



# 111d Update

*Jason Bohrer  
Lignite Energy Council*

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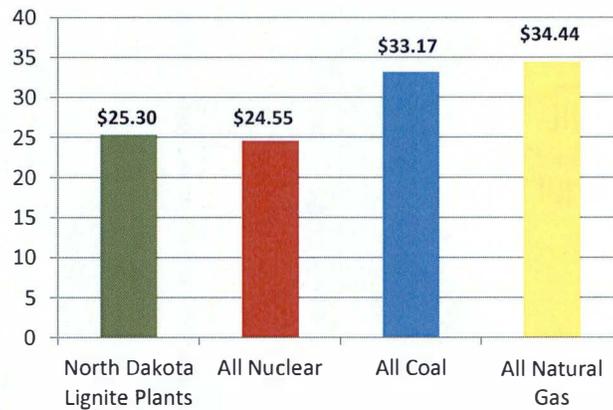
## US Reality

- **The retirement of 200 coal plants as of July 2015 nationwide represents the phase out of nearly 40 percent of the 523 U.S. coal plants that were in operation just five years ago.**



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## Average Electricity Costs 2012 Megawatt-Hour



Source: Ventyx



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## CO2 Rules

- Rules for New Plants
  - 1400 lbs/mwh
- Rules for Existing Plants
  - Efficiency Improvements
  - Natural Gas Reliance
  - Renewable Offsets
- \$1200/per year increase in energy costs



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## Compliance Options

- **Can we comply?**
  - Wrong question
  
- **What are our compliance options**
  - What do they cost
  - Dollar cost and beyond

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## The Chinese Approach

- **Increase “zero emission” sources to 80% of generation by 2030**

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## The Chinese Approach Zero Emissions

- An additional 800-1,000 gigawatts of nuclear, wind, solar and other zero emission generation capacity” must be deployed by 2030 — more than all the coal-fired power plants that exist in China today. Otherwise the goal can’t be met.

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## The Chinese Approach Zero Emissions



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## Compliance Options

- **Can we comply?**
  - Wrong question
  
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## The Chinese Approach Zero Emissions

- **1000 Gigawatts of wind requires a landmass 6 times the size of Indiana**
- **1000 Gigawatts of hydro requires 40 additional Three Gorges Dams**

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## North Dakota Options

- Drop total coal use to eliminate 45% of the current load on coal, replace with “clean” based generation.
  - No load growth.
  - Stranded Assets in the billions
  - Job losses, revenue losses

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## North Dakota Options

- Add “clean” resources to balance carbon footprint so there is an average of 1305 lbs./MWh
- Helps load growth problem
- Needs 1 million acres/1500 Sq. miles
- Infrastructure? Opportunity costs for land?

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## North Dakota Options

- CO2 Capture
- Partial Capture on many plants
- Full Capture on few plants
- Boundary Dam example ~700M for 00% capture of 100MW facility
- We need to capture 90% of 1500MW

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## North Dakota Options

- CO2 Capture Becomes Viable with Oil Partnership
- Post Combustion Capture
  - ALLETE/NRG

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## North Dakota Options

- Retire “111d” plants, replace with “111b” plants
- Kemper County option
- \$2-4B

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## North Dakota Options

- Energy Storage
  - Pumped hydro storage with wind?
- Can we replace coal with biomass?
  - Where does biomass come from
  - Market impacts

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## North Dakota Options

- **Co-firing**
  - Co-fire with gas
  - Co-fire with biomass
- **Nuclear**
  - 2000 mw for \$6-10B, rates remain low
  - Solves load growth
  - CHP—coal into chemicals, etc.

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## North Dakota Options

- **Renewable Credit Markets**
  - \$400-500M per year

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## North Dakota's Answer

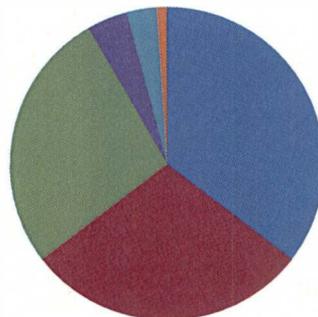
- Increased R&D
  - Allam Cycle
  - Funded during last session
  - Multi-million dollar project coming before the Lignite Research Council
- Oil partnerships
  - Tax policy
- Biggest Challenge is time

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## XXX Generation Under Construction

Number of Projects: Coal = 0



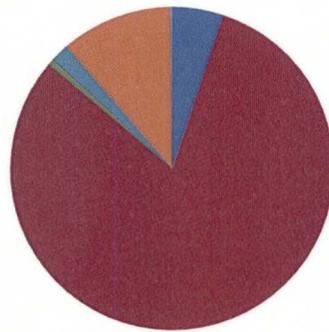
- Wind 34
- Gas 28
- Solar 26
- Methane 4
- Hydro 3
- Nuclear 1

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# XXX Generation Under Construction

Transfer Capacity Requested



- Wind 708
- Gas 11,365
- Solar 84
- Methane 14
- Hydro 248
- Nuclear 1570
- Biomass 25
- Coal 0

