Tenth Annual Conference on Carbon Capture and Sequestration

Session 1-G: CCS for Natural Gas-Fired Electric Generating Plants

Engineering-Economic and Geologic Assessment of CCS Application to California NGCC Power Plants

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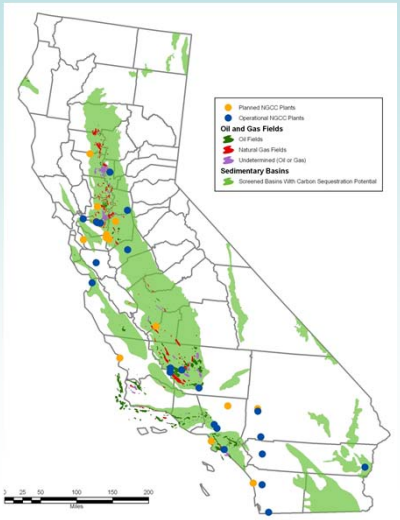
Why Evaluate CCS on California NGCC Units?

- ~ 50% of California's electric power mix is generated with natural gas; coal provides 10–20%, mostly imported from other states
- California's mandatory greenhouse gas reduction law (AB 32) requires GHG reductions of approximately 25% by 2020
  - Many NGCC plants are among the largest CO_2 emitters in the state
  - Electric utilities need information on costs, technical feasibility, and operational impacts of CCS on existing and future NGCC units
- Most power plant CCS studies focus on coal-fired units; NGCC flue gas composition is considerably different
  - ~3–4% CO_2 for NGCC vs. ~13% for coal-fired boilers
  - ~13% O_2 for NGCC vs. ~3–5% for coal-fired boilers

Adding CCS Appears Practicable for Many Large California NGCC Units

- Units have high capacity factors and significant remaining life
- Open plot space could possibly be used for CO_2 capture and compression equipment
- Many plants are within 50 km of potential geological storage sites



Key Questions from Generation Planners

- Which CCS technologies will be most cost-effective and least disruptive to system reliability?
- What are costs and output/efficiency reductions for CCS?
- What is effect on unit operating flexibility (part-load operation; unit ramp rates)?
- What is effect on electricity/gas supply markets?
  What is effect on system reserve margins?
  How will lost capacity be replaced?
- With limited water resources, how will cooling demand be satisfied?
- What permitting issues will CCS add?

WESTCARB's NGCC-CCS Study

- Screen candidate CCS technologies for NGCC units
- Develop and apply procedures for screening existing and planned NGCC units/sites for CCS suitability, including geologic storage potential
- Build engineering-economic model(s) and evaluate selected CCS technology and NGCC unit combinations; conduct sensitivity studies
- Communicate results to stakeholders
- Develop/evaluate a conceptual design for a pilot-scale CCS test on a California NGCC unit or cogeneration unit

CCS Technology and NGCC Unit Screening

- Evaluate CO_2 capture technologies
  - Pre-, post-, and oxy-combustion
  - Emerging technologies and novel configurations
  - Timelines to commercial readiness
- Evaluate sites, configurations, layouts of existing/planned units for CCS retrofit suitability
  - Options for meeting cooling demand
  - Site-specific cost/performance impacts
  - Site-specific permitting obstacles
- Assess the viability of geologic storage near plant sites
  - Suitability of geology for saline formation storage or EOR/EGR
  - Land use compatibility with CO_2 pipeline construction/operation

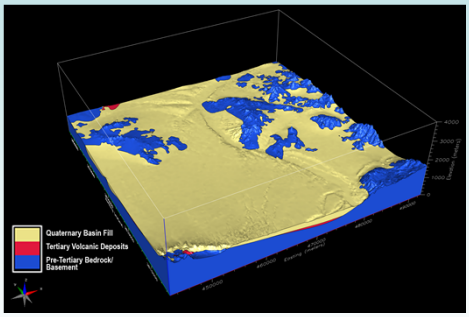
Artist's rendering of PG&E's Colusa Generating Station (in-service December 2010)

Detailed Engineering-Economic Evaluation of Select Retrofit and New-Build Cases

- Develop cost and performance model(s) and risk analysis procedures
- Compare performance, cost, and risk for selected CO_2 capture technologies and California NGCC plant sites
  - Retrofits with nearer-term CCS technologies on existing units
  - New-build installations with nearer-term and emerging CCS technologies
  - Standard economic metrics
- Perform sensitivity studies for selected technology options

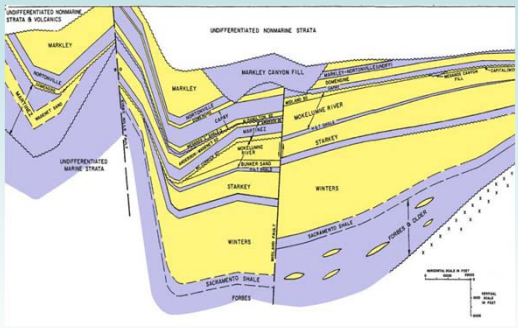
Geologic Evaluation of the CCS Potential of California NGCC Plant Sites

- LLNL has conducted an initial review of the local geology for 42 California NGCC power plant sites
- LLNL will construct detailed 3-D geologic models for the most promising sites



Geologic Parameters Considered in LLNL's Initial Review of the 42 NGCC Sites

- Distance to potential CO_2 sinks; oil and gas fields with enhanced recovery potential
- Stratigraphy at or near the site
- Surface expression of nearby faults
- Depth to saline aquifers >10,000 ppm TDS



Northern California sedimentary basin with alternating layers of sandstone and shale. Adopted from California Division of Oil, Gas and Geothermal Resources, 1983.

Study Results Will Help California Electricity Providers Plan for GHG Compliance

- California-specific information for feasibility, costs, and system impacts of implementing CCS on NGCC units
- Factors that affect the viability of capture technologies for different site and equipment configurations
  - Cost and performance
  - Commercial readiness
  - Environmental, health, and safety considerations
- Improvements in viability factors over time
  - Retrofits with near-term capture technologies
  - New-builds with emerging capture technologies
- Evaluation tools and lessons learned will be applicable to other gas-dominated power systems

Technology Validation Will Help NGCC-CCS Move Forward

- Conduct a feasibility study for a proposed pilot-scale CCS technology validation test at a California NGCC unit or cogeneration plant
  - Consult with stakeholders to select a configuration that can best fill knowledge gaps
  - Develop preliminary project scope, design, cost estimate, permitting plan, and schedule
- Develop plans for proceeding with the proposed pilot test

Got Questions? Ask Us!

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