Evolving Carbon and Clean Energy Markets

The Carbon Emissions Continuum: From Production to Consumption

Jones Walker Law Firm
June 23, 2009

LSU
Center for Energy Studies

David E. Dismukes
Center for Energy Studies
Louisiana State University

LSU
Center for Energy Studies

Overview and Preliminary Thoughts

- Considerable national and international attention has been given to this issue.
- The current increase in energy prices and challenges in supply capabilities confound climate change issues and approaches.
- GHG regulation also raises considerable questions about market organization and structure in restructured energy markets.
- Uncertainty and “policy volatility” creates challenges for the high levels of expensive investment considered needed to address this issue.
- Policies are likely to result in the most dramatic restructuring of energy markets to date.

LSU
Center for Energy Studies

Take Away Points and Conclusions

- Significant increases in the cost (price) of all forms of energy.
- Significant redistribution of wealth between sectors, income classes, and even various regions and countries around the world.
- High near and intermediate term reliance on natural gas particularly for power generation.
- Very large increases in the price of electricity.
- Policies are outpacing technological and institutional capabilities.
- Ability of policy capability to meet goals is questionable.

LSU
Center for Energy Studies

Market Mechanisms

For Affecting Climate Change

LSU Center for Energy Studies

Different Policy Frameworks

Policy Type	Definition
Carbon Tax	Places a fixed tax on end-user energy usage.
Cap and Trade (Downstream, Emissions Type)	Would require certain emitting sectors to acquire emission credits for fuel burned in production processes.
Standards	Would change the efficiency (emissions) standards of appliances, motors, equipment, automobiles, etc.

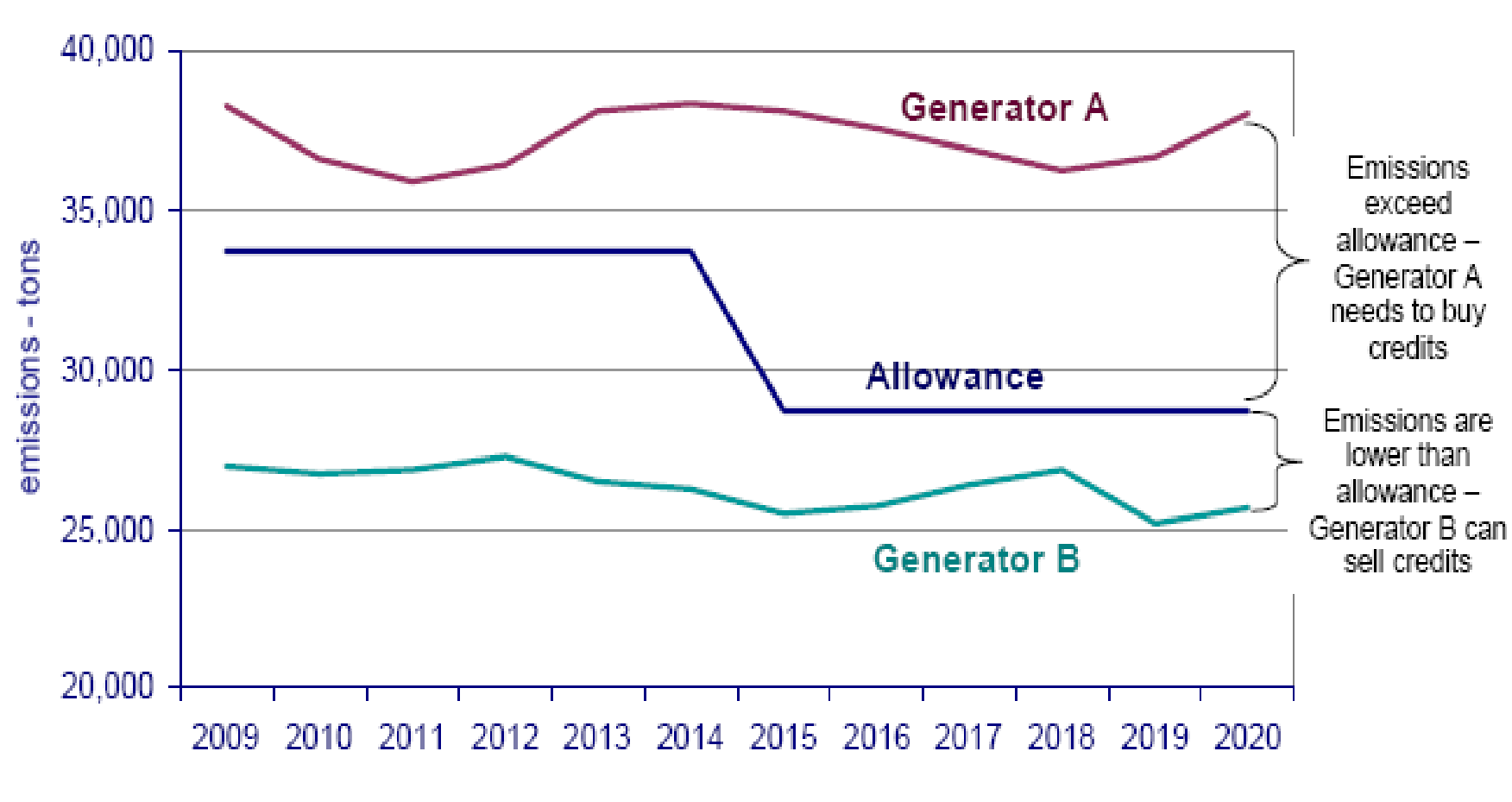
LSU
Center for Energy Studies

Cap & Trade Mechanics

LSU
Center for Energy Studies

How Does Cap & Trade Work?

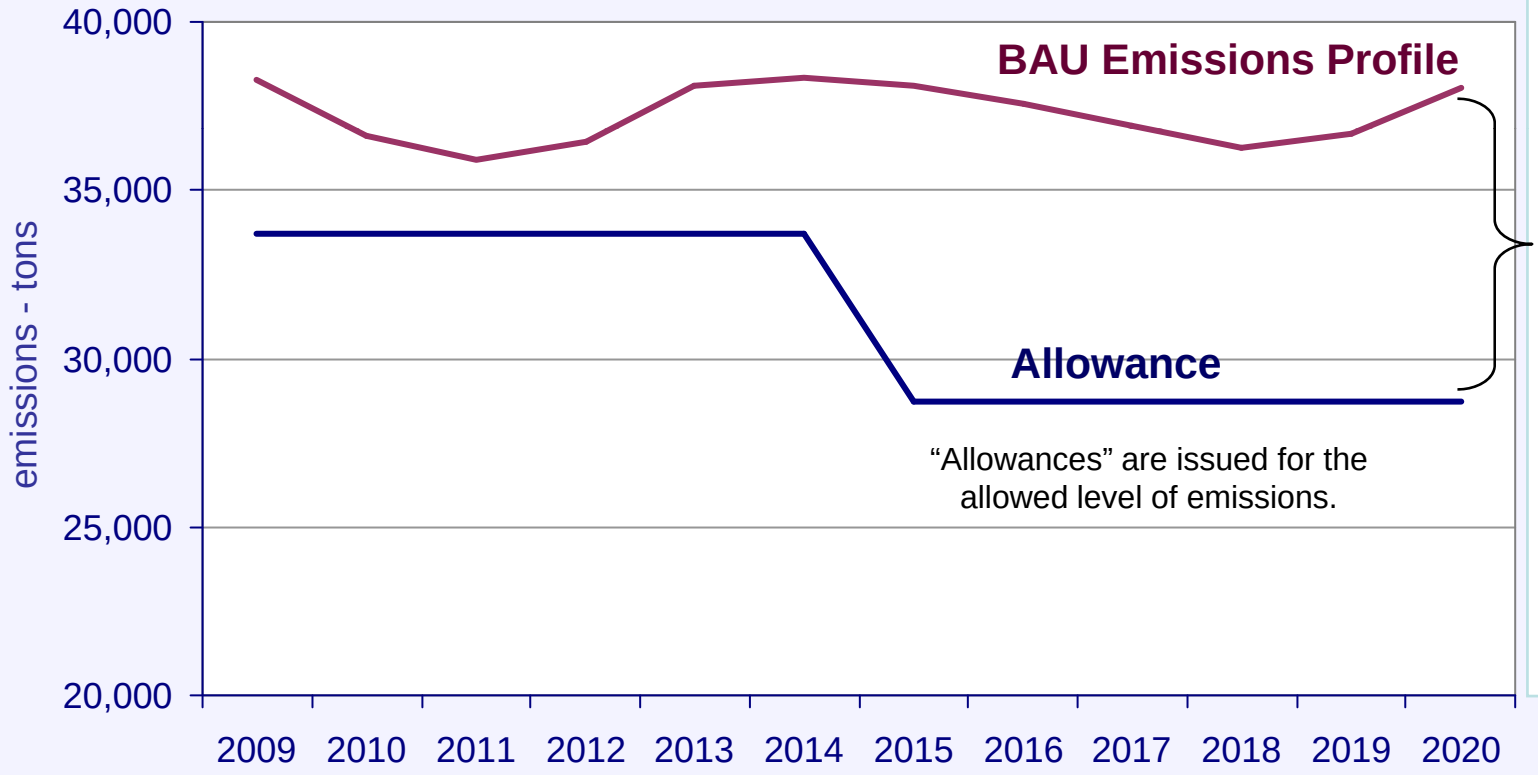
Simply speaking, sources “long” on credits will trade with those that are “short.”



LSU
Center for Energy Studies

How Does Cap & Trade Improve Overall Emissions?

Framework creates “scarcity” because the initial regulatory “design” is intentionally “short” in the aggregate.



Emissions exceed allowance – Shortfall must be made up from:

(1) credit purchases from those facilities individually long ; and/or

(2) capital investments to lower emissions profile.

LSU Center for Energy Studies

How Are Allowances Determined?

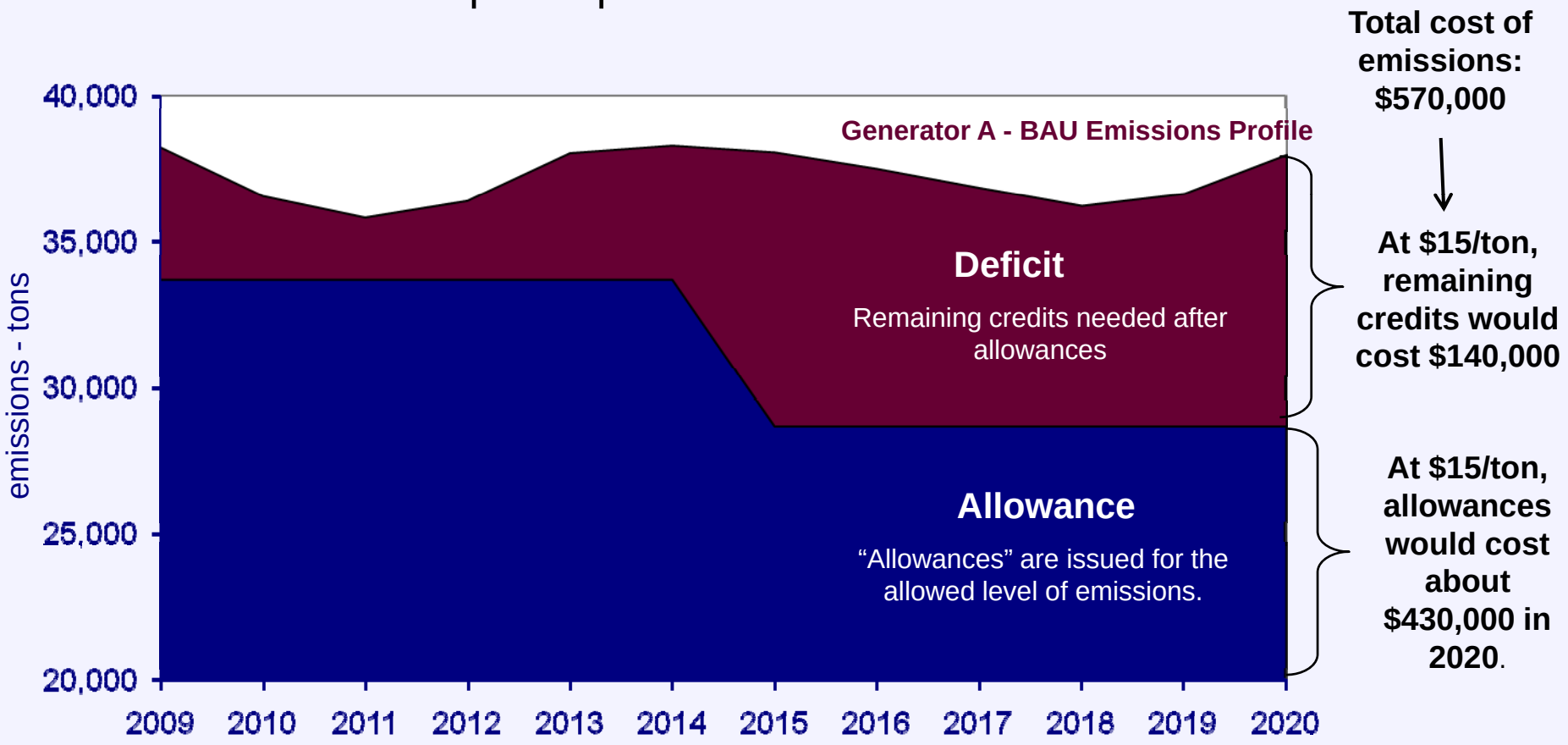
Allowances are offered to participants based upon two different methods:

Allocated	Auction
Regulator makes an administrative determination of who gets allowances.	Market makes the decision about who gets the allowances.
Allocations made on a wide range of considerations and metrics including: Metric (Heat Input, Output) Baselines (Year, Updates) Growth Pool Set-Asides	Periodic auction (think “eBay”) for the credits. Can be done in a variety of methods, but general approach is to allocate credits to those with the highest willingness to pay. There is an important issue associated with what to do with “auction proceeds.” Who gets those?

LSU
Center for Energy Studies

Auction Versus Allowance

An auction system is more expensive because it requires a larger upfront purchase of credits.



Center for Energy Studies

Compliance Alternatives

LSU Center for Energy Studies

Anticipated Forms of Mitigation

Method	Description	Challenges
Credits & Offsets	Initially allocated/auctioned credits and new offsets developed from mitigation projects	Efficiency of system (credits). Monitoring and verification of offsets.
Capital Investment	Carbon capture and storage	Expensive, uncertain, large supporting infrastructure and institutional support.
Fuel Switching	Nuclear, IGCC, natural gas	Expensive, longer-term investments, questionable development realization (cost, scope, reliability).
Renewables	Biomass, wind, solar, geothermal, hydro	Expensive, varying reliability, uncertainty (cost recovery)
Efficiency Improvements	Automotive Appliances Building measures Demand-Side Mgt. Demand Response	Good short run opportunities, significant, but limited in scope. Also require investment to reach pay-back.

LSU
Center for Energy Studies

Credits and Offsets

Carbon Markets

- **Regional Greenhouse Gas Initiative (RGGI)**
  - **2009 is the first full year of operations**
  - **Prices around $4 / tCO_{2e}**
- **Chicago Carbon Exchange**
  - **67 $mmtCO_{2e}$ transacted at a value of $309 million (USD) in 2008**
  - **Prices trading around $1-2 / tCO_{2e}**
    - **Concerns about fungibility if Waxman-Markey becomes law**
- **California Climate Action Reserve**
  - **Largely an exchange for California companies looking for pre-compliance with anticipated federal law.**

Source: State and Trends of the Carbon Market 2009 by World Bank Organization

LSU
Center for Energy Studies

Chicago Climate Exchange
Daily Closing Prices

Source: Chicago Climate Exchange.

LSU Center for Energy Studies

American Clean Energy and Security Act
Caps and Allocation

Caps

- Establishes emission allowances (annual tonnage limits) for 2012-2049, and 2050 and thereafter.
- Prohibits States from implementing any cap and trade programs that covers any capped emissions emitted between 2012 and 2017.
- Reduction targets (based on 2005 levels):
  - 3 percent by 2012;
  - 17 percent by 2020;
  - 42 percent by 2030; and
  - 83 percent by 2050.

Allocation

- Specifies a percentage allocation of various vintage years of the total number of allowances to electricity consumers, natural gas consumers and energy intensive-trade exposed entities.
- About 80 percent of allowances will be issued for free initially, with that number declining over time.
- Auction of specified percentage from each vintage year. Proceeds benefit low income consumers and investment in green jobs. Auction of some unused allowances, initially to be used to fund rebates to consumers.
- Provides for trading, banking and borrowing, auctioning, selling, exchanging, transferring, holding and retiring of emission allowances.

Source: Clayton Utz

American Clean Energy and Security Act

Offsets

- Domestic and international offsets allowed. Projects will be approved by the Administrator on the basis of recommendations from the Offsets Integrity Advisory Board.
- Offsets equivalent to two billion tonnes of emissions can be used for compliance (generally half domestic and half international).
- One domestic offset or 1.25 international offset credits must be submitted for every one tonne of emissions, although up until 2018, one international offset credit can be used.
- Avoided tropical deforestation projects will be recognised as capable of generating offsets for compliance use. This is likely to provide significant support to REDD projects internationally.

Prices and penalties:

- Strategic reserve of 2.5 billion allowances to be created by setting aside a small number of allowances to be issued each year (1-3 percent), to be made available through auction if allowance prices rise to unexpectedly high levels.
- An excess emissions penalty is payable for non-compliance equivalent to the amount of excess emissions (ie. the emissions in respect of which no offset or allowance was held) multiplied by twice the clearing price for the earliest vintage at the last auction.
- There is also a "make good" obligation which means that the covered entity is still obliged to surrender allowances or offsets for the excess emissions in the following calendar year.

Source: World Resources Institute

LSU
Center for Energy Studies

Capital Investments

LSU Center for Energy Studies

What is Carbon Capture and Storage?

- **Carbon Capture and Storage ("CCS") is a method of managing and reducing CO_2 in the atmosphere**
- **Carbon dioxide is captured from a power plant or other industrial source, compressed and put in a pipeline where it travels to a nearby oil or gas field or "sequestration site".**
- **CO_2 can be safely sequestered (or stored) in depleted oil or natural gas fields for an indefinite period of time.**
- **CO_2 can be held underground by the same solid rock layers that have held the trapped oil and gas for millions of years.**

Source: CCS-Education.net

LSU Center for Energy Studies

Big Picture Cost Estimates

Process	Cost range per metric ton of CO_2 captured	Comments
Capture from power plant	$15.00 - $75.00	Net cost
Transportation	$1.00 - $8.00	Per ~155 miles via pipeline
Geological storage	$0.50 - $8.00	Not including EOR revenue
Monitoring of storage	$0.10 - $0.30	Depending upon regulation
Total estimated costs	$16.60 - $ 91.30	

Source: Intergovernmental Panel on Climate Change, JPMorgan Chase

Carbon Capture

- Three main methods industrial capture:
  - Integrated gasification combined cycle (IGCC)
    - Plants can capture 75%-80% CO_2 emissions without major loss of efficiency.
  - Oxygen-fuel combustion
    - Oxygen separators can be retrofitted, but consume up to 15% of generated electricity.
  - Flue gas separation
    - Main focus of research.

Source: National Petroleum Council

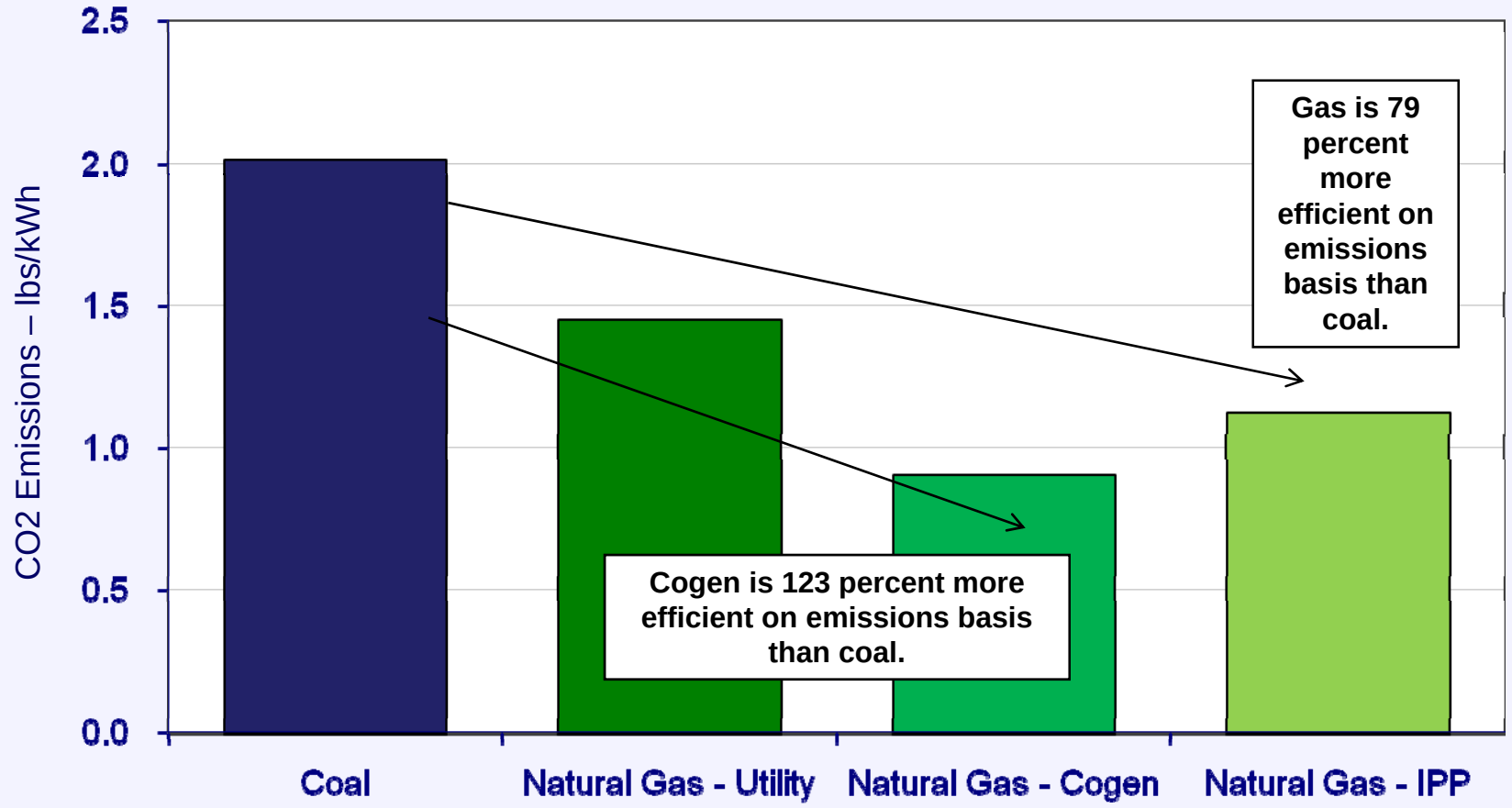
LSU
Center for Energy Studies

Fuel Switching

LSU Center for Energy Studies

CO2 Emissions Rate by Fuel Type

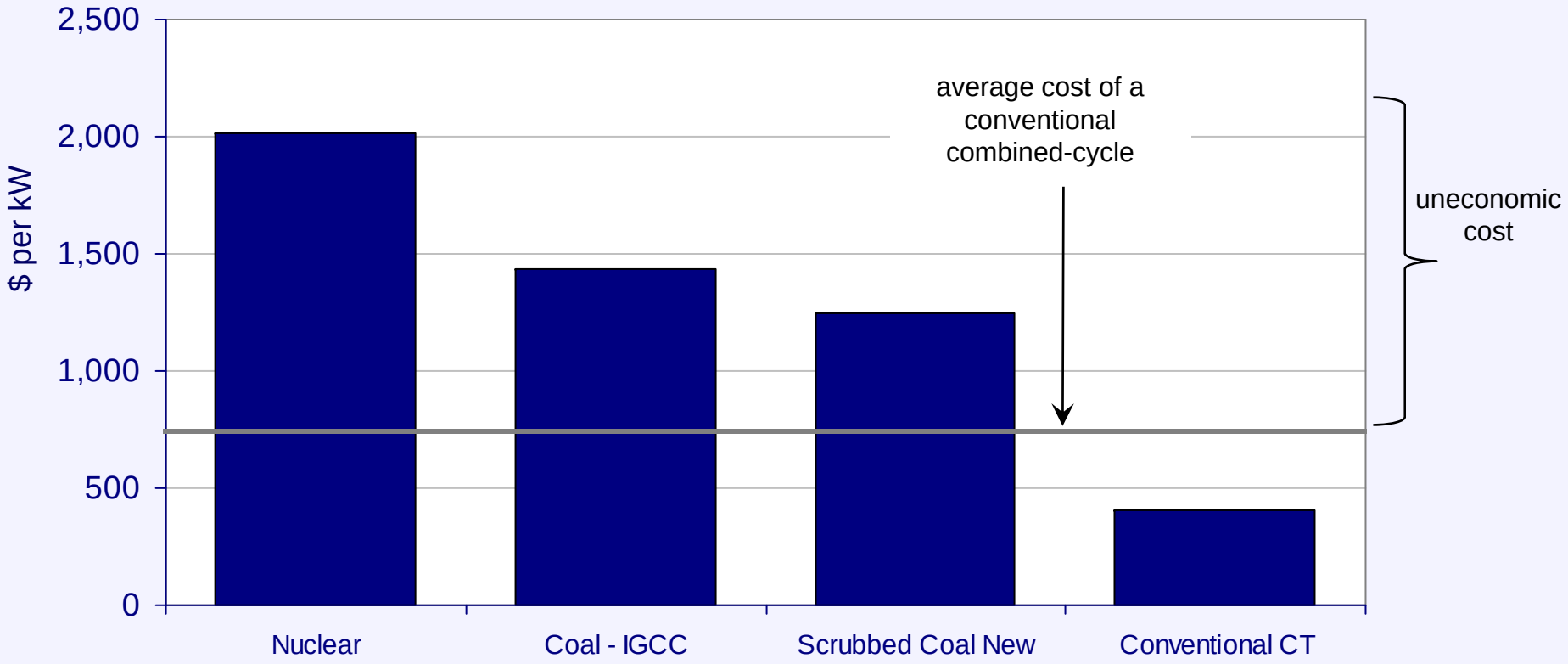
Coal plants have higher emissions rates than all types of gas plants. Cogeneration and newer gas plants have the lowest overall carbon emission rates.



LSU
Center for Energy Studies

Total Overnight Cost for New Plants

Resources are typically uneconomic without additional support



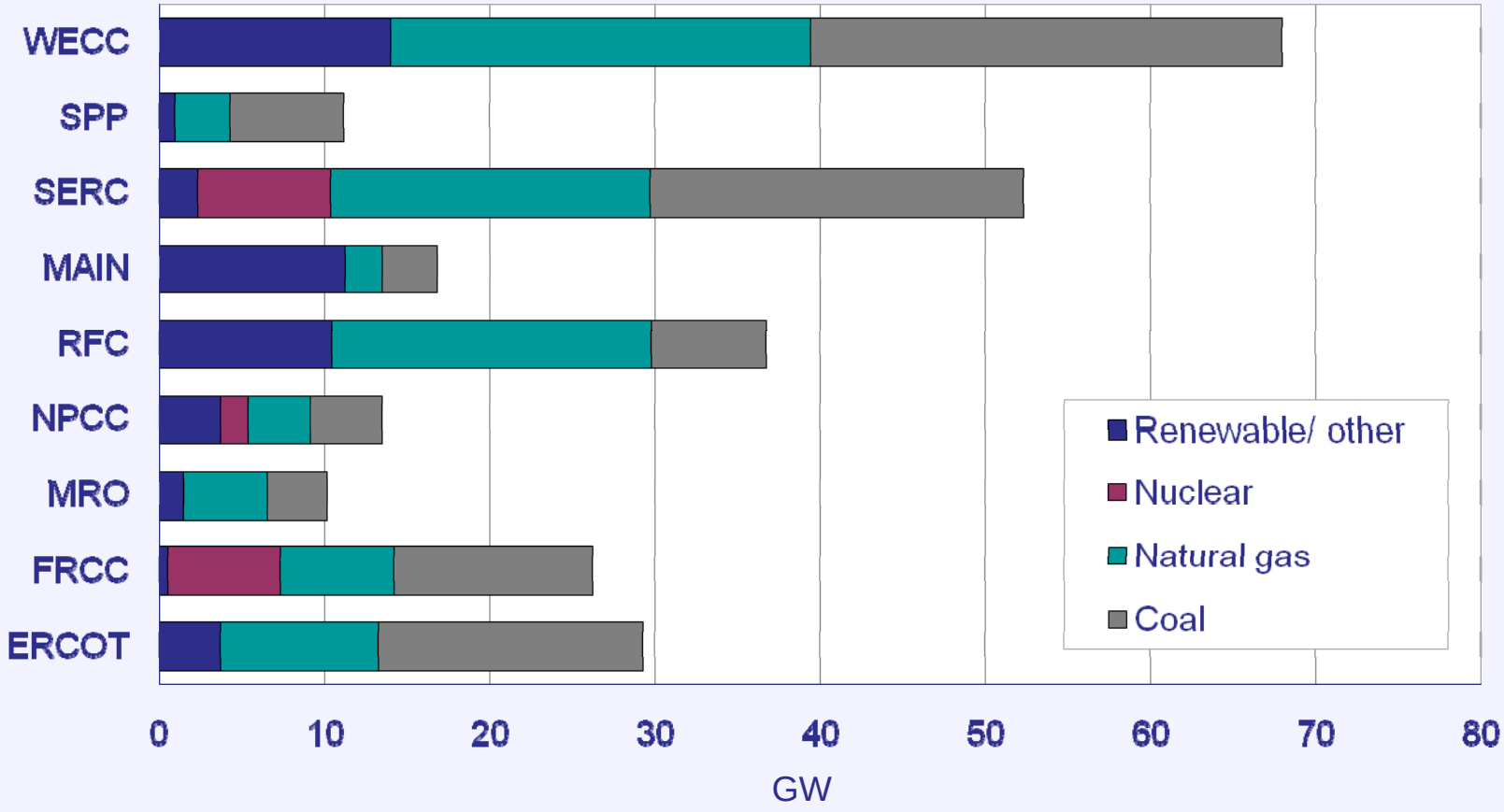
These differentials will have to be recovered from various funding sources

Source: Assumptions to the Annual Energy Outlook 2006

LSU Center for Energy Studies

Electric Generation Capacity Additions By Region and Fuel (2007-2030)

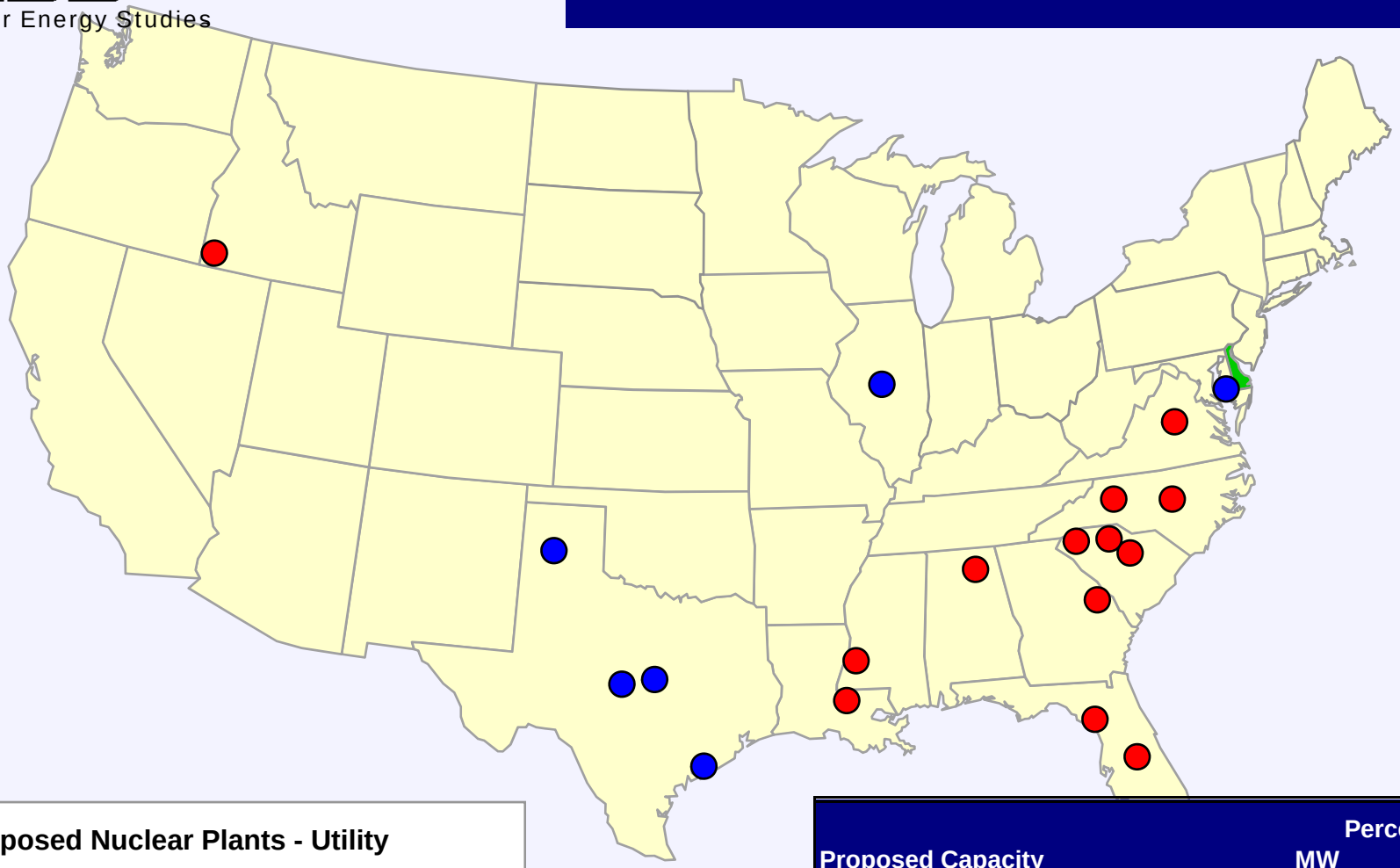
All electricity demand regions are expected to need additional, currently unplanned, capacity by 2030. The largest amount of new capacity is expected in the Southeast (FL and SERC), which represents a relatively large and growing share of total U.S. electricity sales and thus requires more capacity than other regions.



Source: Energy Information Administration, U.S. Department of Energy

LSU Center for Energy Studies

Announced Nuclear Plants



- Proposed Nuclear Plants - Utility
- Proposed Nuclear Plants - Merchant
- Proposed Nuclear Plants - Undetermined

Proposed Capacity	MW	Percent of Total
Utility	22,900	59.2%
Merchant	15,750	40.8%
States w/ Cost Recovery Rules	5,750	14.9%
States w/o Cost Recovery Rules	32,900	85.1%

Note: One proposed plant in Florida and two proposed plants in Texas have locations that are yet to be determined.

Source: Energy Information Administration, US Department of Energy; and Nuclear Energy Institute.

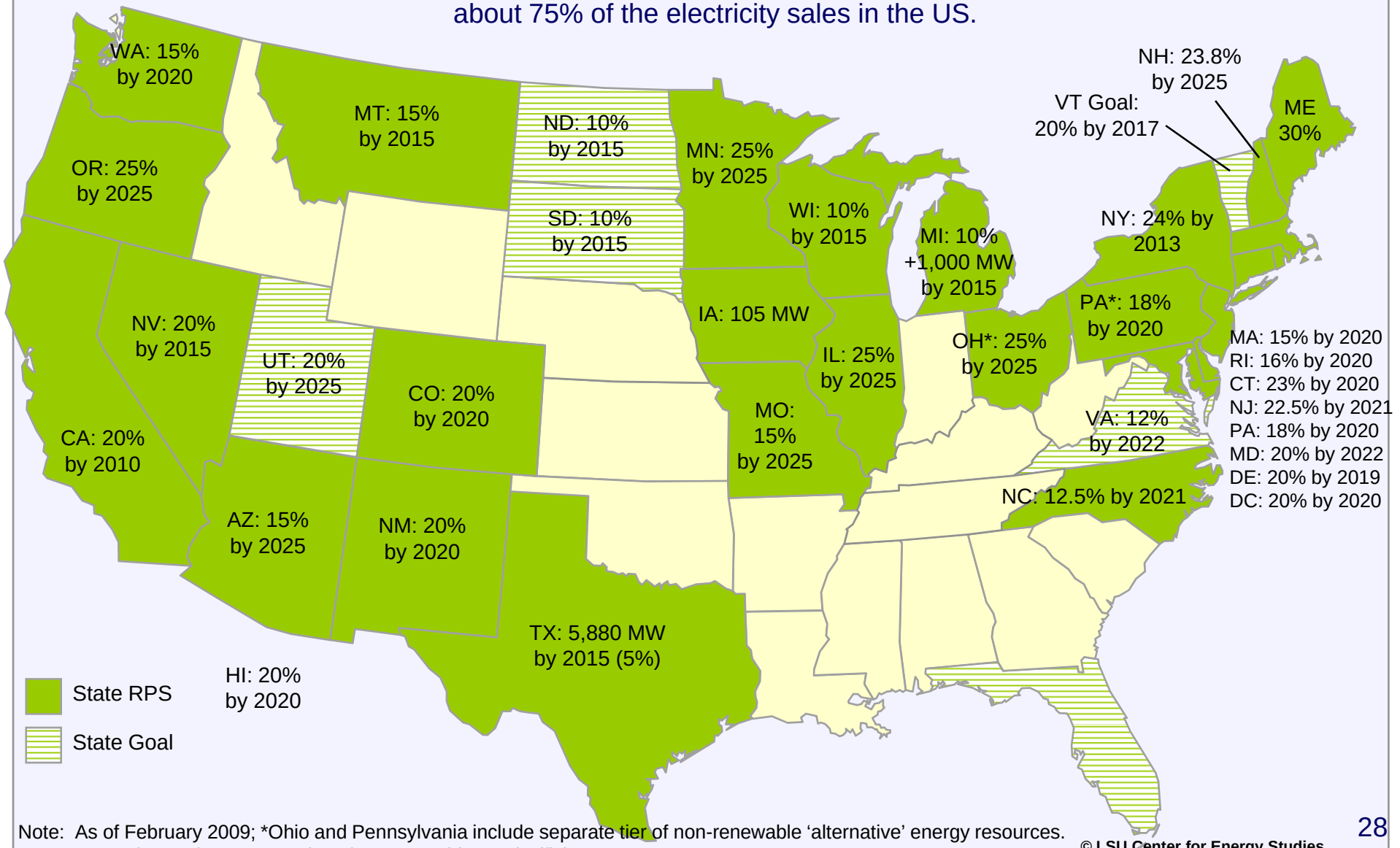
LSU
Center for Energy Studies

Renewables

LSU Center for Energy Studies

States with Renewable Portfolio Standards

Currently there are 33 states that have RPS policies in place. Together these states account for about 75% of the electricity sales in the US.

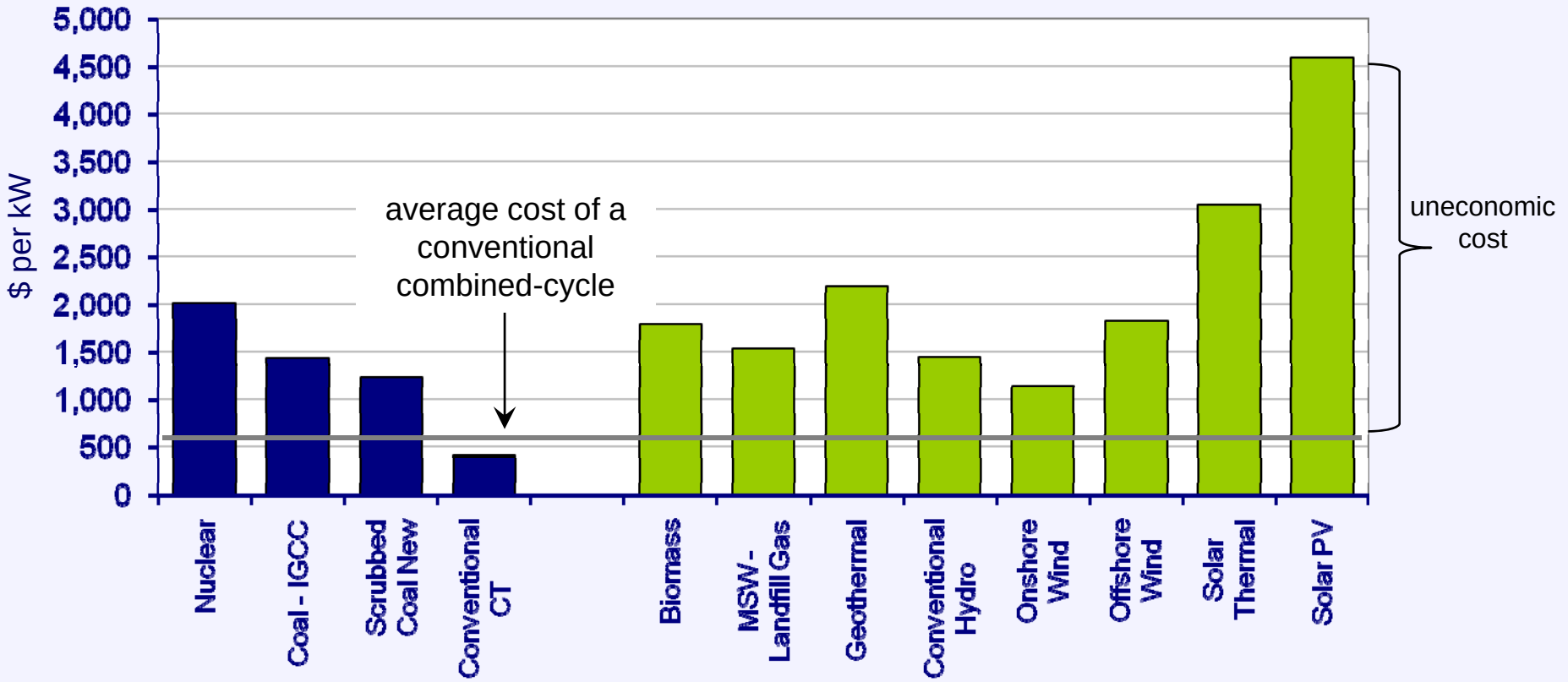


Note: As of February 2009; *Ohio and Pennsylvania include separate tier of non-renewable 'alternative' energy resources.
Source: Database of State Incentives for Renewables and Efficiency.

LSU Center for Energy Studies

Total Overnight Cost for New Plants

Resources are typically uneconomic without additional support



These differentials will have to be recovered from various funding sources

Source: Assumptions to the Annual Energy Outlook 2006

LSU Center for Energy Studies

Renewable Energy Credits and Carbon Offsets

Method	Renewable Energy Credits ("REC")	Carbon Offsets
Type of Projects	RECs only come from renewable energy projects such as solar, wind, geothermal, biofuels, etc.	Offsets can come from renewable projects but also include the collection and storage of carbon through reforestation; ocean and soil collection; and capture and storage efforts.
Units of Measurement	MWh	Metric tons
Design	Forward looking, focused on building a clean energy economy and providing incentives for the creation of renewable energy.	Oriented in the present, dealing with preventing greenhouse gases from entering the atmosphere right now; or removing carbon after it has been released.
Markets	Too many to list	Chicago Climate Exchange, Voluntary Carbon Standard Program
Distribution	Allocated by state or regulatory authority; any amount needed over allocation must be purchased.	Purchased to offset "carbon footprint"

LSU
Center for Energy Studies

Demand Reduction & Efficiency

What are Utility Conservation Programs?

Programs commonly referred to as "demand side management" – attempt to encourage more efficient use of electricity.

Energy efficiency programs: programs that encourage more efficient energy (kWh) consumption.

Load management programs: programs designed to encourage more efficient peak demand (kW) usage.

LSU Center for Energy Studies

Energy Efficiency Resource Standards

ID: Energy Plan puts conservation – DR and EE – as priority resource

MT: state agency reduction initiative: save 20% by 2010

MI: annual savings: 1% of prior year's sales by 2012

MN: reduce fossil fuel use 15% by 2015 through EE, RE

IA: utilities must establish EE goals by end of 2008

WI: RPS requires utility EE

IL: reduce energy 2% by 2015 (EE) and 0.1% from prior year (DR)

OH: reduce peak-demand 8% by '18; 22% energy savings by '25

KY: proposed REPS - EE and conservation to offset 18% of projected 2025 demand

ME: 10% new EE by 2017; in RPS goal as 2nd priority

VT: EE & RE to meet 2007-12 growth

MA: meet 25% of capacity and energy with DSR by 2020

NY: 15% electric use reduction by 2015; doubles EE funding

CT: 4% savings by 2010; a Tier III RPS resource

NJ: reduce consumption 20%, and peak demand 5,700 MW by 2020

DE: EE, RE, DG, and DR are priority resources before new gen

PA: reduce energy consumption 3% and peak demand 4.5% by 2013

DC: reduce peak demand and energy consumption

MD: reduce peak demand and per cap electricity use 15% by 2015

VA: reduce 10% of 2006 sales by 2022 with EE, DR

NC: EE to meet up to 25% of RPS to 2011; later to 40%

FL: PSC to adopt goals to reduce electric consumption, peak demand

WA: must pursue all cost effective conservation

OR: IOUs required to have EE in IRP & assess cost-effectiveness

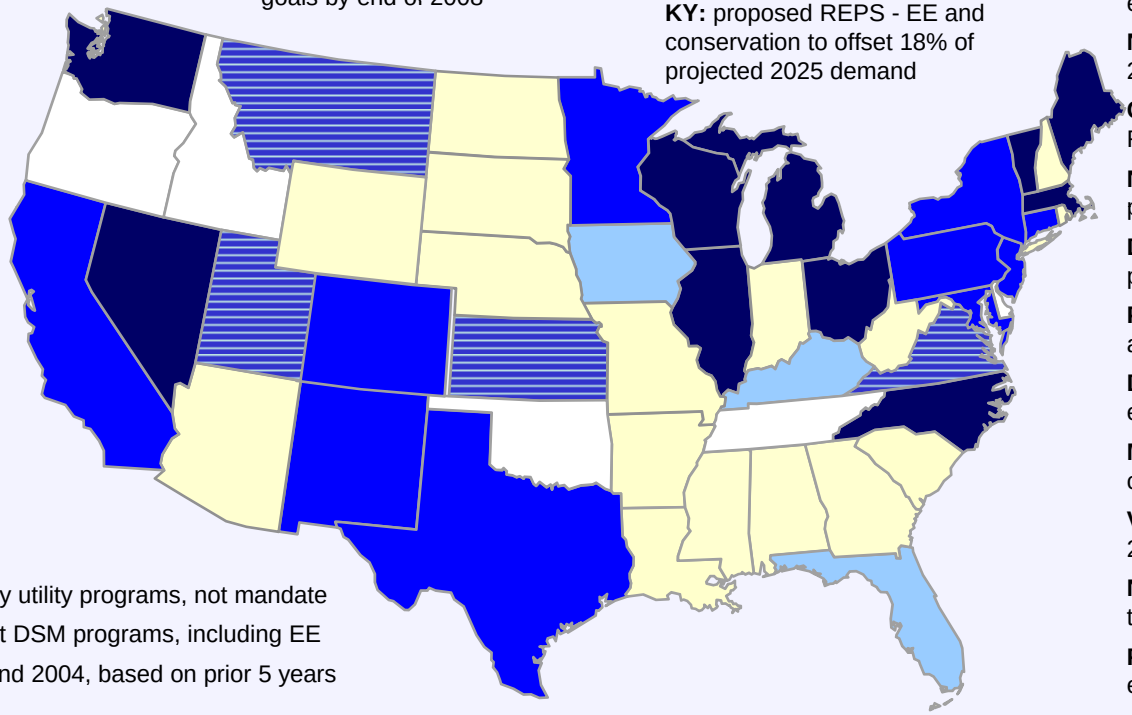
CA: IOUs reduce MW 10%, peak demand (MWh) 12% by 2013; munis 10% by 2017

NV: use EE for up to 25% of RPS by 2015

UT: EE incentives in RPS goal

CO: save 40 MW and 100 GWh annually to 2013

NM: use EE and DR to save 10% of 2005 retail electric sales by 2020



KS: Order advocates voluntary utility programs, not mandate

OK: PSC approved quick-start DSM programs, including EE

TX: 10% of load growth, beyond 2004, based on prior 5 years

- EE only as part of an RPS law, rule or goal
- EERS by regulation or law (stand-alone)
- Voluntary standards (in or out of RPS)
- EE goal proposed/being studied
- Other EE or DSM rule or goal

Source: Federal Energy Regulatory Commission

LSU
Center for Energy Studies

Conclusions

LSU
Center for Energy Studies

Conclusions

- Policy proposals associated with climate change are likely to be the biggest form of energy market restructuring ever experienced.
- Credibility, M&V, volatility, and confusion are likely to be experienced early in this process. Policy is outpacing the technology and institutional capabilities.
- The combination of climate, energy efficiency, and renewables are likely to have unanticipated consequences.
- Significant redistribution of wealth between sectors, income classes, and even various regions and countries around the world.
- High near and intermediate term reliance on natural gas particularly for power generation.

LSU
Center for Energy Studies

Questions & Comments

dismukes@lsu.edu

www.enrg.lsu.edu