Electricity Committee
(Trans)Mission Critical?
Reconsidering FERC’s Electric Transmission Incentives
Moderator:

Phil Moeller, EEI

Suedeen Kelly, Jenner & Block, LLP

Delia Patterson, APPA
Electricity Committee

Up Next at 1:30...

100% Clean Energy: What Comes Next for Regulators?

(Joint with Committee on Energy Resources & the Environment)
100% Clean Energy: What Comes Next for Regulators?

Electricity Committee

Committee on Energy Resources & the Environment
Moderator:
Leia Guccione, RMI

Hon. James Griffin, Hawaii

Sandra Mattavous-Frye, D.C. People’s Counsel

Jeff Lyng, Xcel
Electricity Committee

*Up Next at 2:45...*

100% Clean Energy: What Comes Next for Markets and the Grid?

(Joint with Committee on Energy Resources & the Environment)
100% Clean Energy: What Comes Next for Markets and the Grid?

Electricity Committee

Committee on Energy Resources & the Environment
Moderator:
Debbie Lew

John Moore, NRDC

Armond Cohen, Clean Air Task Force

Mason Emnett, Exelon
Up Next at 4:00...

Beyond Retirements: How Carbon Capture, Utilization, and Storage Can Save Ratepayers Money

Subcommittee on Clean Coal and Carbon Management
Beyond Retirements: How Carbon Capture, Utilization, and Storage Can Save Ratepayers Money

Subcommittee on Clean Coal and Carbon Management
Moderator:
Hon. Jeremy Oden, Alabama

Chuck McConnell, University of Houston

Mike Nasi, Jackson Walker

Paul Bailey, American Coalition for Clean Coal
Electricity/America’s Power
The Low Carbon Role for Coal

Why Carbon Capture Utilization & Storage (CCUS) Must be a Part of Resource Planning

NARUC Summer Meeting
Indianapolis, Indiana
July 22, 2019
The Low Carbon Role for Coal

DISCUSSION OUTLINE

• The Difference Between “Safe” and “Clean”
• Carbon Reductions are Not all Created Equal
• Status of and Business Case for CCUS
• CCUS in Resource Planning
The Low Carbon Role for Coal

DISCUSSION OUTLINE

• The Difference Between “Safe” and “Clean”
• Carbon Reductions are Not all Created Equal
• Status of and Business Case for CCUS
• CCUS in Resource Planning
Then and Now: 50 Years of Success - We Internalized the Externalities of Pollution

Declining National Air Pollutant Emissions

Source: U.S. EPA National Emissions Inventory 2014 ver. 2
Then and Now: 50 Years of Success - We Internalized the Externalities of Pollution

Declining National Air Pollutant Concentration Averages
We Made our Air Safe with Technology, Not Anti-Fossil Fuel Ideology

Sources: Environmental Protection Agency, Air Trends Report 2018; Energy Information Administration, Total Energy Data Browser
CASE STUDY: OZONE NONATTAINMENT

LEGEND
Nonattainment Areas for the 2015 8-hour Ozone Standard
Ozone 2015 NAAQS NAA State Level
- Maintenance
- Nonattainment
Power Plants No Longer Drive Nonattainment

NO\textsubscript{x} Emissions

Source: U.S. EPA National Emissions Inventory 2014 ver. 2
EXAMPLE – DFW: Power Plants Have Not Driven Attainment Status for over a decade

Future Case Contributions to DFW Ozone
Task 20 - APCA Analysis of 2009 Baseline Impacts

Very Small Local & Regional Power Plant Contribution

Source: July 13, 2006
TCEQ Presentation to Senate Natural Resource Committee
CASE STUDY: PM$_{2.5}$ NONATTAINMENT

LEGEND

Nonattainment Areas for the 2012 Annual Fine Particle (PM$_{2.5}$) Standards

PM$_{2.5}$ Annual 2012 Nonattainment Areas

- Maintenance
- Nonattainment
CASE STUDY: U.S. PM$_{2.5}$ – 6x below global average (7x below China, & much lower than Europe)
For Non-GHGs, When Ambient Air Quality is “Safe,” We Should NOT Count Benefits for “Cleaner”

• Per the FCAA, NAAQS are based on what is considered a “safe” level of constituents for humans (plus a margin of safety).
• Only NAAQS nonattainment remaining in the U.S. is NOT being driven by power plants (natural/foreign/mobile sources).
• Thus, it is inappropriate to continue assuming “benefits” from lowering power plant emissions down to absolute zero.
• Yet, 99% of “benefits” of EPA air rules assumed by the prior administration were derived from reducing ambient levels below the NAAQS “safe” levels.
The Low Carbon Role for Coal

DISCUSSION OUTLINE

• The Difference Between “Safe” and “Clean”
• Carbon Reductions are Not all Created Equal
• Status of and Business Case for CCUS
• CCUS in Resource Planning
Not All Carbon Reductions are Created Equal

• Early retirement of well-controlled coal units rarely economically justified.

• State & Federal subsidies and mandates for renewables has already been a significant internalizing function of carbon as an externality.

• Because carbon captured from a dispatchable fossil fuel plant innovates CCUS & provides baseload low-carbon power, it is a much more valuable low-carbon asset (to the grid & the world) than intermittent wind or solar.

• If we are serious about mitigating anthropogenic CO2 & ensuring market transparency, regulatory approvals/planning must ensure that ratepayers know the true and total cost (and benefits) of their low-carbon options.
The Low Carbon Role for Coal

DISCUSSION OUTLINE

• The Difference Between “Safe” and “Clean”
• Carbon Reductions are Not all Created Equal
• *Status of and Business Case for CCUS*
• CCUS in Resource Planning
DON’T FORGET THE MATH: The World Needs our Technology, Not Anti-Fossil Fuel Ideology

2050 IMPACT OF DECARBONIZING ELECTRICITY:
• NO COAL FLEET = 2.06 ppm (0.4%) reduction in CO₂ concentration.
• NO FOSSIL FLEET = 3.3 ppm (0.7%) reduction in CO₂ concentration.
• Modeled global temperature reduced by a mere 0.016°C.

2050 IMPACT OF DECARBONIZING ENTIRE U.S.:
• 10.4 ppm (2.2%) reduction in CO₂ concentration.
• Modeled global temperature reduced by 0.053°C.

<table>
<thead>
<tr>
<th>CO₂ Emissions</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
<th>2040</th>
<th>2050</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>30,834</td>
<td>34,972</td>
<td>36,398</td>
<td>39,317</td>
<td>42,771</td>
<td>+38.7%</td>
</tr>
<tr>
<td>U.S.</td>
<td>5,571</td>
<td>5,260</td>
<td>4,839</td>
<td>4,867</td>
<td>5,071</td>
<td>-8.9%</td>
</tr>
</tbody>
</table>

Petra Nova:

Power Generation:
• Gas CT/peaker for parasitic load

Carbon Capture:
• Post-combustion amine solvent
• 90% of 250 MW slip stream
• 1.65 short tons of CO$^2$ annually

Product Delivery and Utilization:
• CO$^2$ EOR via 80-mile pipeline
• West Ranch oil recovery up from 500 to 5,000-10,000 Barrels Per Day
Path to success – Improving CCUS Economics

$/MCF

Year

2017
2019

CCS with 4%
Cost improvement P.A.

SOURCE: David Greeson, Project Manager, Petra Nova
CASE STUDY: CO & NM
Units that Could be Retrofitted with CCUS Rather than Retired
DOE STUDY: Demonstrates Viability of CCUS Retrofit Rather than Retire & Replace with Wind/Solar/Storage (Tax Equity Owner reduces cost to the consumer even more!)

- **CO₂ sales price for EOR and 45Q tax credit revenue, nominal $/tonne**
  - AEO Reference
  - AEO High Oil Price

- **Jobs created over 23 years (2020-2042)**
  - Pueblo
  - Colorado
    - CEP
    - CCUS

- **CO₂ revenues in 23 years, billion $**
  - CEP
  - CCUS

- **Reduction in CO₂ emissions in 23 years (2020-2042) relative to baseline emissions in 2005**
  - CEP
  - CCUS
The Low Carbon Role for Coal

DISCUSSION OUTLINE

• The Difference Between “Safe” and “Clean”
• Carbon Reductions are Not all Created Equal
• Status of and Business Case for CCUS
• **CCUS in Resource Planning**
# Factors That Regulators Should Address When Comparing CCUS & Renewable Energy

## WIND/SOLAR/STORAGE
- Low Capacity Factors
- Transmission Additions
- Reliability & Resilience Penalty

## KEY CONSIDERATIONS
- **True & Total LCOE**
  - Non-GHG Externalities
    - Bird Strikes
    - Habitat Destruction
    - Lithium/Cobalt Mining for Batteries
    - Rare Earths for Turbines & Solar
  - GHG Externalities
    - Backup Power Emissions
    - Life-Cycle GHGs From Construction & Land Use
    - Missed R&D opportunity
  - Economic Impact & Geopolitical
    - Dependence on Minerals & Products Not Mined/Made in US

## CCUS RETROFIT
- High Capacity Factors
- No New Transmission
- High Reliability & Resilience
- Air Quality Not Impacted > Known “Safe” Levels (NAAQS)
- Successful & Established Coal Reclamation Programs
- No Backup Power Required – (24/7 carbon-free resource)
- R&D Drives Down Future Costs (global game changer)
- Domestic fuels (coal & gas) + export commodity (oil & tech)
The Low Carbon Role for Coal

Charles McConnell
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Carbon Management and Energy Sustainability
UH Energy, Chancellor/President’s Division
cmcconnell@uh.edu

Mike Nasi
Mnasi@jw.com
Partner, Jackson Walker LLP
Director, Life:Powered

QUESTIONS?
“Converting Carbon to a Commodity” Video

https://www.youtube.com/watch?v=TXVvAoQBjc
APPENDIX: Why U.S. Power Markets are NOT Transparent

1. The premise of U.S. RE moving the needle on global climate change is fundamentally flawed.
   - Even if we were to eliminate all U.S. power sector emissions by 2030, it would only reduce 2050 global concentrations by .7% (3.3 out of 480.3 ppm)

2. PTC/ITC subsidies are hidden from consumers.

3. All fuels receive subsidies but there is massive disparity in Return on Investment (in $/MW).

4. Direct/Indirect Subsidies Distort Markets:
   - Transmission socialized across entire markets.
   - Growing costs of balancing wind & solar.
   - Stranded costs & lack of market signals for capacity.

The Lack of Transparency in American Power Markets Leads to “Grid Parity” Claims & and “100% Renewable” Mandates that Mislead Ratepayers & Endanger Grid Resilience.
Many claim that all forms of energy receive “subsidies,” but wind & solar deliver far less return on investment (ROI).

Production tax credit subsidies for existing renewable energy technologies do not promote innovation.

**Comparing the ROI of Federal Energy “Subsidies”**

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Subsidies per Unit of Electricity Generated (2017 USD/MWh, 2003 - 2017 Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydropower</td>
<td>$0.33</td>
</tr>
<tr>
<td>Coal</td>
<td>$1.13</td>
</tr>
<tr>
<td>Nuclear</td>
<td>$1.86</td>
</tr>
<tr>
<td>Natural gas and oil</td>
<td>$2.03</td>
</tr>
<tr>
<td>Geothermal</td>
<td>$6.33</td>
</tr>
<tr>
<td>Wind</td>
<td>$21.70</td>
</tr>
<tr>
<td>Solar</td>
<td>$139.8</td>
</tr>
</tbody>
</table>

Sources: Office of Management and Budget, Analytical Perspectives; Joint Committee on Taxation, Estimates of Federal Tax Expenditures; Department of Energy, Statistical Tables by Appropriation; Census Bureau, Consolidated Federal Funds Report; Department of the Treasury, Section 1603 List of Awards; Energy Information Administration, Electricity Data Browser
Transmission Costs of Integrating Renewables

Case Study: ERCOT
Off-Peak Exuberance vs. On-Peak Reality:

**Off-Peak Exuberance:**
- Total Power Demand
- Houston Chronicle headline, "Texas wind generation breaks record, ERCOT reports"
- 19,168 MW Wind on 12/14/18 when entire grid needed only 36,760

**On-Peak Reality:**
- Wind underperformance from 7/10-7/13/19 on & off peak.

- **Installed Wind:** ~24,000 MW
- **Average from 12 to 6 PM:** 2,704 MW (11% capacity factor)
The Imputed Cost of Wind on (& off) the Grid is NOT Being Adequately Reflected in Market Designs – Note the Forecasting vs. Actual Generation
And it’s Not Just Texas in the Summer!
**Average Daily GWh**

<table>
<thead>
<tr>
<th></th>
<th>12/1-12/26</th>
<th>12/27-1/8</th>
<th>Positive Delta Total</th>
<th>Percentage Change</th>
<th>Share of Positive Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>746</td>
<td>1,113</td>
<td>367</td>
<td>49%</td>
<td>73%</td>
</tr>
<tr>
<td>Gas</td>
<td>607</td>
<td>619</td>
<td>12</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Renewables</td>
<td>127</td>
<td>122</td>
<td>-5</td>
<td>-4%</td>
<td>-</td>
</tr>
<tr>
<td>Nuclear</td>
<td>846</td>
<td>851</td>
<td>5</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Oil</td>
<td>6</td>
<td>117</td>
<td>112</td>
<td>1994%</td>
<td>22%</td>
</tr>
<tr>
<td>Multiple fuels</td>
<td>2</td>
<td>10</td>
<td>8</td>
<td>383%</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td>2,334</td>
<td>2,832</td>
<td>504</td>
<td>21.6%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**How is it Again that America is Going to Live Without Coal?**

Source: DOE/NETL 2018
Globally, More Renewable Energy Means More Expensive Power
Expensive Energy Hurts the Poor the Most

Civil Rights Suit Exposes California’s Regressive Green Energy Agenda

“California’s climate change policies ... have caused and will cause unconstitutional and unlawful disparate impacts to California’s minority populations ...”

“Since most of the world’s energy is still produced from fossil fuels, energy consumption is still highly correlated to economic productivity and per capita incomes ...”

“... the “net zero” GHG threshold would operate unconstitutionally so as to disproportionately disadvantage low income minorities in need of affordable housing relative to wealthier, whiter homeowners who currently occupy the limited existing housing stock...”

“CARB’s VMT reduction scheme and its ongoing efforts to intentionally increase congestion are an assault on the transportation mobility of people, which disparately harm minority workers...”

SUPERIOR COURT OF THE STATE OF CALIFORNIA
COUNTY OF FRESNO
UNLIMITED CIVIL JURISDICTION

THE TWO HUNDRED, an unincorporated association of civil rights leaders, including LETICIA RODRIGUEZ, TERESA MURILLO, and EUGENIA PEREZ,

Plaintiffs/Petitioners,

V.

CALIFORNIA AIR RESOURCES BOARD, RICHARD COREY, in his Official Capacity, and DOES 1-50,

Respondents/Defendants.

VERIFIED PETITION FOR WRIT OF MANDATE; COMPLAINT FOR DECLARATORY AND INJUNCTIVE RELIEF

### Density of U.S. Energy Resources

<table>
<thead>
<tr>
<th>Power Source</th>
<th>W/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>307</td>
</tr>
<tr>
<td>Coal</td>
<td>182</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>101</td>
</tr>
<tr>
<td>Crude Oil</td>
<td>22</td>
</tr>
<tr>
<td>Solar</td>
<td>8</td>
</tr>
<tr>
<td>Hydroelectric</td>
<td>1.7</td>
</tr>
<tr>
<td>Wind</td>
<td>1.0</td>
</tr>
<tr>
<td>Ethanol</td>
<td>0.3</td>
</tr>
</tbody>
</table>


---

**Land Requirements for a 1000 MW Power Plant**

- **Nuclear:** 1 mi²
- **Coal:** 2 mi²
- **Natural Gas:** 3 mi²
- **Solar:** 27 mi²
- **Wind:** 115 mi²

---


Amount of land required for 5,000 GWh of annual production, assuming 60% capacity factor for nuclear, coal, and natural gas, 20% for solar, and 34% for wind. Land requirements for wind include spacing between turbines. Values for wind and solar do not include land for transmission lines or energy storage to ensure equal reliability to dispatchable power.
What does levelized cost of electricity mean?

- Typically, levelized costs are used to compare new electricity sources to one another. However, levelized costs are also useful to compare existing power plants to new sources.
- EIA: “The cost of building and operating a generating plant over an assumed financial life and duty cycle.”
- Levelized costs are calculated by summing all the costs (variable and fixed O&M, capital investments, and financing costs) of an electricity source over its lifetime and then dividing those costs by the amount of electricity the source is expected to generate over its lifetime.
- LCOE is a way to compare the cost of different sources of electricity. A source with a lower levelized cost is preferable to one with a higher cost.
From “The Levelized Cost of Electricity from Existing Generation Resources.” LCOE for solar and wind are shown with and without imposed costs.
Caveats

- These levelized costs represent national averages. Actual circumstances will differ for each new and existing source of electricity. However, LCOE is still a useful consideration in decision-making.

- The cost of additional transmission is not included in these LCOE estimates.

- The cost of new gas infrastructure is not included in these LCOE estimates.

- Stranded costs are not considered.
For more information, please contact —

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