Coal-fired Power Plants in the U.S.—Examining the Costs of Retrofitting with CO_2 Capture Technology*

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Descriptive Statement

This presentation examines 325 coal-fired power plants and their potential to be sources of CO2 for sequestration.

Notes to Accompany Map (Page 7 of 18 [Slide 6 of 17]) of Coal-Fired Power Plants

- Analysis indicates that 323 (83.2%) power plants are located within 25 miles of an oil and gas sequestration opportunity.
- For saline aquifers, 244 (62.9%) plants are within 25 miles.
- Significantly, for CO_2 pipelines, although they have limited build-out at this time, they are located within 50 miles of 11 plants.
- When combined, analytical results show that a total of 324 (83.5%) plants of the viable population are within 25 miles of a sequestration opportunity.
- A 25-mile distance was used to represent a reasonable threshold for a viable transportation of CO_2 within CCM. This is more conservative than NETL's Bituminous Baseline Final Report, where 50 miles was assumed as an appropriate distance for CO_2 transportation to a saline aquifer.
- With the addition of the distance to sequestration criterion, the viable population decreases to 324 plants. Figure (map) shows the derivation of the viable plant population based upon removal of different nonviable categories of plants from the population.

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Websites/URLs

EIA http://www.eia.gov/cneaf/electricity/page/co2_report/co2report.html (accessed August 24, 2010)

NETL http://www.netl.doe.gov/energy-analyses/refshelf/detail.asp?pubID=289 (accessed August 24, 2010)

Coal-Fired Power Plants in the U.S.—Examining the Costs of Retrofitting with CO_2 Capture Technology

Presented to:

AAPG Carbon Capture and Sequestration: New Developments and Applications, Case Studies, Lessons Learned

Golden, CO

Presented by: Jeffrey Eppink

Enegis LLC

August 12, 2010

Agenda

- Purpose
- Brief overview of the methodology
- Analysis and results

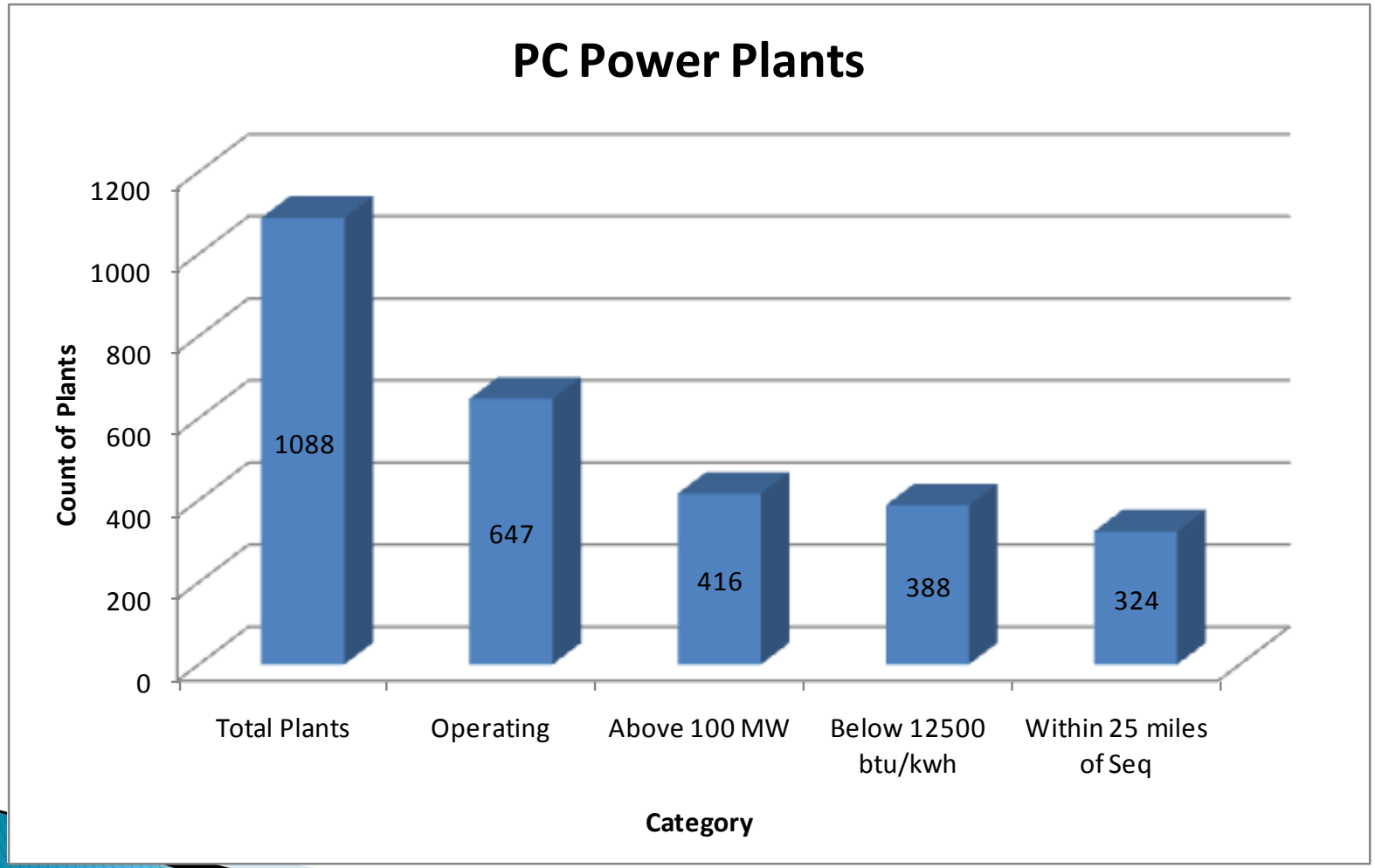
Purpose

- Given the importance of coal-fired power (CFP) generation in the U.S. and the size of the existing CFP fleet, DOE's National Energy Technology Laboratory (NETL) wanted to investigate
  - the costs and practicability of CFP plants for CO_2 capture retrofit
  - the potential for improvements in efficiency
- NETL asked Enegis to assist in developing a study to elucidate these issues:
  - Defining a viable population of pulverized coal plants for which retrofit and efficiency improvements could be considered
  - Providing examination of each CFP plant individually
  - Based upon a database and geographic information systems (GIS) model
    - Carbon Capture Model (CCM)

Overview of the Methodology

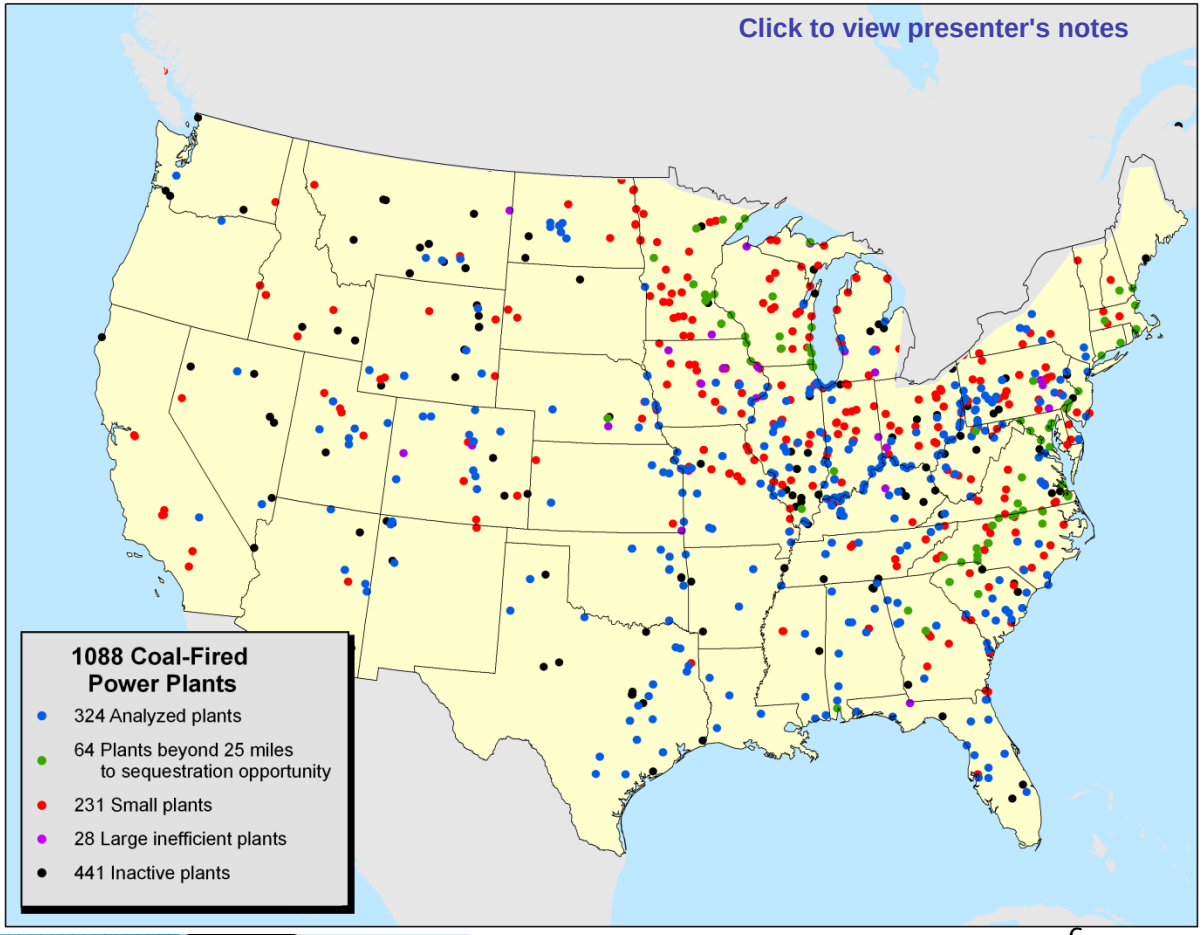
- Population sample determination
- Unit-specific requirements
  - Physical size and cost scaling
  - Emissions controls
  - Recirculating cooling
  - Multiple units discount
- GIS analysis
  - Construction difficulty
  - Additional land requirements
- Marginal calculations
  - CAPEX
  - OPEX
  - Parasitic load

Defining the Sample Population



Defining the Sample Population (cont'd)

- Sample Population of Coal-Fired Power Plants



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AEP Conesville as the Base Case

- Physical Size and Cost Scaling

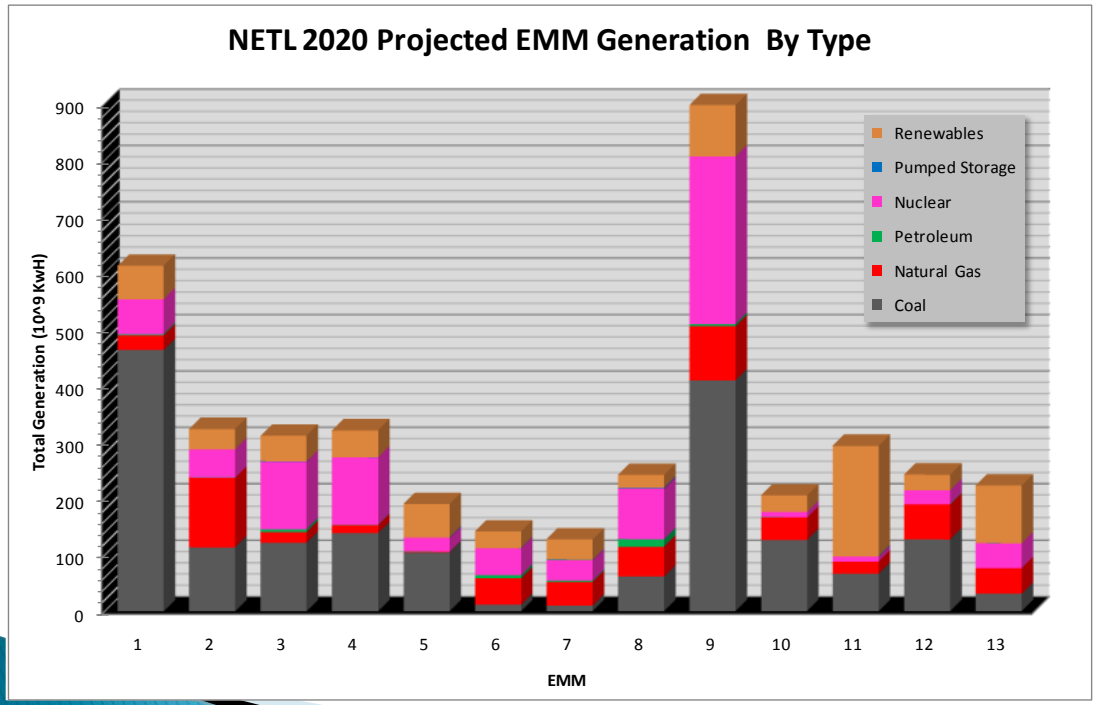
- Required equipment geometries were digitized from the Conesville report so they could be scaled, relocated, and rotated to accommodate the remaining plants in the sample population

Analysis and Results

- Carbon capture retrofit
  - CO_2 Capture Cost
  - CO_2 Mitigation Cost
  - CO_2 Net Mitigation Cost
- Refurbish/retrofit option analysis
- Sequestration analysis

Waxman-Markey Projections

- 2020 EMM-specific electricity price used for make-up power
- Carbon Allowance—value of $40.80/tonne CO_2 (2020 value) used as an offset to operating costs

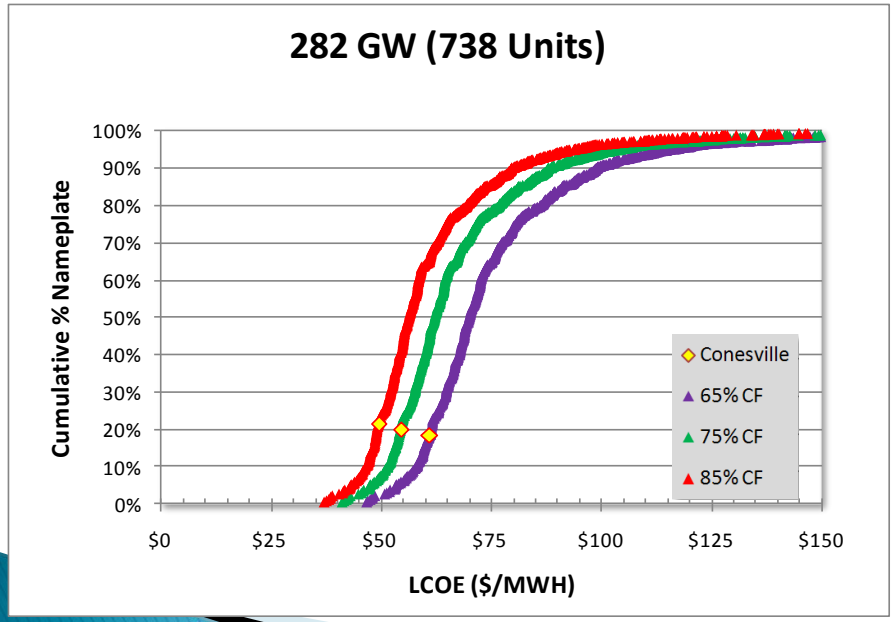


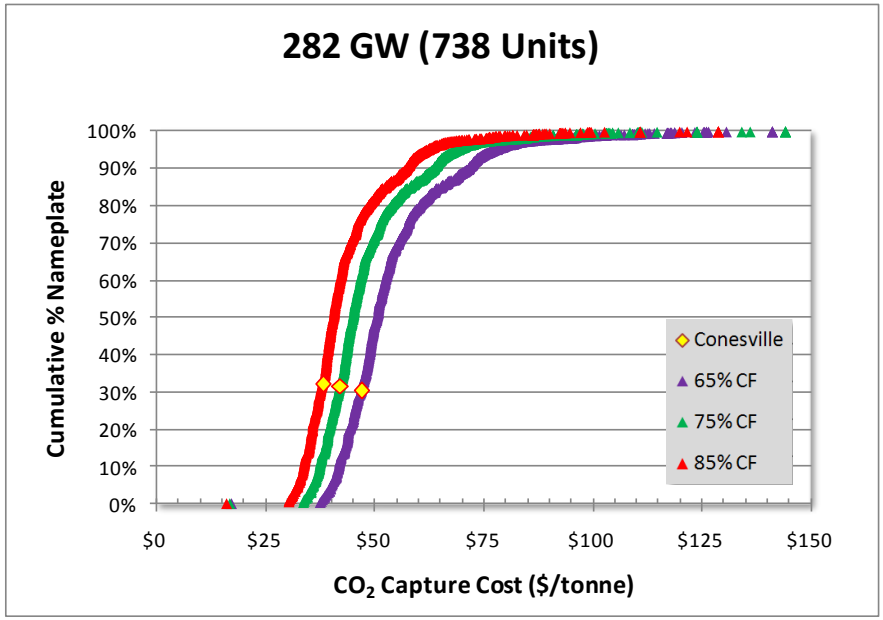
Type	Associated Carbon Loading (g/KwH)
Coal	909
Petroleum	821
Natural Gas	465
Nuclear	6
Pumped Storage	4
Renewables	-

Source: carbon loading based on EIA, http://www.eia.gov/cneaf/electricity/page/co2_report/co2report.html

Capacity Factor Scenario Results

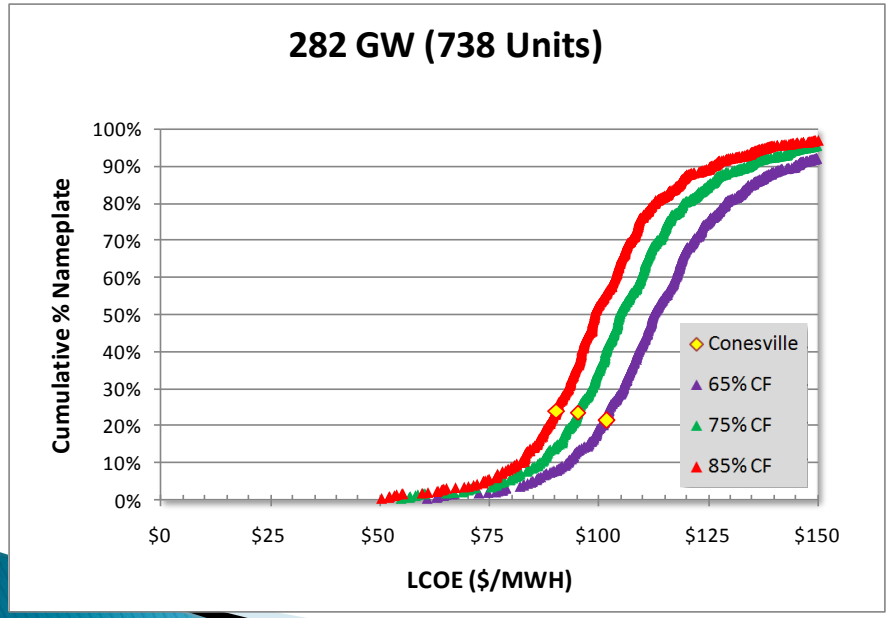
- Marginal CO_2 Capture Cost
  - LCOE
    - Does not include make-up power cost
    - No carbon allowance
  - Captured carbon
    - Does not include make-up power CO_2 emissions

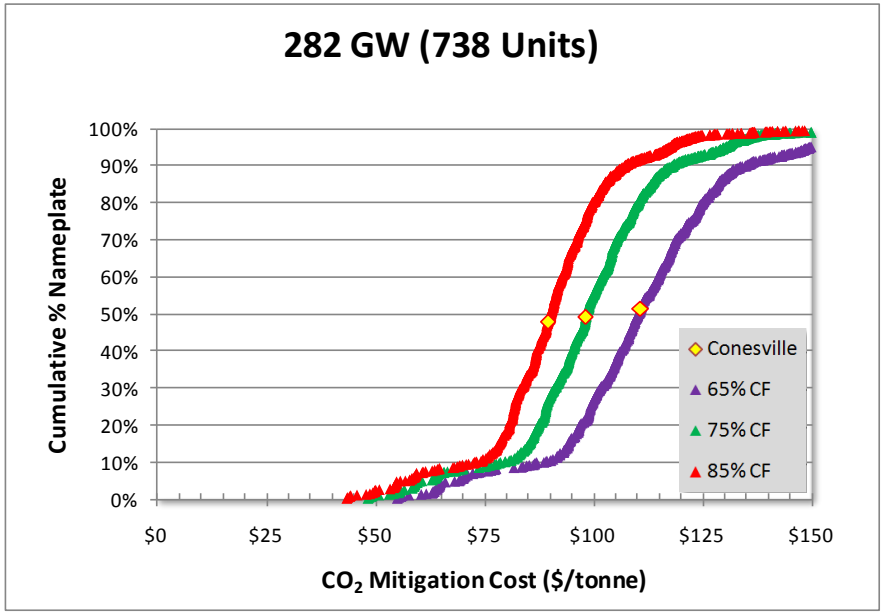




Capacity Factor Scenario Results (cont'd)

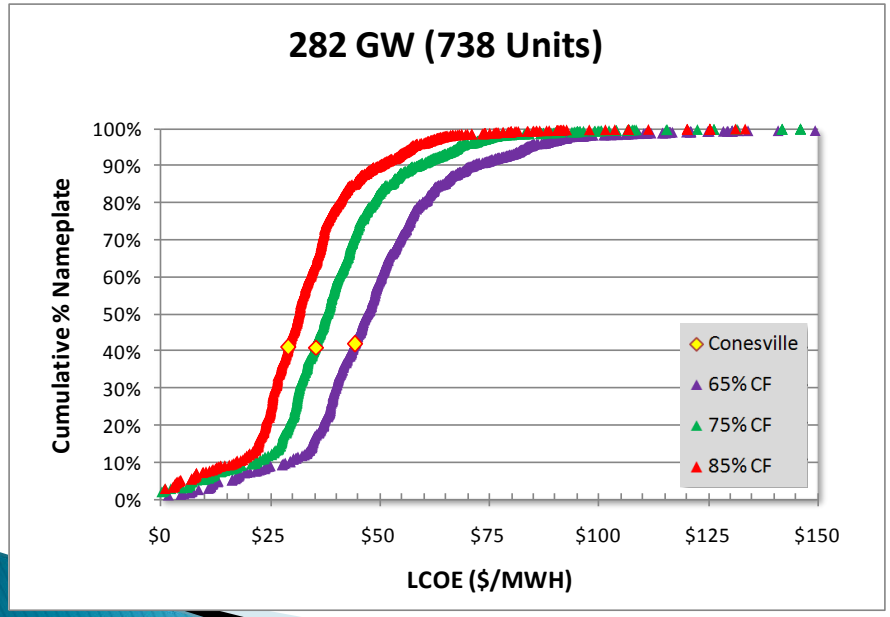
- Marginal CO_2 Mitigation Cost
  - LCOE
    - Includes Waxman-Markey make-up power cost
    - No carbon allowance
  - Mitigated carbon
    - Includes Waxman-Markey make-up power CO2 emissions

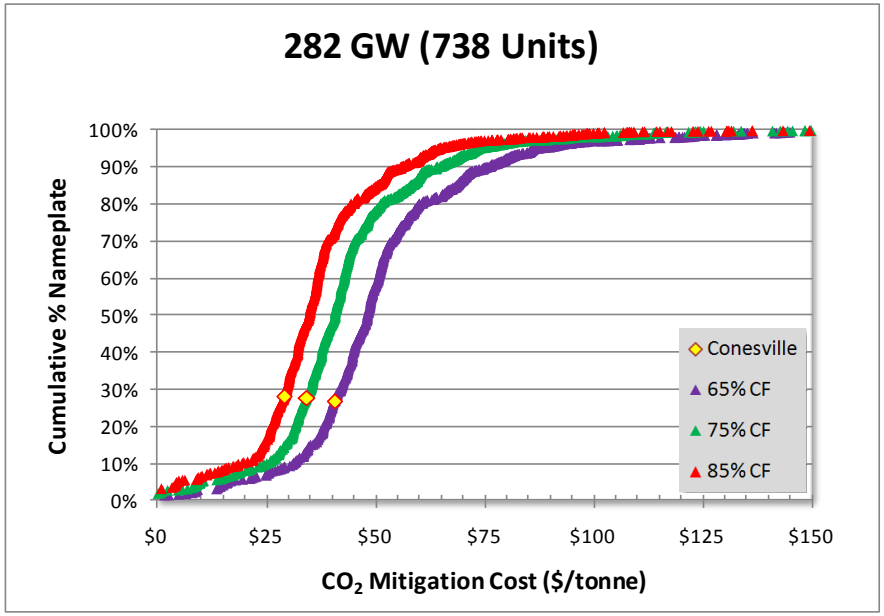




Capacity Factor Scenario Results (cont'd)

- Marginal CO_2 Net Mitigation Cost
  - LCOE
    - Includes Waxman-Markey make-up power cost
    - Includes carbon allowance
  - Mitigated carbon
    - Includes Waxman-Markey make-up power CO2 emissions

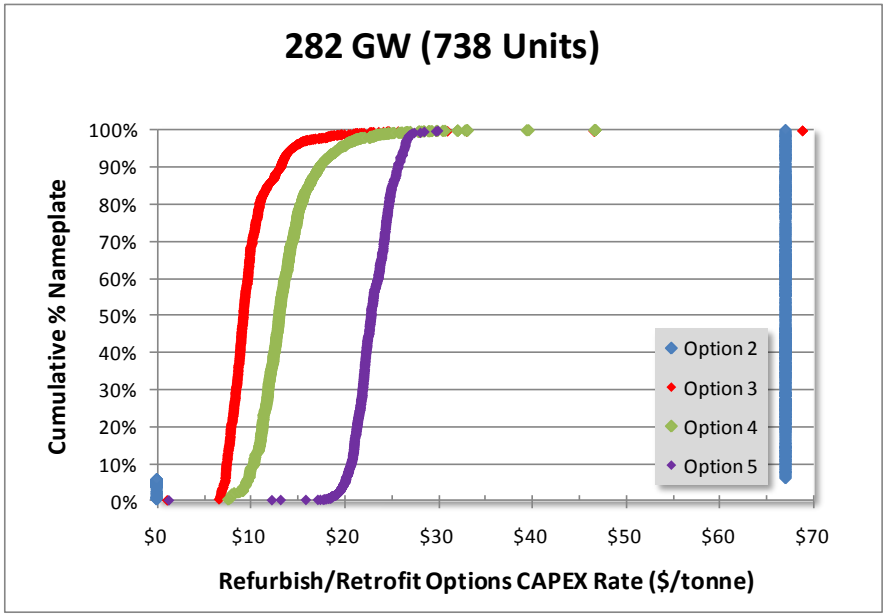


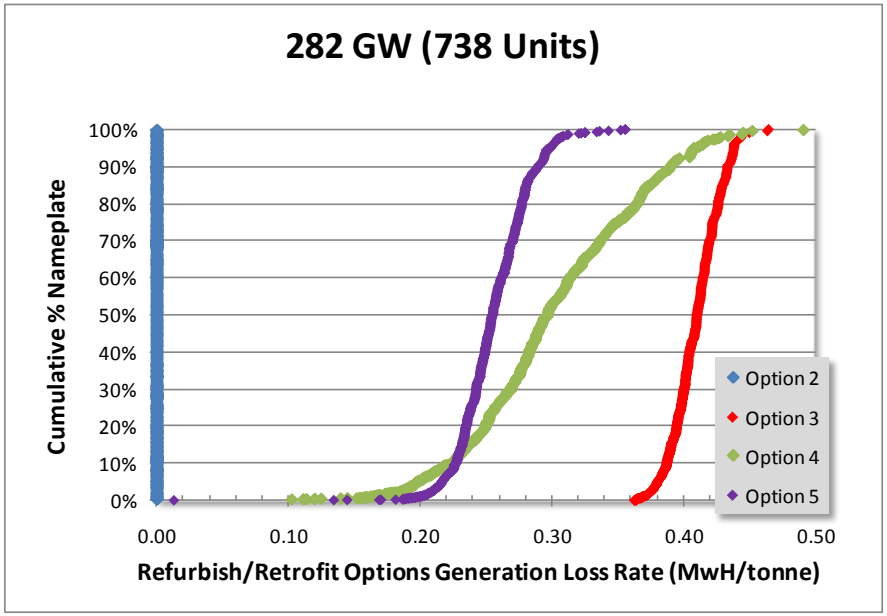


Parameters for Carbon-Minimization Scenario Analysis

- Scenarios
  1. Do nothing
  2. Refurbish for efficiency
  3. Retrofit with CO_2 capture technology
  4. Refurbish and retrofit
  5. Raze and build new plant
- Purpose: analyze population of CFPPs to determine effectiveness of carbon-minimization approaches

Parameters for Carbon-Minimization Scenario Analysis—Results

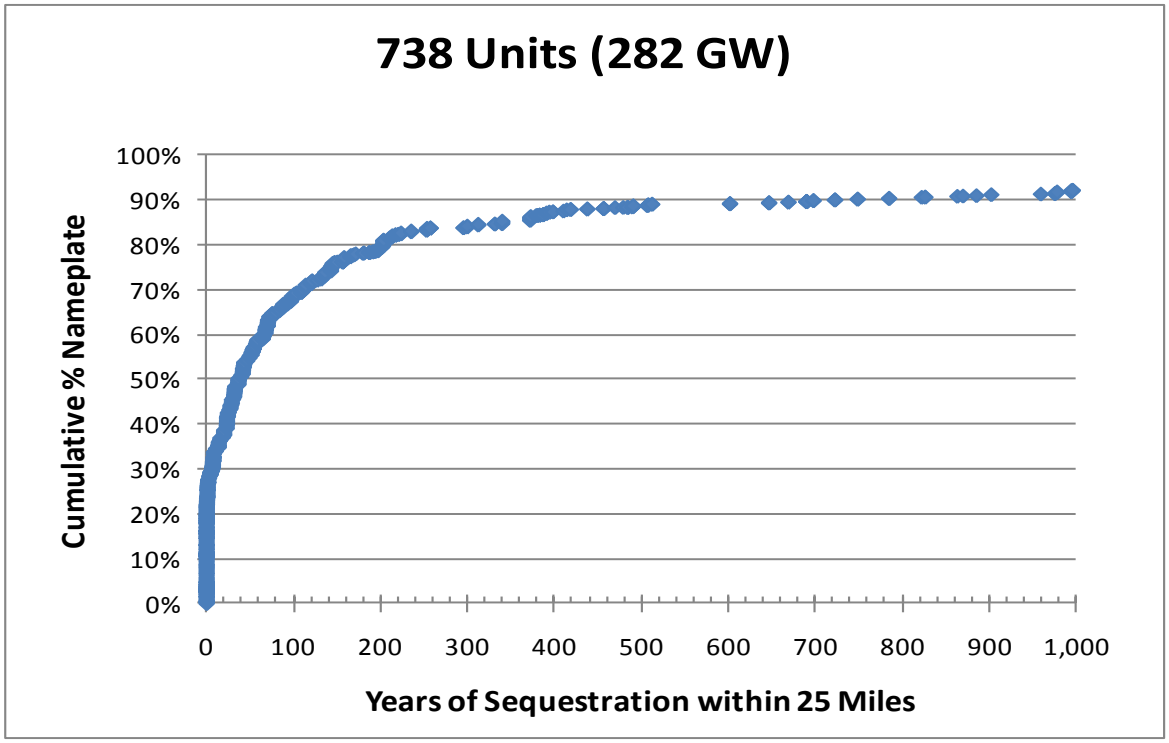




- Scenario Options
  1. Do Nothing
  2. Refurbish
  3. Retrofit
  4. Refurbish and Retrofit
  5. Raze and build new plant

Sequestration Analysis

- Years of sequestration capacity within 25 Miles



Limitations and Attributes

- This study provides an overview of the plant sites. It is not an engineering-level analysis of individual plants and does not address the consequences of design
- The analysis only addresses a single carbon capture technology
- The CCM only analyses to the plant gate—sequestration costs not included
- The CCM uses assumed power contracts and cost structures at existing plant

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Report can be found at: http://www.netl.doe.gov/energy-analyses/refshelf/detail.asp?pubID=289