CERA WEEK 2014

A Report Prepared for the

Legislative Finance Committee

By

Nick Brown & Stephanie Morrison

March 13, 2014

LFD

MONTANA LEGISLATIVE FISCAL DIVISION

INTRODUCTION

The legislature needs the Legislative Fiscal Division (LFD) to have substantial knowledge of the Montana economy and the revenue sources that are the basis for the Montana budget. With significant staff retirements in the area of revenue estimating, new staff does not have the depth of understanding of energy production and the Montana economy as previous experienced staff. The IHS energy conference is an investment in new staff to gain understanding from the experts in the energy industry and Montana's econometric contractor.

In addition, the LFD hired an economist with experience in analyzing the impacts of oil production in the Bakken relative to Montana population. This experience in combination with the recent challenge of matching anticipated wage growth with withholding taxes paid has led the LFD staff to question the IHS methodology and resulting Montana specific econometric forecast. The IHS energy conference offered the unique opportunity for LFD staff to visit with both the energy economists and the Montana regional economists to ask specific Montana analytical questions.

In order to get the most from the opportunity, revenue staff outlined specific questions by seven areas of interest for IHS analysts at the conference, and set up individual meetings. The insights gained as a result of these meetings, as well as through conference general and breakout sessions, are outlined in this report. They are organized by the following topics:

- Energy Insight—an overview of the IHS energy analytics branch
- Western LNG Study—highlights of a recent regional study
- Econometrics
- Oil
- Infrastructure & Innovation
- Natural Gas
- Coal
- Power
- Renewables
- Policy & the Environment

An appendix is included with information on each of the IHS analysts from the individual meetings.

ENERGY INSIGHT

Analyst Meeting

IHS Analyst: Rachel DeLeon, Senior Account Executive
Sharon Reishus, Senior Research Director of North American Power
TJ Deora, Commercial Director of PGCR Americas
Sam Andrus, Director of North American Natural Gas

Highlights

1. Gas, coal & power are regional; forecasts of these sources are integrated with econometric forecasts driving residential & commercial demand forecasts, which in turn impact demand forecast; the petrochemical analytical team forecasts the industrial demand; supply & demand, together with transportation capacity, impact prices, which are then integrated back into the econometric forecasts
2. Gas forecasts are built at the "play" & sub-play" level, then aggregated; "sub-play" detail is only available for 50 of the largest fields; may not be available for Montana
3. Gas extraction productivity continues to increase

4. Oil is global; national forecasts of this energy source are integrated somewhat with Canadian oil sands production forecasts
5. Oil transportation impacts are accounted for within the forecasts; more detail needed in subsequent sessions

WESTERN LNG STUDY

Analyst Meeting

IHS Analyst: Ed Kelly, Vice President of Natural Gas Consulting

Highlights

1. Study that involves 11-13 terminal projects in Canada, 1 terminal project on the Oregon coast & 3 scenarios
2. Bakken LNG prices driven by the Rocky Mountain & Alberta prices
3. Enough projects being built to actually stimulate an increase in LNG production
4. Demand may outstrip supply
5. Henry Hub prices in the $3.75-$4.50 in real 2012 dollars needed to for new production, although this estimate is likely to be increased slightly

ECONOMETRICS

Analyst Meeting

IHS Analyst: Brendan O'Neil, Managing Director of Economics & Country Risk
Mohsen Bonakdarpour, Director of Strategy & Planning Group

Questions

1. As a result of the energy development in primarily in western North Dakota, there has been strong population growth in rural eastern Montana. Although small compared to the total population, this growth is reversing previously declining populations in these areas, and is running counter to the usual pattern of growth being concentrated in urban areas. How is IHS incorporating these trends into the population and income forecasts?
2. Montana's primary impact from the Bakken development is through secondary economic impacts, rather than actual oil production. Examples include increased commercial construction in Billings, increased income for Montana residents working in North Dakota, and of course the housing and local infrastructure pressures near the border. To what extent are these impacts being accounted for in the IHS Montana forecast?
3. How region-specific are the models?
4. Can we get access to the data inputs?
5. Does the population migration estimate include an amenity factor?
6. Is there a possibility of purchasing Alberta & Saskatchewan econometric data without getting the international package?

Answers

The answers to questions 1 & 2 remained a bit vague. The granularity of the data used to tease out economic effects in Montana is not clear—although this issue was resolved in later meetings. The models for Montana include state-wide, each of the three MSAs and the remaining rural areas—essentially four independent models. It may be possible to get inputs for these models, particularly as they apply to population growth. We will send the comparison of the CEIC/IHS population forecast comparison to Mohsen; he may be able to explain why the difference in assumptions in economic migration that are driving the difference between these two forecasts. We will also connect with the head of regional economic forecasting David Iaia, as well as regional economist Steven Frable to test the IHS assumptions on this issue.

Research by IHS with Darrell Dukhart, commissioner of Dunn County, North Dakota was mentioned; it may be available online and we will do further research.

Brendan mentioned several times the research he and other IHS analysts did on behalf of Chris Mihos for tourism impacts in Montana. This research was published as "Beartooth Regional Economics." It was inferred that an amenity factor is likely only implicitly included in migration forecasts.

Rachel will check on availability & pricing for provincial data.

We will investigate the IHS construction services project, which is available at the state and MSA level.

Follow-up Telephone Call

IHS Analyst: Steven Frable, Regional Economist
Jim Diffley, Sr. Director U.S. Regional Economics
Tom Jackson, Sr. Economist U.S. Regional Service
David Iaia, Director of U.S. Regional Services

Further detail on questions 1 & 2 from above:

1. Specific inputs for population forecasts include
    a. Building permits—they were unaware of the under-counting issue for non-MSAs from this data
    b. Employment by sector
    c. Metro versus non-metro
2. After forecasts are produced, they are checked for internal consistency
3. New population data is available for 2013; migration patterns for eastern Montana much higher than historical patterns
4. Strong ramp-up in non-MSA growth not expected to be sustained

Breakout Sessions

Impact of Tight Oil on the North American Petrochemical Industry

1. Shale gas production resulting in large price advantage for natural gas products
2. Natural gas supply will exceed demand for the foreseeable future—note contradiction with other opinions on this issue
3. Large increase in petrochemical investment since 2010; largest risk to continued growth is lack of skilled labor force
4. Methane & ethane are likely competitive in the long term; propane may not be so competitive
5. Access to global markets is an important investment decision

The Next Generation of IHS Scenarios: Exploring Uncertainty, Risk & Opportunity in the Global Energy Markets

1. IHS is in the process of revising the narrative and structure of their baseline & alternative scenarios
    a. "Scenario": a specific outlook on the future; needs a consistent internal story
2. Story for developing the baseline and alternative scenarios was the implementation of the federal CO2 emissions policy
    a. This was used, rather than including a specific event or terrorist attack
3. While the baseline scenario will still be the most likely outlook, changes are being made to the structure of the alternative outlooks
    a. Instead of the standard optimistic/pessimistic alternatives, the revised alternatives will be based on increased volatility (i.e., three recessions in the outlook to 2040) or fundamental shifts to the economy (i.e., large technological changes)

b. These revised forecasts are scheduled to roll out in October of 2014
    i. This timing may be a concern for us, as we would have little time to kick the tires on the alternatives before presenting the LFD revenue forecast to RTIC in November
    ii. Initial narratives & information on these new forecasts should be available mid-summer
    iii. According to Rachel, the old-style baseline, optimistic/pessimistic scenarios will still be available at the time of our forecast; it may make more sense to introduce the concept of the revised alternatives, but hold off on actually developing alternative revenue scenarios until next revenue estimate.

OIL

Analyst Meeting

IHS Analyst: Leta Smith, Sr. Manager or Research
Bob MacKnight, Director of Research

Questions

1. Impact of CO2 injection on tertiary recovery
    a. Economic viability
    b. Potential roadblocks to development
    c. Timeline
    d. Has this been successful elsewhere? If so, what are basic characteristics of those fields?
2. Bakken & Three Forks—Development outlook for 5, 10, 15, 20 years
3. Montana is a producer & exporter of conventional & renewable energy. What national or international policy decisions are on the horizon that could impact the production, sale or growth of these sources, given Montana's location relative to major population centers and/or transportation hubs?

Answers

1. CO2 Tertiary Recovery
    a. CO2 recovery is generally in the 8%-12% additional range
        i. Permain planning case was 6%
    b. Cost of transporting CO2 can be a limiting factor, longest pipe currently about 400km
        i. Usually companies will pay 2%-4% of the price of the oil for CO2
    c. Pilot projects often take ~2years, in unknown areas it could easily be 6-8 years
    d. Denbury is a purely CO2 operator
2. Growth possibilities and challenges
    a. Possible tech coming down the line that could make the less productive areas of the Bakken more economic
    b. Appache has a big amount of assets north of Richland, any one company securing large amounts of assets can slow down development due to lack of competition
    c. Three Forks can be problematic as it's a little gassy
    d. Unconventional techniques appled to older fields could bring on more production
    e. Heath field is not a big deal now, but analyst thinks ~100 wells are needed to determine the characteristics of a field
3. Bakken Plateau: the Bakken is likely to hit a plateau. Analyst believes it will be ~1.6million barrels per day by the end of the decade, higher than many of the estimates in the 1.0 million range. Despite this growth, large increases in secondary and tertiary effects are unlikely as the addition is due to additive effect, current work force can handle the increase, in fact number of wells staying steady.
4. Data Source: look into "America's New Energy Future," available in 3 volumes.
5. Summary: "Business as usual" in the Bakken field

Breakout Sessions

The Future of Canadian Crude & LNG—Dialogue with Minister Joe Oliver

1. Canadian Production
    a. Canada has 200 Years of domestic supply at current consumption rates.
    b. Oil Sands are expected to produce $2.1 trillion in economic activity over the next 25 years and support 500,000 jobs.
2. Pipelines/Export
    a. Only exports to the US currently, would like to expand to other markets.
    b. In addition to KXL, pipleines are planned going both east and west out of the oil sands area.
    c. Northern Gateway Project: 500,000 barrels to west coast.
    d. Inter Morgan Trans Mountain Line
    e. Trans Canada mainline, to move oil sands to East.
3. Environmental
    a. This is an area of concern that the Canadians are acutely aware of.
    b. Think the oil sands are going to be developed regardless so developing KXL will be environmentally the better thing to do, to avoid other forms of shipping oil as well as increased efficiencies.
    c. The oil sands represent 0.1% of global GHG emissions, thinks this is the wrong environmental target.
    d. Centrifuge technology is being utilized to deal with oil sands waste.
    e. Canada is phasing out coal plants

Tight Oil New Frontiers: North America & Beyond

1. The Monterey formation in California
    a. Company working in the Monterey thinks that area is in a similar position that the Bakken was in 2002-2005, but thinks many more companies will need to be trying there to unlock the potential.
2. Issues with unconventional oil outside the US
    a. The US is great for unconventional oil in part because so much is known about the formations from decades of conventional oil exploration
    b. Other things needed besides the right geology to make unconventional oil work outside of the US
        i. Energy Infrastructure
        ii. Established Service Industry
        iii. Incentivized Fiscal Regime
        iv. Local Support
        v. Land Owner Incentives
3. Western Canada
    a. They believe Western Canada has some areas akin to the Bakken

Downstream Plenary: Is a Peak in Oil Demand on the Horizon?

1. Peak Demand?
    a. Both refiner and Saudi said no peak
    b. Growth in demand will come from non-OPEC countries, OPEC countries will decline in demand at least through 2025 in part due to efficiencies.
    c. Saudi representative thinks oil demand will grow at 1.5%-2% per year, which would double demand form 47mbpd to 100mbpd by 2050
2. Refinery Expansion

    a. There is a thought that refinery expansion in Latin America, which is being talked about, is unlikely to happen due to the capacity in the gulf and the economic margins which refineries have to work in.
3. On moving away from oil
    a. In Saudi representative's view, most efforts to move away from oil will be policy driven but will not go far due to economic constraints.

The Anatomy of Unconventional Plays: the Bakken

1. IHS Tool for analyzing shale plays.
    a. IHS has a tool for analyzing shale plays that works similar to the JMP software. It is labeled "Tableau"
2. Major Aspects of the Tool
    a. Converts gas to bbls of oil to get a value of the well for comparison. Usually companies use a 6mcf to 1bbl for conversion, but they use a 20 to 1 as that makes more sense with current prices.
    b. Software breaks wells up into quintiles of productivity and maps those, which gives a good visual understanding of the play
    c. Bar charts and other analysis can also be done in order to understand the play, see averages, splits, etc.
3. Some Results
    a. Eagle Ford about 5% developed, 12% of best area develop
    b. Any one well can only give good information about 2-3 miles away

General Sessions

Keynote Address: John Watson, CEO Chevron

1. Cost is a major issue
    a. Costs keep going up, this is the major issue for producers, basically making $100 oil the new $20 oil.
    b. This period of high costs has defined the past decade of the oil industry, but is in a period of transition to getting these costs under control
    c. Chevron has a fine supply of labor, but is concerned with contractors abilities to get positions filled and keep costs down.
2. New areas of focus
    a. Chevron's focus is in unconventionals in the Permian, Marcellus and Canadian Davianan
    b. New areas for exploration/production include Argentina, and then Europe and China.
3. Other Issues
    a. Cheveron sees oil subsidies as unsustainable policies that will fade globally.

U.S. Energy at a Crossroads

1. There is activity at the Congressional level to change federal policy regarding drilling federal lands crude oil exports. These changes could be made through administrative rule, rather than legislative action.
2. Sen. Murkowski from Alaska is leading the charge, as federal lands account for 62% of all of Alaska.
3. "Energy 2020" is her blueprint, and she has some other white papers.

Economic & Geopolitical Outlook

1. Unusual activity at the beginning of 2014
    a. Cold weather
    b. China's New Year
    c. Japanese consumer tax hike shifting consumption into the first quarter
2. Forecast fundamentals are

    a. U.S. drags are lower
        i. Decreasing private debt
        ii. Government retraction is over
        iii. Trade deficit is diminishing
    b. There are developed market strengths—big point: recovery is being driven mature markets
        i. Europe finally recovering
        ii. Japan finally growing
    c. BRICS party is over
        i. Fast growth in mid-2000's was an anomaly based on commodities & hyperglobalization
        ii. Very few structural reforms in the good times
        iii. Chinese data is very suspect
        iv. China has had a historical run-up in total debt
        v. Likely big correction in the next 3-5 years, role of government unclear
3. Middle East outlook: instability may continue for the next 30 years, influencing energy supply.

Emerging Geopolitical Hot Spots

1. China policy
    a. 75% of electricity is consumed by industry; rest of the world is average 20%
    b. Changes in the global economy greatly affects their energy expenditure
    c. Pollution paradox: increasing energy production leads to increasing wealth leads to increased desire for clean air leads to decreased use of carbon-intensive energy sources
    d. Coal plants commissioned as recently as 2008 in Beijing are being converted to natural gas.

Markets in Transition

1. Oil prices stable due to offsetting impacts of Middle East instability and increasing U.S. production.
2. BIG IF no further disruption, then modest price softening. BUT Ukraine, Venezuela, Russia, Iran, Iraq!!!
3. Energy rivalry: growth in natural gas and renewable
4. Transportation is oil's last big monopoly, but NG is gaining; ultimately push down oil demand by about 6%
5. Next big plays: 10-15 fields may be able to contribute longer term.
6. Global issues include access to markets and high costs of production leading to project delays.
7. 2013 was a low in conventional discoveries.
8. U.S. & global refining capacity: golden age of U.S. refining—very profitable and largest exporter of oil products in the world
9. Europe: big lowers in refining capacity
10. Mexico opening up may impact U.S. oil

INFRASTRUCTURE & INNOVATION

Analyst Meeting

IHS Analyst: Kurt Barrow, Sr. Director of Downstream Consulting

Questions

1. What is the outlook for increased infrastructure capacity—refineries, transportation options or ports—that will affect the economic competiveness of Montana's natural resources?
2. What do you know about a potential refinery in Great Falls for Canadian tar sands?

Answers

1. Pipelines
    a. Permitting of pipelines remains a concern

    b. Philadelphia Energy Solutions is currently taking ¼ of Bakken crude
    c. A pipe to the east from the Bakken is not likely so maintenance on rail is necessary
    d. There is some right-of-way in MT for pipeline, also an eastern Canadian pipeline is being looked at which could accommodate 200,000-300,000 barrels of oil per day
2. Kurt was not familiar with the refinery expansion in Great Falls. Rail maintenance is needed & tanks need to be "beefed up." It's not clear what pipes will be built out of the Bakken. Diesel demand a potential issue

Breakout Sessions

Pipes, Trains & Barges: the Transformation of North American Oil Logistics

1. Logistical challenges in the Bakken (from Continental Resources)
    a. Historical
        i. Moving from a scarcity mentality to an abundance mentality
        ii. Adapting a regulatory environment to a new technology
        iii. Midstream reluctance
    b. Future
        i. Refining capacity ahead of production capacity
        ii. Gas issue: North Dakota flaring ~35% of gas
        iii. Safe handling of crude by rail or pipe
2. Policy issues on the horizon
    a. Lifting export restrictions
    b. Transportation safety, esp. by rail
    c. East coast refineries
    d. Renewable fuel standard
    e. Safety & regulatory regime of tight oil development
3. Logistical bottlenecks' impact on prices
    a. Good for refiners
    b. Volatility of differential as big of an issue as the differential itself
    c. No curtailing of Canadian production due to high price differential
    d. Bakken discounts resulted in a push to rail, rather than pipeline; i.e., going to east & west coasts, rather than south to Cushing
4. Refining capacity limited→crude exports?
    a. Steep learning curve of the issue
    b. Small changes available by administrative rule
5. Rail transportation is likely to remain a part of some markets
    a. Pipe & rail transportation will be complementary

Energy's Innovation Dilemma: Scaling New Technology

1. Energy development infrastructure requires large projects, large capital & large time commitments
2. Use collective intelligence to promote innovation
    a. Utilize external intelligence; i.e. crowd sourcing
    b. Improve internal intelligence
        i. Emotional intelligence
        ii. Equal degree of participation by group members; i.e., reduce dominating by a few group members
3. Capacity & assets needed for committing to large scale investment
    a. Capacity most important

Infrastructure Boom: Financing Natural Gas Pipes, LNG & Processing

Three converging issues

1. Infrastructure boom

2. Dodd-Frank regulations
3. Federal Reserve tapering

This conversation basically unraveled to a discussion of the advantage of the tax structure of MLPs. Nothing of particular interest.

NATURAL GAS

Analyst Meeting

IHS Analyst: Jihad Traya, Associate Director of North American Natural Gas
Darryl Rogers, Director of North American Natural Gas
Sam Andrus, Director

Questions

1. What is the timeline for market viability of Montana natural gas; i.e. at what point will prices support the transportation costs?
2. How will flaring-limiting regulations affect the industry? Will there be increased demand for pipelines, transportation subsidies, or reduced drilling on the margins?
3. What is the outlook for increased infrastructure capacity—refineries, transportation options or ports—that will affect the economic competiveness of Montana's natural resources?

Answers

Darryl was very interesting & had a lot to talk about:

1. IHS Gas Analysis includes quarterly break-even price by field
2. Total US gas rigs ~ 370
3. The lack of drilling in the Bakken (and Montana) not so much an issue of price, but of low production
4. The Marcellus field is increasing by ~3Bcf per day, while all else is declining by ~1.5% per day
5. Expect very limited new drilling in Montana
6. Read "Report on Bakken Drilling"
    a. ND flaring 29-36% of gas
7. New gas plant being built on the border?

Breakout Sessions

Residential & Commercial Natural Gas Consumption: Rethinking Regulation Post "Shale Gas"

1. Policy
    a. Light on ideas, primarily the speakers feel they are losing the environmental discussion on fracking
    b. Many policies are pre-shale era and need to be revisited
2. Growth and change in the industry
    a. 3 areas for growth in natural gas
        i. Power generation
        ii. Petro chemicals
        iii. Transportation
    b. 46% decrease in cast iron main line since 1985
3. Federal level
    a. QER (quadrennial energy review) a project being done at the federal level where they are looking from local input.

New Map of Global Gas

1. Australia: largest exporter of LNG
2. Mozambique: deep water drilling

Keeping Pace: Can North American Gas Supply Meet the Coming Demand Surge?

1. Yes, 3 people from industry and an IHS analyst all think industry will keep up
2. Infrastructure is the possible limiting factor
3. Natural gas needs to be above $5 for increased drilling

General Sessions

Energy & Global Competiveness

1. We are living in an era of volatility
    a. Countries are competing like companies
    b. Unemployment is hear to stay
    c. Most countries do not have a balance energy policy
2. Trade issues
3. Limited access to the entire value chain

The Future of the Shale Gas Revolution

1. Natural gas resources are steady or growing
2. Responsible development is key
3. Improving water management
4. Declining costs of production
5. In Colorado, large companies worked with the administration to develop regulations; the bill was just passed by the legislature
6. Low costs for reducing some types of emissions
7. Current hot topic: fugitive emissions
8. Land & mineral ownership system make U.S. unique
9. "License to Operate"
    a. Understanding the stakeholder base
    b. Responding to stakeholder concerns
    c. Communication & transparency
    d. Recognizing there will always be trade-offs
    e. Issues of trust

COAL

Analyst Meeting

IHS Analysts: James Stevenson, Sr. Principal Research Analyst
Jim Thompson, Director of North American Coal

Question

1. What is the short- and long-term outlook for Powder River Basin coal relative to other domestic coal sources, both for domestic consumption and potential for export?

Answers

GREAT conversation!
Demand issues

1. Generally, coal is in decline

2. Global demand is increasing, but not enough to offset decreasing domestic demand
    a. Healthy market for PRB coal in Asia
        i. Less China, more South Korea & Japan
    b. 30-40 million tons of demand in Asia
3. Coal prices are current abnormally low

Montana coal availability

1. Closer to the Asian market than other sources of coal, including Wyoming coal
    a. BNSF a better route than UP
    b. Rail doesn't seem to be a limiting factor to export capacity
    c. PRB is the slowest declining coal source
    d. Peabody owns Wyoming coal, but helps export Montana coal due to rail & port locations
2. Three terminals in development
    a. CA, OR (Scheduled to open 2015) & WA
        i. Combined capacity of 100 million tons
    b. Vancouver is expanding but expensive to access

Montana coal quality

1. Higher BTU content when compared to other sources
2. This matters particularly in Japan & South Korea, because PRB is better than Indonesian coal
    a. Recent South Korea tax favors higher heat-content coal

Other issues

1. PRB has a big push for dust mitigation

POWER

Analyst Meeting

IHS Analyst: Meg McIntosh, Director of North American Power
Parker Littlehale, Associate Director of North American Power

Meeting Highlights

1. IHS power analysis offers three deliverables
    a. Power market fundamentals (data)
        i. Prices
        ii. Demand
        iii. Capacity additions & retirements
        iv. Generation by source
    b. Power market briefings
    c. Power market profiles
2. Power demand increasing 1.7% on average per year→new investment needed
3. Wind & hydro generation have had trouble coexisting in recent years
    a. Wind tax credits not applicable if there is no production
4. Case study for Ontario
5. LOOK FOR MEGAWATT DAILY SOURCE

Breakout Sessions

Outlook for North American Power Demand

1. Strong demand forecast through the end of the decade
2. Generational differences could impact power demand
    a. Trend of sharing among millennials
3. IHS is no longer including carbon trading in their forecast
4. Technology changes have the largest impact on growth

5. Montana is the largest non-reporting natural gas storage state in the west

The State of Coal vs. Gas Fuel Competition in North American Power

1. Restocking
    a. With the high hit by gas during the cold spell, suppliers are planning on filling reserves during the summer. This may put some short term upward pressure on coal prices as coal takes over for power generation
2. Growth
    a. A marker that gas production is ready to increase will be rigs going to the 400-450 range, they currently sit at 370, nationally.
    b. IHS thinks 4.5B mcf is sustainable year over year growth
3. Petrochemicals
    a. Lots of petrochemical expansion planned; skilled labor may be a time limiting factor

General Sessions

Markets in Transition

1. U.S. & Global Power Production
    a. Power has a monopoly of all new technological devices
    b. Asia & South America→high growth
    c. U.S.→low growth
    d. Europe→very low growth
2. Energy sources for power generation over next 15 years
    a. Oil→losing about 6% market share to natural gas
    b. Coal→remains king, but decreases 40% to 35%
    c. Renewables→grow from 5% market share to 12%

North American Power Plenary

1. Infrastructure expansion
2. Portfolio simplification
3. Positioning for the future
4. Building for a transition in the industry
5. Growth comes from new customers
    a. Per customer growth flat or slightly declining
6. Industrial demand still below 2007
    a. Best recovery in the auto industry
7. Access to capital not an issue
8. Polar vortex showed a power system under stress
    a. A number of coal plants are retiring in mid 2015. During the cold snap, 89% of these plants were online; retirements may cause issues with power availability.
9. Future of U.S. coal fired generation
    a. Will decrease
    b. Increasing gas, renewable & nuclear generation
    c. Coal will remain a key player
    d. No new coal-fired plants due to regulatory environment
10. There are many innovations in power on the horizon; however, not many in coal, which seems to be a mature technology
11. Asian priorities are cheaply available power
    a. No concerned with renewables at this point
    b. Coal will likely be a major player

The Global Power Challenge

1. Distributed and modular capacity in power generation will likely be the high growth area as it reduces risk exposure.
2. Risk in renewables is different than for fossil fuels as return can be less than expected, but never goes to zero. This is something that is being added to grids to hedge exposure to any specific rule.

Gina McCarthy: U.S. EPA

New guidelines for climate change

1. First drafts available in June
2. These guidelines will be done with authority through the Clean Air Act
3. Because it is through the Clean Air Act there will be no specific CO2 reduction target
4. The EPA has social cost of carbon numbers, but they may not be a driver in the guidelines

RENEWABLES (MISSED MEETING—SET UP PHONE CALL)

Analyst Meeting

IHS Analyst: Alex Klein, Research Director
TJ Deora, Sr. Principal Research Analyst of Energy & Environment
Andy Lubershane, Sr. Research Analyst

Questions & Answers

1. What impending developments in the wind industry may impact the production and exportation of this energy source in a rural state like Montana?
2. Montana is a producer & exporter of conventional & renewable energy. What national or international policy decisions are on the horizon that could impact the production, sale or growth of these sources, given Montana's location relative to major population centers and/or transportation hubs?

POLICY & THE ENVIRONMENT

Analyst Meeting

IHS Analyst: Marcus Gay, Sr. Principal Research Analyst
Sarah Fletcher, Sr. Research Analyst of Water

Questions

1. Are there significant water quality & resource issues looming as Montana natural resource development grows?
2. Montana is a producer & exporter of conventional & renewable energy. What national or international policy decisions are on the horizon that could impact the production, sale or growth of these sources, given Montana's location relative to major population centers and/or transportation hubs?

Answers

Recent analysis done on water management strategies across 13 plays in the U.S.

1. A variety of perspectives
2. Cost of water management in the Bakken is the highest in the nation
3. It costs $300,000-$500,000 per well to heat the water in the winter
4. Water supply was an issue in ND in 2011 & 2012
5. New water pipelines are coming online
    a. Private
    b. Municipal

6. Water stressing an issue
7. ND looking to allow aggregation of waste water for reuse in drilling operations
8. TX dealing with water issues

Breakout Sessions

Shale Gas & the Environment: Methane Emissions & Water

1. Outlook for unconventional exploration at risk due to public concern for the environment
2. Industry must be at the forefront of addressing environmental issues
3. Regarding water quality: EPA has not released their regulatory findings for water handling; will be a big deal
4. Regarding methane: need to obtain a global understanding of the impact of methane emissions relative to CO2 & other gasses
5. Natural gas is an important part of the federal environmental strategy
6. Support for unconventional development in the federal budget
7. Federal R&D needed to understand fracking & water quality, develop new data for methane emissions, use of CO2 as a replacement for fracking
8. Methane is #2 after CO2 for greenhouse gas impacts
9. Regarding methane emissions: consistent measurements, global data, natural to manmade ratio research are all needed
10. Critical water issues include: not enough information, water quality throughout lifecycle, fate of water held for extended time periods in pools, ultimate disposal procedures
11. Need a water "cradle to grave" strategy
12. Currently a patchwork approach: 32 states with differing approaches, rules, and standards; this is complicated for multistate projects
13. One solution: use methane & NG to produce electricity @ oil sites

General Session

Energy, Commodities & the Global Economy

1. In the next 20 years, 1.7 billion people will gain access to electricity
2. 2/3 of new demand will come from Asia
3. Fastest growth in demand comes from Africa
4. Countries will balance energy cost & energy security
5. The long-term energy industry must
    a. Reduce emissions
    b. Must mitigate & adapt to climate change
    c. Contribute more technical expertise to being a part of the solution
    d. Encourage constructive policy

APPENDIX

ANALYST BIOS FOR INDIVIDUAL MEETINGS

Sam Andrus, Director

Samuel J. Andrus, IHS CERA Director, leads the IHS CERA North American Gas fundamental analysis team. Mr. Andrus has 30 years of energy industry experience, with technical and commercial expertise in most areas of the industry, including asset valuation and project screening, supply and demand forecasting, gas and power transmission modeling, pipeline and generation dispatch, pipeline and power plant project development, and natural gas trading and hedging.

Mohsen Bonakdarpour, Director of Strategy & Planning Group

Mohsen Bonakdarpour, Director of the Strategy and Planning Group for IHS Consulting, is responsible for economic analysis and directs advisory projects across various industry sectors.

Mr. Bonakdarpour has experience in global industry and macroeconomic analysis. He has worked with a wide range of clients, helping them to size their markets, predict product demand and to better target their marketing efforts. He has led a series of studies and developed methodologies to undertake economic impact analysis, and he has managed the development of IHS Business Market Insight, designed to support strategic planning, market segmentation and economic development analysis. Mohsen was also responsible for development of a global Information and Communication Technology database.

Kurt Barrow, Senior Director of Downstream Consulting

Kurt Barrow, Managing Director in the Downstream Energy group of IHS Consulting, provides technical, commercial and strategic advice to a diversity of clients in the midstream and downstream petroleum and biofuels space. Formerly a Vice President with Purvin & Gertz, Mr. Barrow leads a consulting team that specializes in mergers and acquisitions, crude oil and refined products market analysis, strategic analysis and technical assessments.

Prior to consulting, Kurt began his career at the Exxon Baytown Refinery in various engineering and planning roles. Mr. Barrow also worked in Singapore for Purvin & Gertz for six years. Mr. Barrow was the lead author for the Purvin & Gertz Pricing and Margins module of the Global Petroleum Market Outlook service and the director of the Residual Fuel Market Outlook study.

TJ Deora, Director of Business Development

Tanuj Deora, IHS Director of Business Development, specializes in electric power generation strategy, focusing on power markets, renewable energy, and the energy industry's license to operate. Prior to his time at IHS, Mr. Deora led EDPR's state and RTO relations efforts across the eastern US. In that capacity he served on the board of the Colorado Independent Energy Association, Interwest Energy Alliance, Renewable Energy New England, and the Mid-Atlantic Renewable Energy Council, and served as Vice Chair of the American Wind Energy Association Transmission Conference.

He has developed wind energy projects across the Rockies and in New England, was a consultant for McKinsey and Company's electric power and natural gas practice, and provided analytical support for Calpine's energy trading operations. Mr. Deora came to IHS after serving in the cabinet of Governor John Hickenlooper as head of the Colorado Energy Office, and holds a mechanical engineering degree from the University of Texas and an MBA from Harvard Business School.

Sarah Fletcher, Senior Research Analyst of Water

Sarah Fletcher researches issues at the intersection of water and energy, with a focus on water use in unconventional gas. Her primary expertise lies in risk and uncertainty analysis of complex systems with technical, economic, and social interactions.

Prior to joining IHS, Ms. Fletcher was a Graduate Research Assistant at the MIT Energy Initiative, where she focused on risk analysis of water and energy technologies in emerging markets and also worked on the MIT study *The Future of Natural Gas*. Her master's thesis developed a methodology for assessing groundwater contamination risk from shale gas operations, and provided both an engineering assessment and an analysis of the public risk perception and stakeholder incentives. She holds an SM in Technology and Policy from the Massachusetts Institute of Technology and a BA in Physics and Economics from the University of Pennsylvania.

Marcus Gay, Director of Water Information & Insight

Marcus Oliver Gay, IHS Research Director, Water Information and Insight, is a key member of the IHS water initiative. His expertise is in water and wastewater treatment, aquatic ecology, environmental remediation and bio-based renewable energy technologies.

Prior to joining IHS, Mr. Gay was Principal Researcher, Head of Field Operations, Director of Technology Development across the environmental and clean-tech industry including positions at the Marine Biological Laboratory in Woods Hole, MA, GreenFuel Technology Corporation and Trophos Energy LLC. More recently Mr. Gay provided critical product and business development support to SRS Energy and Reed-Elsevier.

Mr. Gay is a patented inventor in the water space, he has co-authored scientific papers on prior research and is an authority on water management issues in the unconventional landscape. Mr. Gay's activities have been featured in published interviews with National Public Radio, Forbes Magazine, National Geographic Magazine and recently within the Houston Chronicle and The EnergyMakers Show. He holds an MS in Environmental Chemistry and a BS in Marine Biogeochemistry.

Ed Kelly, Vice President of Natural Gas Consulting

Mr. Kelly, a Vice President and leader of IHS' Americas Gas and Power consulting practice, has over 25 years experience in the natural gas business, including over 20 years in research and consulting. Mr. Kelly leads major consulting engagements and advises energy firms regarding business strategy in the North American gas and power industries. Mr. Kelly joined IHS in 2012 from Wood Mackenzie, where he was Vice President, North American Gas and Power, and a founder and leading spokesperson for Wood Mackenzie's North American Gas research and consulting practices. Mr. Kelly's responsibilities at Wood Mackenzie included directing consulting engagements as well as contributing to research, with focus on the gas midstream business, and market and basis analysis.

Prior to Wood Mackenzie he was Director of Research, North American Gas for Cambridge Energy Research Associates (now IHS CERA). During his ten years with CERA, Mr. Kelly edited the research product, and directed numerous consulting engagements, especially applying CERA's scenarios to client investment and decision-making.

Prior to joining CERA, Mr. Kelly held a variety of strategic planning, market analysis, and storage development positions for two separate interstate pipeline companies. Mr. Kelly holds an MBA from UT at Austin, and a BA in economics from the University of Chicago (1982).

Alex Klein, Research Director

Alex Klein, Director, IHS Energy Insight, is responsible for renewable power advisory services at IHS. Mr. Klein's work focuses on analyzing trends across the global renewables sector and in development strategy. He has managed and authored several in-depth market studies on renewables policies, solar, geothermal, wind,

ocean energy, transmission, and energy storage. He has 15 years of consulting and research experience in the energy sector, with a focus on renewables market and technology analysis.

Prior to joining IHS Mr. Klein was with Juniper Consultancy Services in the United Kingdom, where he conducted due diligence, independent assessments, and critical appraisals of novel technologies related to clean and renewable energy. Mr. Klein holds a BS from the University of Vermont and an MS from Columbia University. He is based in Cambridge, Massachusetts.

Parker Littlehale, Associate Director of North American Power

Parker Littlehale, Associate Director, IHS Energy Insight, focuses on power market analytics, supply and demand fundamentals, wholesale power pricing, industry structure, and market policy in the Western Electricity Coordinating Council. Topics of his recent and upcoming reports include conventional power plant valuation trends and managing transformational change in the power business. Mr. Littlehale was the project manager for the IHS CERA Multiclient Study *Smart Grid: Closing the Gap between Perception and Reality* and was a contributor to the IHS CERA Multiclient Study *Fueling North America's Energy Future: The Unconventional Natural Gas Revolution and the Carbon Agenda*.

Prior to joining the Power, Gas, Coal, and Renewables–Americas Group he worked in the IHS CERA sales department managing client relationships in the utility and financial sectors. Mr. Littlehale holds a BA from the University of New Hampshire and an MBA from Suffolk University.

Andy Lubershane, Senior Associate of North America Renewable Power & Wind

Andy Lubershane is a Senior Analyst for IHS EER's North America Renewable Power and Global Wind advisory services. Andy focuses on wind energy development in the US, Canada, and Mexico, with an emphasis on power market dynamics and grid integration.

Prior to joining IHS, Andy taught in a public middle school, and then worked for a non-profit municipal energy advisor. He holds a BA in Government from Wesleyan University and a MS in Natural Resource Economics from the University of Michigan and is based in IHS EER's Cambridge, MA office.

Bob MacKnight, Director of Research

Bob is an expert in upstream access, exploration strategy, and North American tight oil and shale gas development. He manages the Global Oil & Gas Supply research team, and has recently launched the North America Supply Analytics service. His current research focuses on the drivers of success and failure in emerging play development both in North America and internationally. Mr. MacKnight has provided strategic advisory services to small-cap and multi-national oil companies, and lead several due diligence exercises for private equity firms assessing investment opportunities across the oil and gas value chain in North America. Prior to joining IHS he spent seven years at PFC Energy, leading consulting and research initiatives in the Upstream Practice on frontier regions and onshore North America.

Mr. MacKnight has worked as a geologist on ExxonMobil's Chad Development Team, and with the US Department of Energy and Lawrence Livermore National Laboratory. He holds a BS and an MS from the University of California, Santa Cruz.

Meg McIntosh, Director of Research

Ms. McIntosh's current research is focused on various renewable technologies and the outlook for their expansion in North America. Previously Ms. McIntosh was a Director at The Massachusetts Renewable Energy Trust, where she oversaw the Industry Investment and Development Program, making loans to and equity investments in early stage renewable energy companies. While at the Renewable Energy Trust she also was responsible for optimizing the organization's renewable energy certificate contract portfolio position.

Prior to joining IHS CERA, Ms. McIntosh worked as an independent consultant and for PA Consulting for over eight years, advising energy and financial sector clients on a variety of wholesale energy market issues including generation asset valuation and strategy. She was also previously with Apogee Research, Inc., and with Hygienetics, Inc. Ms. McIntosh holds a BA from Hobart & William Smith Colleges and an MBA from the Yale School of Management.

Brendan O'Neil, Director of Consulting

Brendan O'Neill is a Managing Director in the IHS Consulting Group. Mr. O'Neill oversees the State & Local Government and Trade Associations segments of the IHS Consulting business. In addition to his project execution efforts, he is responsible for developing client and strategic partner relationships and executive management of client engagements. Mr. O'Neill has specialized in assisting clients with their market sizing and forecasting, economic and policy impact analysis, economic development initiatives and supply chain cost containment efforts. With over 15 years of experience in market and policy research, Mr. O'Neill's has expanded the firm's business by engaging clients in a wide range of industry sectors and through multiple product and capability launches.

Prior to joining IHS Consulting, Mr. O'Neill served in various Business Development roles at Global Insight, World Markets Research Centre and Forrester Research. Mr. O'Neill's policy experience stems from his work in Massachusetts and New York state legislatures. Mr. O'Neill holds a BA degree in Political Science from Syracuse University and graduate studies at Suffolk University.

Sharon Reishus, Senior Director of Research in North American Power

Sharon Reishus, IHS CERA Senior Director, is responsible for leading the development and delivery of the research content of IHS CERA North American Power Advisory Service. Ms. Reishus returned to the company in August 2010 after answering a call to public service as a Commissioner of the Maine Public Utilities Commission for seven years, where she served as Chairman her last two years and in addition to state regulatory duties engaged with other policymakers and stakeholders in regional and national activities on transmission, climate change, energy efficiency and the smart grid.

While at CERA previously (prior to its purchase by IHS), she coauthored the CERA Multiclient Study Energy Restructuring at the Crossroads, and has authored or coauthored several reports, including research on US energy policy legislation. Earlier she spent eight years in the utility industry as a financial analyst with the Maine Public Utilities Commission and as a planner with the Central Maine Power Company. She also worked in The White House as a Situation Room Duty Officer and as an intelligence analyst for the Central Intelligence Agency. Ms. Reishus holds a BS from Stanford University and an MBA from The Wharton School, University of Pennsylvania.

Darryl Rogers, Director of North American Natural Gas

Darryl Rogers, IHS CERA Director, North American Gas, is an expert in short term and long term market analysis of the North American natural gas market, natural gas supply, gas processing and related natural gas liquids (NGLs) production, LNG, and fundamental supply and demand analysis for the IHS CERA North American Natural Gas retainer service and various IHS consulting projects. Mr. Rogers has provided consulting and advisory services to gas, NGLs, and LNG industry participants for both IHS and Purvin & Gertz. Prior to joining Purvin & Gertz Mr. Rogers was employed at The Dow Chemical Company (Dow) in natural gas, LNG, power and cogeneration, petroleum coke, hydrogen and other industrial gases, and petrochemicals, spanning manufacturing, finance, marketing/sales, and commercial management. Mr. Rogers has a B.S. in Business Administration from Western Carolina University, a B.S. in Chemical Engineering from North Carolina State, and an M.B.A. from Louisiana State University.

Leta Smith, Director of Research

Leta Smith, IHS CERA Director, is an authority on upstream supply, focusing on current trends and challenges in exploration and production (E&P) and the implications of those trends for the future supply outlook. She directs and undertakes research for the IHS CERA E&P Trends Forum and tracks oil productive capacity for the United States and Latin America. Among other current research efforts Dr. Smith was the principal author of the IHS CERA analysis of the shale gas potential outside of North America and coauthor of an evaluation of liquids production capacity to 2030.

Dr. Smith has over 15 years of experience in the petroleum industry, with expertise ranging from the reservoir to the global level. Before joining IHS CERA Dr. Smith was a Managing Consultant with IHS Inc., where she led studies and advised clients on reserves and production analysis, resource valuation, market studies, and strategic planning activities. Her professional experience also includes research in enhanced oil recovery and gas exploration technology development with the Institute for Energy Research and Amoco Production Research. Dr. Smith is a licensed Professional Geologist in the states of Texas and Wyoming. She holds a bachelor's degree from San Francisco State University and a PhD from the University of Wyoming.

James Stevenson, Associate Director of North American Coal

James Stevenson, IHS CERA Director, leads the IHS CERA North American coal market analysis. His expertise includes supply-demand dynamics of the North American and international coal markets, coal price forecasting, and coal export logistics and infrastructure. Prior to joining IHS CERA, Dr. Stevenson spent five years in coal trading, most recently as Vice President, Coal Analysis at Mercuria Energy Trading, Inc. and before that as Coal Strategist at Louis Dreyfus Highbridge Energy. Before that he worked in the energy trading team at Eraring Energy in the Australian utility industry. Dr. Stevenson holds undergraduate and master's degrees from the University of Sydney in Australia, and a PhD from Yale University.

Jim Thompson, Director of North American Coal

Jim Thompson, Director for IHS Coal and IHS Coal Markets Expert, has analyzed and provided insight on coal markets for more than two decades. He is lead commentator for the IHS Coal & Energy daily newsletter and editor of US Coal Review. Thompson's major area of expertise is the North American coal markets, though he is conversant on worldwide market trends.

Mr. Thompson's expertise is both in thermal coal for electricity production and metallurgical coal for use in the steelmaking process. He is widely quoted in by major financial newspapers and speaks at multiple industry-related conferences. Thompson has performed coal market consultations both for coal producers and consumers as well as for financial analysts and investors. Thompson's views on the coal markets are widely read throughout the world. Thompson came to IHS as a part of its acquisition of Energy Publishing, of which he was a co-founder. Mr. Thompson was educated at Dallas Baptist University.

Jihad Traya, Associate Director of North American Natural Gas

Jihad Traya, IHS CERA Associate Director, is an expert in North American Natural Gas Markets. Mr. Traya has a rich and diverse background in the energy industry. He has over 10 years of experience in fundamental analysis, strategic planning, and front to back office energy trading functions. Most recently, Mr. Traya was the Manager for Commodity Risk and Analytics at Superior Plus. He has a particular focus on Western US and Canadian markets. Mr. Traya holds a BA with a focus on Applied Energy Economics from the University of Calgary.