North, South, Texas and the Rest

CEE Annual Meeting 4-5 December 2013
Welcome!

- Agenda highlights and other logistics
- Introductions – “Up at Night” rules of the game and Chatham House rules for meeting
"To sleep: perchance to dream: ay, there's the rub"

WHAT KEEPS ME UP AT NIGHT
What Keeps *Us* Up at Night

- Rapid changes and increasing complexity of commodity markets
- Reconciling project announcements and status
- Fuzzy data
  - On macroeconomics, OPEC, climate (!), etc
- Science, technical, economic literacy; human factor literacy
  - *How can we achieve more impact from CEE research?*
(Not So) Simple Value Chains

How do we do this??? Commercial frameworks

US Gas/Power, ERCOT balances
Power

Activity and economic impacts
Industrial

Transportation
NGVs

“Res, Comm”

Upstream
Economics, industry structure, NOCs

Midstream
Economics and market structure

Downstream
Implied market balances and policy/regulation

Raw Material Imports, Exports

Interaction of:
• Substitute fuels and competing alternatives
• Sectoral fundamentals, macro conditions, stakeholder perceptions

Energy Webs

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CEE High Case Demand Stack

- LNG exports CEE
- Pipeline exports CEE
- Power generation CEE
- Industrial CEE

Years: 2012 to 2030

Units: TCF (Trillion Cubic Feet)
At What Price Can Producers Deliver?

NGL Uplift: how much, when & where?

<table>
<thead>
<tr>
<th>Year</th>
<th>Average All Producers</th>
<th>U.S. Cash Operating Costs $/MCFE</th>
<th>U.S. All Source FD Costs $/MCFE</th>
<th>Henry Hub Spot Price $4/MCFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$7.28</td>
<td>$0.66</td>
<td>$0.66</td>
<td>$2.71</td>
</tr>
<tr>
<td>2010</td>
<td>$7.16</td>
<td>$0.65</td>
<td>$0.65</td>
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<tr>
<td>2011</td>
<td>$6.67</td>
<td>$0.61</td>
<td>$0.61</td>
<td>$3.66</td>
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<tr>
<td>2012</td>
<td>$7.84</td>
<td>$0.71</td>
<td>$0.71</td>
<td>$3.73</td>
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</table>

Note: All Source FD Costs are 3-year rolling averages
As of: December 4, 2013

Monitoring U.S./Global Oil and Gas: Upstream Attainment, Producer Challenges
Resource – Reserve - Deliverability

Nat. Gas % of U.S. All Source Additions

As of: December 4, 2013

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NG Price Deck (OIES NG 58)

- Actual Spot (YTD)
- CEE Projection, Fall 2011 ($Nominal)
- EIA AEO 2013 ($Nom, Dec 2012)
- EIA AEO 2013 ($2011, Dec 2012)
- Current Strip NG

$/MMBtu

Timing?
CL Price Deck (OIES NG 58)

- Actual Spot (YTD)
- CEE Projection, Fall 2011 ($Nominal)
- EIA AEO 2013 ($Nom, Dec 2012)
- EIA AEO 2013 ($2011, Dec 2012)
- Current Strip CL

Timing?
73 Climate Models Produce Too Much Tropical Atmospheric Warming During 1979 - 2012

- Mauna Loa observed CO2 (1975 = 331ppm; 2012 = 394ppm)
- 73 model avg temp
- Avg of 2 satellite-observed temp datasets

Courtesy Dr. Roy Spencer (Dr. John Christy), NOAA-University of Alabama Huntsville
O[H] CANADA!
North America Energy Integration, 1998

Cliff Notes Version

• **Finding:** Given the treatment of energy in the NAFTA, the lack of clarity with respect to provisions that indirectly impact on energy and the historical, economic, political, legal and technology considerations associated with North American energy, the NAFTA provides only a weak framework for North American gas and electricity integration.

  – Consequently, *trends toward integration are and will be more heavily influenced by other factors – the historical, economic, legal, political and technology contexts for natural gas and electricity development and trade.*
NAEP, cont.

• A “CUS” system for electricity: Will the process for electricity restructuring parallel natural gas restructuring in Canada and the U.S.?
  – Our analysis of Alternative Future 1 led to a qualified “yes,” within our ten-year time frame, electricity integration would proceed in a manner similar to that of natural gas.

• Mexico joins the “CUS”: How does Mexico fit into the Canada-U.S. (CUS) market relationship and process?
  – Alternative Future 2 failed under the criteria we established.
<table>
<thead>
<tr>
<th></th>
<th>CANADA</th>
<th>U.S.</th>
<th>ISSUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Customers</td>
<td>+</td>
<td>+</td>
<td>Industrial customers are positive forces for electricity restructuring; they benefit most from technology change that allows decentralized power purchases</td>
</tr>
<tr>
<td>Ratepayers</td>
<td>+&gt;</td>
<td>+</td>
<td>Customer choice in residential markets may occur more quickly in Canada because of the longer, more intense winter heating season</td>
</tr>
<tr>
<td>Existing energy industries (gas and electric utilities)</td>
<td>-&gt;</td>
<td>-</td>
<td>Existing electric utilities are barriers to electricity restructuring, more so in the case of Canada’s Crown corporations</td>
</tr>
<tr>
<td>Potential new players (“energy entrepreneurs”)</td>
<td>+&lt;</td>
<td>+</td>
<td>Energy entrepreneurs, companies that will drive the direction and pace of restructuring, can play a more effective role in the U.S.</td>
</tr>
<tr>
<td>Federal vs. state/provincial regulators, policy makers</td>
<td>-&lt;</td>
<td>-</td>
<td>In the CUS, decentralization is both a strength and a weakness but Canada could reach consensus among federal and provincial officials more quickly than the U.S. may among federal and state officials</td>
</tr>
<tr>
<td>Environmentalists</td>
<td>-&gt;</td>
<td>-</td>
<td>Strategies, focal issues (“the North”) and the level of conflict in Canada appear to be stronger negative influences. Many environmental groups in the U.S. view electricity restructuring to be a strike against policy-mandated alternative fuels and conservation programs long imposed on utilities.</td>
</tr>
</tbody>
</table>
Alternative Future 2

- Technology is a constraint in every dimension
- Attitudes toward the national monopolies and natural resource endowments create untenable political constraints
- Centralized control of investment and decisions relative to infrastructure and resources
- Pace of change is slow enough that opposing coalitions are able to restructure themselves
- **Political elites** are much more important in Mexico than Canada and the U.S. with respect to energy
- **Industrial customers** play much the same role as in Canada and the U.S. in driving energy sector restructuring; strong relationships with the national energy monopolies complicate analysis
- The external **financial community** may be a force for change; worldwide competition for private capital for energy
- **Elite influence from northern Mexico** may be an interesting variable
Texas

MILES AND MILES....
The Complicated World of Oil & Gas Taxes, I

Employment impacts relative to base case of reduced oil and gas capex with IDC treatment eliminated.

- WM = WM/API results
- REMI prod+capex = CEE results
- REMI prod+capex+subsidy = CEE results with all federal energy subsidies returned to consumption (all categories)
The Complicated World of Oil & Gas Taxes, II

Impacts on capex relative to base case of reduced oil and gas capex with IDC treatment eliminated.

- WM = WM/API results
- REMI prod+capex = CEE results
- REMI prod+capex+subsidy = CEE results with all federal energy subsidies returned to consumption (all categories)
The Complicated World of Oil & Gas Taxes, III

Impacts on output relative to base case of reduced oil and gas capex with IDC treatment eliminated.

- WM = WM/API results
- REMI prod+capex = CEE results
- REMI prod+capex+subsidy = CEE results with all federal energy subsidies returned to consumption (all categories)
Midstream: We Care About NGLs. Why?

• NGL uplift has been helping upstream economics
• ~40% of NGL yield is ethane
  – Ethylene crackers
    • Need capacity expansion, 2017-18
    • Need export markets
  – Methane stream: limited due to pipe gas specs
• ~15% condensate
  – Cannot blend all with crude oil due to refinery specs
  – Need to export
NGL Production-Source of Ethane

- Excess ethane supply until at least 2017
- 2013 S is about 1 MMBPD + 300-350 MBPD rejected, flared or blended
NGL Prices

$/MMBtu

Jan-10 | Apr-10 | Jul-10 | Oct-10 | Jan-11 | Apr-11 | Jul-11 | Oct-11 | Jan-12 | Apr-12 | Jul-12 | Oct-12 | Jan-13 | Apr-13 | Jul-13 | Oct-13

Pentane | Isobutane | Butane | Propane | Ethane | Methane

CEE based on CME/NYMEX
NGLs Values Relative to Crude Oil

CEE based on CME/NYMEX

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Global Ethylene Capacity

Ethylene Capacity (tpy)

- Middle East, Africa
- Asia Pacific
- North America
- South America
- Eastern Europe
- Western Europe

Oil & Gas Journal
Ethane (and many other) Questions

- Provides uplift to upstream economics
- Demand Constrained
- Price collapse & rejection $\rightarrow$ uplift reduced
- Need Ethylene Crackers
- Need Export Market
- Global ethylene capacity $\uparrow$? Demand?
- Can US ethylene compete if ethane P $\uparrow$?
- Without ethane uplift, upstream economics?

Is there a fundamental difference today in how production streams are considered and, if so, implications for: producers, midstream, downstream, customers.

Is there more market exposure for production streams that once were embedded in integrated business models?
CEE Industrial (very) High Case

<table>
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<th>Year</th>
<th>GTL</th>
<th>MTG</th>
<th>Metals</th>
<th>Propylene</th>
<th>Polyethylene</th>
<th>Chlor-Alkali</th>
<th>Methanol</th>
<th>Ammonia-urea-fertilizer</th>
<th>Ethylene Crackers</th>
<th>Base Demand</th>
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High Case Construction Impacts Only

Total capex: US $98.9bn, Texas $38.4 bn

**Total Output Change - Texas**

- **Total Output Change - Rest of US**

**Employment & Population Change - Texas**

- **Employment & Population Change - Rest of US**

- Total Employment
- Population
The Rest

GLOBAL ENERGY VIEWS
Energy Exports

• Crude oil, product exports – US DOC is gatekeeper
  – White House has final say
• Any product leaving has to have incoming of like volume or quality
  – Issue lately with crude shipments by rail
• Fact: Light sweet crude is stuck
  – Lease condensate as test case
• DOC “tests” are subjective
  – DOC appetite to review applications is a consideration
• End game – strip DOC of authority
  – “Outmoded, outdated, inefficient”
Regulatory Chain

U.S. Department of Commerce

Bureau Of Industry and Security (BIS)

Commerce Control List (CCL) of ECCNs

Part 754 of EAR (Export Administration Regulations)

Supplement No. 1
ECCN 1C984

DOE

Supplement No. 1: 1C981-983
Ramifications of Not Allowing Exports

• Forward curve already collapsed
  – Reserves reporting and NGLs: At what point do constraints on what can be produced and sold affect reserves bookings?
• Producer effects
  – Rash of overleveraged producers collapsing?
• Market effects
  – Associated gas heavily affected (low oil: high nat gas)
• Oil:gas implications
  – Vanishing spread – impact on investments
• Geopolitics
  – OPEC backlash (Iran/Iraq, Iran/Saudi)? Impact on country fiscal balances? But NOCs are expensive and “cost of political stability” is high
• Volatility will be worse because regulatory context will create difficulty in achieving market response
  – Includes inexperience of new registered futures traders as well as less liquidity
Ramifications of Allowing Exports

• No infrastructure needed – new capacity already under development
• Refiner positions are mixed
• Price of refined products won’t change (except in OK?) – international prices for products will prevail
• National security? Is there a “lobby” for national security?
  – Outdated laws, regulations
  – Will FDI sponsors support exports to get higher value for light crude production? What are their real interests?
Conclusions

Clear as mud
Is U.S. LNG Competitive?

**$/MMBtu**

- Low Cost
- High HH
- High Cost Europe
- High Cost Pacific

**$15-16/MMBtu Asia spot**

- $11/MMBtu Japan 2010
- $10/MMBtu NBP
- $9/MMBtu European floor

* Value Chain Cost NA to Asia (DES – cost of supply)

**CEE analysis; * Australia bank sources**
South

“MÉXICO LINDO Y QUERIDO”
Workshop/Scene Setting

GAS-POWER
CEE Research Portfolio

• Potential for gas use in power generation
  – Coal risks: CSAPR/CAIR, MATS, 316 (b) - water use for cooling, coal ash, GHG (federal and/or state)
  – Nuclear retirements
  – Renewables: capacity and capacity factor
  – Demand response, energy efficiency

• ERCOT resource adequacy
  – Competitive and mostly isolated ERCOT market is a good testing ground for above-listed factors as well
Coal Retirements

- Up to 80 GW of coal capacity may retire by 2020
  - announced about 26 GW (2014-2020)
  - 2.6 GW in 2011; 8 GW in 2012; 2 GW by mid-2013 already retired (mostly older, smaller units)
Nuclear Retirements

• 4 recent announcements; more on the way?
• Only 1-2 new plants under construction
Dampers on Gas Use in Power

- Currently, coal is competitive with gas at $3-4/MMBtu of gas price
- Renewables capacity has been growing
  - Better capacity factors for wind
  - Declining cost of PVs
  - Storage projects seem to be moving forward
- Smart grid and demand response
- Energy efficiency and conservation (EIA AEO 2013 Reference Case: 0.9% annual demand growth; 0.2% in “best technology available” case)
Competing Views of the World

Consumption of Natural Gas (Index, 2010 = 1)

Based on data from EIA AEO 2013 & IHS Global Insight
A CEE Scenario on Gas Use in Power

Quads

2030

U.S. Gas-Power Linkages: Building Future Views for details:

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The ERCOT Market - Basics

- ERCOT is an energy-only market
- Reserve margin target of 13.75% (was 12.5%; might be increased to ≥16%)
- Rapid demand growth over the last decade
- Generation capacity expansion falling behind
- Extreme weather in summer of 2011
- System-wide offer cap (price cap) was raised to $4,500 (from $3,000) on August 1, 2012; and will increase to $9,000 by 2015.
Demand & Generation Growth Mismatch

Peak demand increased >10 GW but net operational capacity declined ~7 GW between 2002 and 2012

Why is Generation Falling Behind?
Possible Contributing Factors

• Competition works
• Low natural gas prices since 2008 → low electricity prices → tighter margins
• Low price caps & infrequency of price cap hits
  – Even in August 2011, only 17 hits
• Negative prices due to wind dispatch
• Aftershocks of the 2008 crisis: more cautious investment & lending practices
Wholesale Price in ERCOT

Average All-in Price for Electricity in ERCOT

- Uplift
- Ancillary Services
- Energy
- Natural Gas Price

Electricity Price ($ per MWh)

Natural Gas Price ($ per MMBtu)

IIM, ERCOT State of the Market 2011 & 2012
Still the question: Was this a “once in 100 years” event or more of a new normal?
Reserve Margin – Forecasts v Actual

2012 Update 1: de-mothballed units
2012 Update 2: de-mothballed units, lower demand growth, new resources


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Change in Demand Growth Assumption

CDR Revisions

• Lower demand growth scenario from Moody’s since December 2012 CDR
• Going forward, a different approach to estimating demand growth
  – Weather modeling
  – Energy efficiency & demand response
• Possible change to target reserve margin (≥16%)
• Wind ELCC to rise from 8.7% to ~14% for West Texas & ~33% for coastal areas
Demand Complexities

• Increased oil & gas activity
  – Upstream: drilling in Barnett, EF, Permian, and more
  – Midstream: pipelines, processing facilities
  – Downstream: petrochemicals
  – Exports: LNG & pipes

CEE Research
## Generation Interconnection Requests

**GENERATION INTERCONNECTION REQUESTS CURRENTLY UNDER REVIEW**
Currently tracking 161 generation interconnection or change requests

<table>
<thead>
<tr>
<th>As of August 31, 2013</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>Security Screening Study</td>
<td>13</td>
</tr>
<tr>
<td>SSS Completed</td>
<td>14</td>
</tr>
<tr>
<td>Full Interconnect Study</td>
<td>93</td>
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<tr>
<td>FIS Completed</td>
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<tr>
<td>Suspended Studies</td>
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<tr>
<td>Capacity of Suspended Study Projects</td>
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<tr>
<td>Interconnect Agreement Completed</td>
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<tr>
<td>Capacity under Interconnection Agreements</td>
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<tr>
<td>Capacity for Grid, MW</td>
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<tr>
<td>Wind Capacity, MW</td>
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<td>Cancelled Projects</td>
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</tbody>
</table>
Natural Gas & Wind Dominate

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Confidential Projects (MW)</th>
<th>Projects Under Full Study (MW)</th>
<th>Public Projects (MW)</th>
<th>Suspended Studies (MW)</th>
<th>Grand Total (MW)</th>
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<td>Gas-AllOther</td>
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<td>11,132</td>
<td>374</td>
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<td>Total Gas</td>
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<td>Wind</td>
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<td>Storage</td>
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<td>Grand Total</td>
<td>3,064</td>
<td>26,505</td>
<td>12,779</td>
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<td>42,348</td>
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</tbody>
</table>
Increasing IAs

** Having begun commercial operation since January 2006

*** Began tracking cancellations by month in March 2008

* Nameplate capacity will change across time due to additional projects, cancellations, expirations, adjustments from study results, and projects being placed in service.
CEE Analysis: Impact of Higher SWOC

Impact of Higher Demand Growth & Natural Gas Price Scenarios

Recent CEE Research

• **Base Case**—2013 AEO natural gas price forecast and ERCOT low demand growth scenario

• **Target Reserve Margin (TRM)**—Set target reserve margin equal to 13.75%

• **MATS**—Added cost compliance with MATS, CSAPR/CAIR, 316 (b) and coal combustion residuals as estimated by ERCOT

• **Renewables**—Inserted planned renewable builds in ERCOT through 2017 according to SNL/ERCOT data + employed higher ELCC figures
Retirements (2013-2023)

- All retirements in the Base Case are natural gas.
- Under the MATS Case, there are 3.1 GW of coal retirements.
- Very few retirements in the TRM case due to “capacity payments.”
Base Case New Builds (2013-2023)

From the perspective of resource adequacy, ELCC is what matters.
TRM Case New Builds (2013-2023)

- Fewer new builds than the Base Case, especially in CC, due to fewer retirements ➔ probably less gas use
• MATS case brings more CT/CC online to replace lost coal units ➔ probably more gas use
Renewables Case New Builds (2013-23)

New ELCC: 13% for Western Wind and 30% for Coastal Wind.
Net Builds (2013-2023)
Net Natural Gas New Builds
Reserve Margin (2013-2023)
Going Forward

- Due diligence on recent results
- Combined effects (e.g., MATS + renewables)
  - Add DR & EE (?)
- Expand to the rest of the US (i.e., update the analysis from early 2012)
  - Coal & nuclear retirements
  - Renewables