Fuel and Power Options

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Power - We Need All the Options

• There is no “silver bullet” answer to all the questions for the power industry
• Today’s supply of natural gas looks promising and the industry is responding but where will the price be in a few years?
• Wind and solar are growing rapidly but remain higher cost and both are variable - is the grid up to it?
• Nuclear power provides low dispatched cost of power and is reliable but capital cost? Few new units are planned
• Existing coal is under pressure but it still is a major source of generation and new coal is not on the table now

Policy > Finance > Technology
Gas and Regulations Change the US Fossil Outlook

• “Fracking” for gas is changing supply

• A few years ago coal was > 50% of Generation

• In April gas power generation caught up with coal for the first time on record - 32% generation for each fuel

• Gas price now makes natural gas cheaper than some coal for dispatch (e.g., Central Appalachian coal)

• Existing coal is facing many new requirements for primary pollutants, mercury, solids and water use

• New coal is facing a limit for CO₂ requiring expensive carbon capture – new natural gas gets a “pass”
Comparing Fuels (in US $/MMBtu)

Oil, Coal, Natural Gas and Propane Daily Spot Prices

Source: FERC Market Oversight

Gas was less expensive than Central App coal
Global LNG “Landed Prices” (in US $/MMBtu)

World LNG Estimated August 2012 Landed Prices

Graphic: FERC Market Oversight

Will US gas seek world market and price?


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Gas Impacts Renewables and Nuclear in the USA

• It competes with both for new units - lower capital cost, and now low variable (dispatch) cost.

• If no production tax credits are available for renewables, they may not be built at the recent fast pace.

• Nuclear capital cost and permit issues make gas look good today.

• Gas (particularly peaking) is quick to build and will back up variable renewables like wind and solar, and can provide variable load and grid support for nuclear units which operate base load.
Tough Planning Questions Abound

• What will load look like?
  – Growth negative in 2012 first quarter – coal “cycling”

• What price will we see for natural gas in the future (it was lowest in a decade dipping below $2/MM Btu now > $3)?

• What environmental limits?
  – Air, water, solids limits for coal (MATs and mercury rule reconsideration, CSAPR, 316b, combustion products), EPA greenhouse gas limits

• Financial incentives?
  – Loan guarantees for nuclear, fossil, renewable
  – Production Tax Credits for renewable

• Cost of alternatives?
Cost Near-Term: 2015

Report available at www.epri.com #1022782
Update later this year (note these are *generic* costs)
Natural Gas Combined-Cycle (NGCC) Fuel Cost Sensitivity Comparison – 2015

Levelized Cost of Electricity, $/MWh

Cost of CO₂, $/Metric Ton

All-in Capital Costs: $ 1,275 – 1,375 / kW

Fuel Costs: $ 4 – 8 / MMBtu

Source Report #1022782 Program on Technology Innovation: Integrated Generation Technology Options –

0.37 Metric Tons CO₂/MWh

$ X $50/Ton = $19/MWh

All costs are in December 2010 $
Coal Combustion and Gasification Comparison – 2015

Levelized Cost of Electricity, $/MWh

All costs are in December 2010 $

IGCC All-in Capital Costs: $ 3,150 – 3,450 / kW
Fuel Costs: $ 1.8 – 2.0 / MMBtu

Pulverized Coal All-in Capital Costs: $ 2,400 – 2,760 / kW
Fuel Costs: $ 1.8 – 2.0 / MMBtu
Wind – 2015

Levelized Cost of Electricity, $/MWh

Cost of CO₂, $/Metric Ton

All-in Capital Costs

Off Shore Wind: $ 3,250 – 4,200 / kW
On Shore Wind: $ 2,120 – 2,825 / kW

No investment or production tax credits are assumed.

All costs are in December 2010 $
Concentrating Solar Thermal – 2015

All-in Capital Costs: $ 4,050 – 6,500 / kW

No investment or production tax credits are assumed.

Note different Y axis scale

All costs are in December 2010 $
Solar Photovoltaic – 2015

Levelized Cost of Electricity, $/MWh

- All-in Capital Costs: $3,725 – 5,050 / kW
- No investment or production tax credits are assumed.
- Note different Y axis scale

All costs are in December 2010 $
 Comparative Levelized Costs of Electricity – 2015 – Dispatchable Technologies

Levelized Cost of Electricity, $/MWh

Cost of CO₂, $/Metric Ton

Average LCOE values based on estimated capital cost ranges.
No investment or production tax credits are assumed for any technology.
Comparative Levelized Costs of Electricity – 2015 – Non-Dispatchable Technologies

Levelized Cost of Electricity, $/MWh

Cost of CO₂, $/Metric Ton

All costs are in December 2010 $

Note different Y axis scale

No investment or production tax credits are assumed.

Average LCOE values based on estimated capital cost ranges.
No investment or production tax credits are assumed for any technology.

Solar PV
Solar Thermal
Offshore Wind
Onshore Wind

No investment or production tax credits are assumed.
Comparing Low-Carbon Options
Longer-Term: 2025
PC, IGCC, NGCC, 2025—Impact of CO$_2$ Removal, Transport & Storage (CCS) and Cost and Performance Improvements on Levelized Cost of Electricity

Levelized Cost of Electricity, $/MWh

All costs are in December 2010 $

CCS = CO$_2$ Capture, Transport & Storage. Capture costs included in capital costs; transportation and sequestration assumed to be @ $10/metric ton
Comparative Levelized Costs of Electricity – 2025 – Non-Dispatchable Technologies

Levelized Cost of Electricity, $/MWh

No investment or production tax credits are assumed.

Note different Y axis scale

Average LCOE values based on estimated capital cost ranges. No investment or production tax credits are assumed for any technology.

All costs are in December 2010 $

Solar PV
Solar Thermal
Offshore Wind
Onshore Wind
Conclusions…Options – But No Crystal Ball

• Natural Gas – great prices now – where is it going?
  – Warm winter, fracking, storage, LNG export (2016)
• Coal - MATs, CSAPR – CO$_2$ GHG - solids?
  – Hard for existing coal – loss of 10-20% of fleet? New?
• Wind – Size improves costs -Production Tax Credit fails
  – Birds, Bats, TV interference, neighbor concerns
  – Variability and “inverse correlation” with load
• Solar – PV /Solar thermal cost coming down but still high
• Nuclear power – new licenses and shared risk
  – Existing sites favored but what will build-out cost?

Policy > Finance > Technology
Together…Shaping the Future of Electricity

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