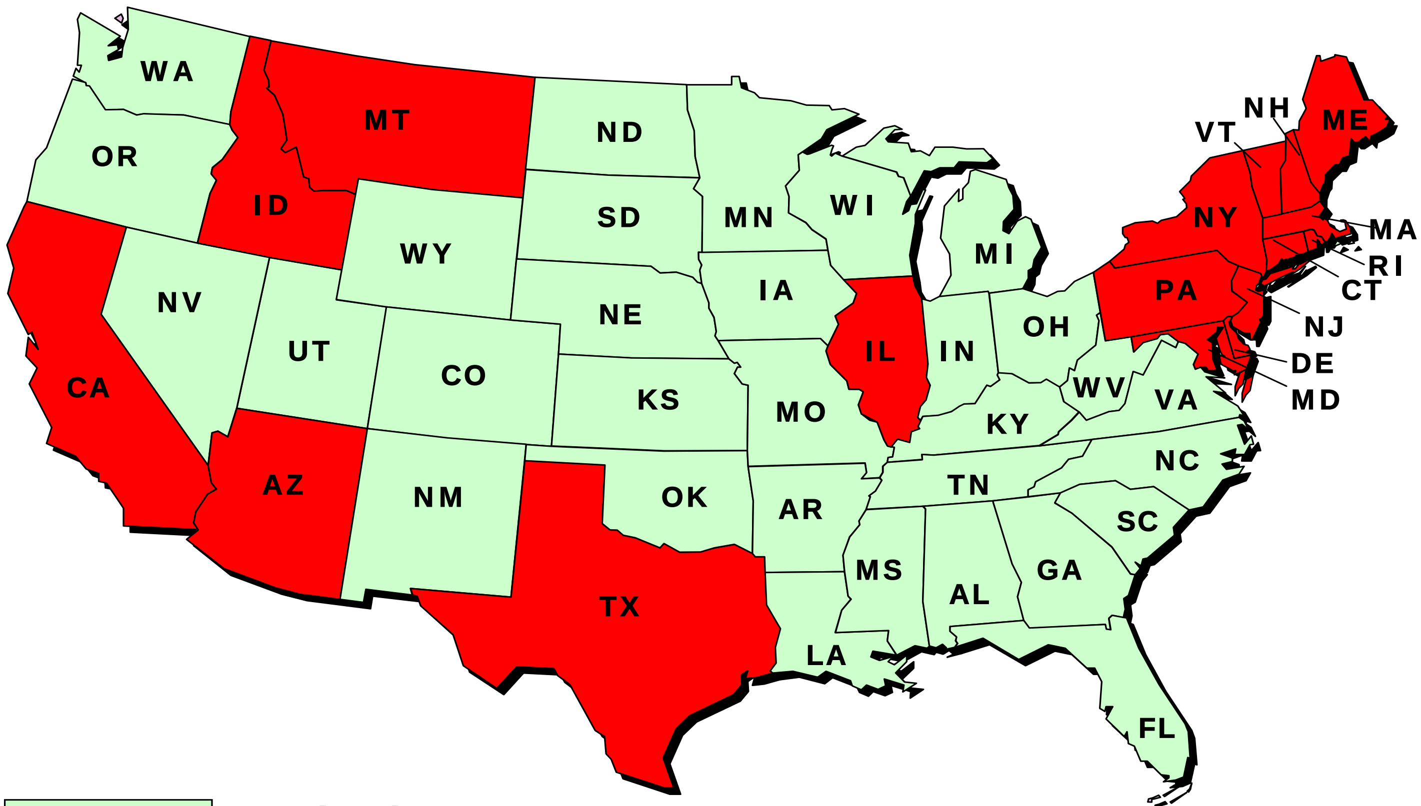

- Thus, Allocation to Emitters Does NOT Create a “Net Asset” or Windfall because of the Liability of Complying with the $CO_2$ Cap. In fact, except for non-fossil generators, NET LIABILITY

# $CO_2$ Program Impacts: Deregulated vs. Cost Regulated States

- $CO_2$ Program increase electricity costs and prices resulting in utility profit gains or losses. The key distinction is whether a generator is subject to:
  1. **Cost-of-Service Regulation**—Utility generators are subject to cost based regulation with electricity prices based on the average costs of fuel, O&M and capital. **In these states, a $CO_2$ program will increases electricity rates by the *average cost* of $CO_2$ reductions.**
  2. **Deregulated Generation Markets---** Utility generators are "unbundled" from retail distribution service and charge market prices. **In these states, a $CO_2$ program will increase electricity prices by the *price* of $CO_2$ in all hours.**
- CO2 program will increase electricity prices much more in deregulated states because the price of $CO_2$ will be included in ALL electricity sold.
- Most states and the vast majority of coal fired generation are subject to cost based regulation. (See Map)

# Currently “Regulated” vs. Deregulated States

In most states, generation “cost-regulated” today




Regulated

Unbundled/ Deregulated

Note: Based on “current” state status of regulation/deregulation. States that have continued cost-based POLR rates or extended transition rates considered to have kept generation “regulated”.

*Only the ERCOT portions of TX are in competition.

# Allowance Auctions Increase Customer Rates Significantly in “Regulated” States

- Most generators are in states with cost-of-service regulation and part of vertically integrated utilities. (Today, AEP generation is subject to cost based regulation in 10 out of our 11 states).
  - About 80% of coal-fired generation is cost-regulated. For regulated generators, ONLY compliance costs are passed thru to customers. Thus, there are NO profit windfalls.
  - If regulated generation must also buy allowances at auction electricity rates increase substantially more.

# Allowance Auctions Increase Customer Rates Significantly in "Regulated" States

Example: Utility must reduce from 100 to 80 tons. Assume Allowances Price = $10.

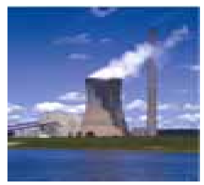
## *No Auction*

Beginning of Year

Allowances 80 Tons

Allocated

Company Emits 100 Tons



At Year End

Net Emission Reduction / Liability 20 Tons

=

Total Costs/ Customer Rate Impact

$200 (20 tons at $10 per ton)

## *50%Auction*

Beginning of Year

Allowances 40 Tons

Allocated

40 Tons at Auction

Purchased

Company Emits 100 Tons

At Year End

Net Emission Reduction / Liability 20 Tons (100 tons emitted – 40 tons allocated – 40 tons purchased)

=

Total Costs/ Customer Rate Impact $600

$200 (20 tons at $10 per ton)

\+

$400 (Auction purchase 40 Tons at $10 per Ton)

# Allocations and Auctions—Price Deregulated States

- The $CO_2$ cap (not allowance allocation) will increase electricity prices and for some participants increase profits.  BUT ONLY in states (primarily in the Northeast and West), where generation is "unbundled" and retail prices deregulated.
- In these states, SOME generators will have higher profits IF their revenues increase more than their costs:
  - Much of the profit increase will go to nuclear and hydro, because they have no emissions.
  - Natural gas units will also see profit increases because their CO2 reduction costs are small.
  - Coal units will see some profit increases, depending on their CO2 reduction costs and prices, reduction requirement and allocation.
- Auctions do little to "tax away" these higher profits since mostly from non-emitting or low emitting units.

# Allocations for Coal Units – Price Deregulated States

- Most deregulated states are in electricity markets where:
  1. Hourly prices are determined at most times by the marginal costs of generation from a gas-fired unit.
  2. Gas fired units have approximately half the C02 emissions of a typical coal fired unit. (0.5 Tons/Mwh vs. 1.0 Ton/Mwh)
  3. Assuming a $10 per ton CO2 price, electricity prices will rise by $5 per Mwh (i.e., 0.5 Tons per Mwh X $10 per Ton) in these markets under a CO2 program
  4. A coal generator that produces 1 Mwh and emits 1 Ton of CO2 per year will have revenues increase $5.
  5. If it receives 50% of its emissions (0.5 Tons) in the form of "no-cost" allowances, it will have to buy 0.5 Tons from the market to cover its emissions at a cost of $5.
  6. **<u>Thus, typical coal generator makes no added profits if it receives an allocation of 50% of its emissions.</u>**

# WBCSD Roadmap: Global electrification including CCS

**World Business Council for Sustainable Development believes**:

- Consistent and integrated policy and regulatory measures must underpin and support investment in low carbon technologies, both on the demand and supply sides
- A ‘one size fits all' approach will fail and a combination of complementary mechanisms must be used
- Specific policies will be necessary to drive the implementation of currently available technologies
- Large-scale multi-country R&D efforts are required for those future solutions that currently face technological or commercial barriers to deployment (CCS)

Power to Change at: www.wbcsd.org

# Today's Electric Power System

**Transmission systems connect multiple suppliers to load.**

- **Core Elements**
  - Generators
  - Transmission facilities (regional)
  - Distribution facilities (local)
- **Analogous to the highway system.**
  - Extra high voltage transmission = Interstate highways
  - Lower voltage transmission = State highways
  - Distribution = Local roads and streets
- **Electricity: an "on demand" resource that must be produced, transmitted, and consumed instantaneously.**

# Role of EHV Transmission

**Eastern U.S. benefits significantly from AEP's Extra High Voltage (EHV) 765-kV transmission system.**

- **Provides low-resistance path for electricity to flow over distances.**
- **Connects large generation resources to market.**
- **Efficiently links remotely located generation to load centers.**
- **Voltage class selected based upon:**
  - Amount of electricity to be transmitted.
  - Distance energy must be transmitted.
  - Efficiency of transmission system.
- **The higher the voltage, the more electricity that can be transmitted over longer distances with fewer losses.**

*Expanding EHV on a broader scale would extend these benefit beyond the Eastern US.*

# EHV Transmission & Generation

**Integration of new resources presents a challenge.**

- **How a resource ties into the system depends upon size.**
  - **<u>Small</u>**-typically located behind customer's meter reducing customer demand.
  - **<u>Midsize</u>**-connected behind meter of larger consumers or interconnected to distribution.
  - **<u>Large</u>**-connected to the transmission system.
- **Adequate transmission capacity is required to move electricity from new generation to load centers.**
- **Large scale resources will be located in remote areas where transmission grid is weak or non-existent.**