The Business Landscape for Unconventional Natural Gas

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Introduction

In the last few years the energy landscape in the United States has been revolutionized by technological innovations in natural gas drilling. These innovations have allowed previously untouchable resources to become economical. The introduction of the combined use of hydraulic fracturing and horizontal drilling has been rightly named a game-changer, as it has resulted in a reverse of the country’s reserve decline to the point where it can become an exporter.

However, while the U.S. is busy developing its unconventional resources, most other countries have not yet begun significant commercial or even exploratory development of their unconventional natural gas resources. Despite the challenges that can be identified for countries that seek to replicate the success of the U.S., there exist major opportunities for investors interested in unconventional natural gas markets.

To assess the ability to develop such unconventional resources and therefore their investment potential, this report attempts to analyze and answer a few key questions about the availability and feasibility of unconventional gas development within six countries: Argentina, Australia, Canada, France, Poland and the UK. It is first determined whether or not the geology and infrastructure support development. If so, then it must be determined whether political and business leaders, as well as the general public, are behind this new method of extraction. Furthermore, it must be established that laws and regulations can allow this development to happen safely on a large scale and with reasonable costs, and if not, what must happen for the laws to change. Markets must then be assessed to determine how competitive these resources could be. A scenario analysis is then conducted using this research to illustrate potential good and bad business environments and highlight significant indicators that will cause or precede changes to the industry.

In short, by focusing on technical issues like resource stock and water availability to social issues like political and social opposition, the report creates a simple matrix of key themes across five categories; namely regulations, politics, markets, geology and infrastructure. The scenario analysis then determines which indicators and variables are at the root of a strong or weak business environment for unconventional gas. Based on this work, final recommendations are made to Crédit Agricole to continue observing these variables as indications of changes in the investment landscape.
COUNTRY FACT SHEETS
Country Factsheet: ARGENTINA

Summary: To address domestic concerns about energy security and quell international concerns about regulatory capture, the Argentinian government is aggressively promoting shale gas development as a national policy. With potentially abundant resources and satisfactory infrastructure, the biggest challenges seem to be political, with significant risk in its unpredictable foreign capital constraints, strict anti-competitive regulations, and government price controls. After a long history of credit defaults, nationalization, and the consolidation of federal power, foreign parties are hesitant to invest in the country’s uncertain environment. The government’s recent nationalization of YPF stock from the Spanish oil and gas company Repsol has revived many of these fears and further complicated international financing of major energy projects. Nonetheless, the potentially huge reserves coupled with growing regional demand and a commitment to liquefied natural gas (LNG) projects makes for an interesting, if not particularly attractive, market.

Regulations
- “Hydrocarbon Sovereignty,” a national policy to centralize exploration under the federal government
- Mineral rights belong to the Provinces (except for deposits more than 12 miles off the coast), each with its own regulations, Environmental Impact Assessment standards and its Water Code
- Both public and private companies can conduct gas exploration, but transportation and distribution activities are reserved for private companies
- Legislation limiting foreign ownership of land
- Price controls, including energy prices
- The Supply Law: government can penalize or even take over companies if it deems that the companies have failed to provide an adequate product supply to the national market
- “Gas Plus” program incentivizes private companies to explore unconventional gas fields

Politics
- Current government headed by President Kirchner, continuing her predecessor’s social populist agenda
- Legislative elections in October 2013 and Presidential in 2015, which may revive political discontent
- Kirchner administration has deep involvement in many aspects of economic activity, including a number of policies addressing foreign investment and capital restrictions
- Growing nationalism associated with energy independence
- Tensions between public and private enterprises as well as foreign and domestic interests
- No significant opposition to fracking or to the country’s “Hydrocarbon Sovereignty” strategy

Markets
- Biggest gas consumer in South America, recently became a net importer of natural gas
- In May 2012, Argentina nationalized the remaining 51% of YPF controlled by the Spanish company Repsol, scaring foreign investors from entering the market
- Companies already active in the country such as Exxon, Apache, Chevron and Shell are also limiting operations while awaiting a resolution
- Foreign exchange regulations create additional costs because most of technology and materials need to be imported
- The breakdown of fracking and drilling costs is not readily available

Infrastructure & Technology
- Excess pipeline capacity following a decline in conventional gas production
- Potential shale gas extraction sites correspond with traditional gas locations
- Road infrastructure and water challenges in some basin areas

Geology
- Estimated 774 billion MMbtu of technically recoverable shale gas, third largest in the world
- Most resources are located in the Neuquen Basin in the Vaca Muerta and Loma de Lata formations
- To date, most exploration has occurred in the in the Neuquen Basin
- Based on preliminary results from test drilling, the rock is potentially twice as rich in organic matter as the best portions of the Eagle Ford shale formation in Texas
- A lot of uncertainty remains about the quantity and quality of reserves
Country Factsheet: AUSTRALIA

Summary: Conditions for development vary significantly on a state-by-state basis, and the country is divided into three separate gas markets. Unconventional supply is dominated by coal bed methane (CBM), also called coal seam gas (CSG), which is easier and cheaper to extract than shale gas. The Australian government predicts national gas production to increase significantly, primarily driven by LNG and growing domestic demand.

Regulations

- Mineral energy rights are enshrined on the state and governed by state laws
- Most important regulatory decisions are made at the local level, e.g. gas prices
- Legislation in support of a carbon tax and an Emissions Trading Scheme in place
- Minerals Resource Rent Tax in place, designed to contain corporate profits by redistributing high resource rents to the federal government

Politics

- Next federal election to be held in November 2013, currently ruling Labor party trails the opposition Liberal-National coalition in the polls
- An ongoing protest movement against CBM and fracking is centered in New South Wales and Queensland, but since fracking is legal, these movements have a limited impact

Markets

- Australian government projects national gas production will quadruple by 2035 from LNG exports and domestic demand
- Medium-term increase in prices expected, but once the market adjusts the government is confident that prices will fall
- LNG export contracts are primarily long-term to Asia
- Confidential long-term bilateral contracts limit transparency
- The market is shifting from to shorter-term contracts and spot market transactions
- Australia is the fourth largest LNG exporter in the world, expected to overtake Malaysia and Indonesia, maybe even Qatar
- Australian shale gas comes at a higher cost than CBM

Infrastructure & Technology

- Developed infrastructure
- Three separate gas markets: Eastern States market, the Western Australian market, and the Northern Territory gas market
- The size of the country and harsh weather conditions present challenges to gas developers
- All exports in the form of LNG: at the moment, two LNG export facilities in place, 8 projects under construction

Geology

- According to EIA estimates, the quantity of technically recoverable shale gas resources in Australia is 396 billion MMBtu
- A significant source of Australia’s natural gas is CBM from Queensland’s Bowen and Surat Basins and New South Wales-together accounting for 13% of Australia’s gas production in 2010
- CBM gas is easier to extract than shale gas deposits
- Many of the large shale gas plays in Australia are located in remote areas of the country, or in some cases, in deep water offshore
- CBM fields currently under development are located in Queensland and New South Wales near several of Australia’s population centers, signaling potential for friction between extraction companies and the local population
Country Factsheet: CANADA

Summary: Shale gas production has not yet begun in Canada, however many provinces show promising resources and have begun development and exploration, including Alberta, British Columbia, Nova Scotia and New Brunswick. Differences in regulatory structure differ amongst provinces, as does the level of public and political opposition. Additionally, First Nations groups have proven to be a strong obstacle in many areas. Canada is also exploring LNG exports to Asia.

| Regulations | • Laws and jurisdictions are divvied up between the federal government and the provinces  
• Provinces have the right to enact laws for the development, conservation, management, taxation and export (within Canada) of non-renewable natural resources  
• Regulatory framework for shale gas, especially the treatment of wastewater, currently under review  
• Surface right and mineral rights are allocated separately  
• Majority of oil and gas are owned by the provincial Crown  
• Several policy incentives for natural gas in place |
|---|---|
| Politics | • Conservative Party is currently in power and appears to be largely behind the development of unconventional natural gas resources  
• Oil and gas industry supported by regulatory reforms  
• Environmental activists are being monitored by the Canadian government  
• First Nations amongst the key opposition groups  
• Current moratorium on chemical fracturing in Quebec |
| Markets | • The Canadian gas market is hub-based, the most important hub being the AECO-C hub in Alberta  
• Access to transport, hubs, and storage facilities are the key determinants of success in sales  
• Canada is already exporting natural gas to the U.S., but exports are dwindling  
• Increasingly promoting LNG exports to Asia – three LNG export projects have been given approval  
• Close integration between the U.S. and Canadian markets  
• Canadian prices intensely affected by the shale gas revolution in the U.S.  
• Different provinces carry different regulations and royalty demands, which affect supply costs |
| Infrastructure & Technology | • Well-developed infrastructure in the central and western parts of the country, in eastern part of the country infrastructure is still in the development phase  
• Integrated network linking production to North American markets |
| Geology | • The EIA estimates that Canada has 388 billion MMBtu of technically recoverable shale gas resources  
• Most of this is found alongside conventional gas reserves in large sedimentary basins in British Columbia, Alberta, and (to a lesser extent) Saskatchewan, although additional shale plays can be found in Quebec, New Brunswick, and Nova Scotia  
• Geological conditions vary significantly amongst different shale formations |
# Country Factsheet: FRANCE

**Summary:** The political opposition to hydraulic fracturing and the regulatory barriers are the largest obstacles towards unconventional natural gas development in the country. Assuming no major change in public perception, or dramatic development in new technology to extract shale gas that does not involve hydraulic fracturing, the political support of shale gas development in France is not likely to change until at least the next election in 2017.

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<tr>
<th>Regulations</th>
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<tbody>
<tr>
<td>• Current moratorium on fracking, all shale gas activities suspended in 2011, not yet resumed</td>
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<tr>
<td>• National commission, that is tracking changes in extraction and exploitation of liquid and gaseous hydrocarbons, has launched a scientific program to learn more about the effects of fracking</td>
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<tr>
<td>• Complex permitting process for natural gas extraction</td>
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<table>
<thead>
<tr>
<th>Politics</th>
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<tbody>
<tr>
<td>• Political opposition to hydraulic fracturing</td>
<td></td>
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<tr>
<td>• Concern for environment overrides desire for greater energy security and reduced dependence Russian imported gas</td>
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<tr>
<td>• The current ruling party, La Partie Socialiste, is committed to maintaining the status quo on shale gas</td>
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<tr>
<td>• However, several prominent politicians and thinkers have been questioning the complete ban on hydraulic fracturing suggesting that drilling for research purposes should be allowed if it can be done safely</td>
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<table>
<thead>
<tr>
<th>Markets</th>
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<tbody>
<tr>
<td>• France is sixth largest gas importer in the world in 2010</td>
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<tr>
<td>• Dominated by long-term oil-indexed contracts; currently a number of contracts under renegotiation</td>
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<tr>
<td>• Even though France has no domestic natural gas production, it could theoretically export to neighboring countries</td>
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<thead>
<tr>
<th>Infrastructure &amp; Technology</th>
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<tbody>
<tr>
<td>• Overall, well-developed infrastructure for conventional natural gas</td>
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<thead>
<tr>
<th>Geology</th>
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<tbody>
<tr>
<td>• The EIA estimates that France has 180 billion MMBtu of technically recoverable shale gas resources</td>
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<tr>
<td>• Most of this gas is located in the northern part of France in the Paris Basin and near Aquitaine in the Southeast Basin</td>
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</tbody>
</table>
## Country Factsheet: POLAND

### Summary:
The Polish government is aggressively promoting exploration and development of unconventional natural gas resources to reduce its dependency on gas imports from Russia. Currently, there is no developed gas infrastructure in place to cope with large-scale production. Additionally, lowered reserve estimates may damper the initial optimism held by the government and early investors.

### Regulations
- EU regulations apply to Poland
- There are currently no laws that specifically address shale gas
- Comprehensive legal frameworks for hydrocarbon exploration, environmental protection, and water management are applicable for shale gas development
- New legislation to facilitate shale gas exploration promised, with draft released in February 2013
- Mineral rights belong to the government or large corporations that can afford to purchase large tracts of land; individual landowners are frequently overlooked

### Politics
- Extremely favorable political environment with a relatively straightforward regulatory process that includes national regulation on hydrocarbon development and environmental standards set by the European Commission
- No significant public opposition to fracking
- However, there are backlogs in obtaining licenses for exploration, transfer of rights, and securing land rights

### Markets
- Over 50% of natural gas demand met by Russian imports
- Historically there have been long-term oil-indexed contracts with Russia
- Unconventional production is not predicted to have a strong effect on domestic prices
- In the short-term, limited export opportunities

### Infrastructure & Technology
- Given the lack of historical gas production, Poland is investing heavily to build a sufficient infrastructure to support shale gas development
- Currently, the most promising areas in these basins are at various stages of exploration and development ranging from the survey to drilling stages
- LNG re-gasification plant is scheduled to finish construction in 2014
- Concerns over the capacity and technical capability for wastewater treatment

### Geology
- In 2012 the Polish Geological downgraded Poland’s onshore and offshore recoverable resources estimates from 27.1 to 12.2 billion MMbtu
- Most of these resources are found in the Baltic-Podlasie-Lublin Basin
- Most of shale gas is located relatively deep compared to other shale basins
Country Factsheet: UK

Summary: The moratorium that followed the small earthquakes near hydraulic fracturing sites was lifted at the end of 2012. More industry monitoring is expected, including the creation of the Office for Unconventional Gas and Oil within the Department of Energy and Climate Change. A significant increase in production with the next 3-5 years is unlikely due to a lack of economic incentives.

<table>
<thead>
<tr>
<th>Regulations</th>
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<tbody>
<tr>
<td>• Natural resources are owned by the state</td>
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<tr>
<td>• EU law takes precedence over the UK law</td>
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<tr>
<td>• There was a short moratorium on fracking in 2011, lifted at the end of 2012</td>
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<tr>
<td>• Stricter mandated impact controls post-moratorium</td>
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<tr>
<td>• Office for Unconventional Gas and Oil will be created within the DECC specifically to monitor and responsibly develop sahel gas</td>
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<thead>
<tr>
<th>Politics</th>
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<tbody>
<tr>
<td>• The ruling conservative party generally seems to be in favor of shale development</td>
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<tr>
<td>• Two counteracting arguments—energy security versus environmental health—compete for support in the Parliament</td>
<td></td>
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<tr>
<td>• Some politicians have expressed the view that the sprint toward shale development is unlikely, as it will be years before the commercial production becomes viable given lack of economic incentives</td>
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<thead>
<tr>
<th>Markets</th>
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<tbody>
<tr>
<td>• The country has increasingly been relying on natural gas imports, mainly from Norway</td>
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<td>• LNG imports are also important part of the UK gas supply mix</td>
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<tr>
<td>• Very recently (March 2013) the U.S. has been added as a soon-to-be exporter of gas to the UK</td>
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<tr>
<td>• UK hosts a natural gas hub, thus has easy access to spot market gas</td>
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<tr>
<td>• High well costs, 3 times higher than the U.S.</td>
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<tr>
<th>Infrastructure &amp; Technology</th>
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<tbody>
<tr>
<td>• Well developed, privately controlled natural gas sector</td>
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<tr>
<td>• Four pipelines link to Norway and Netherlands through incoming flows, Ireland through outgoing flows and reversible flows with Belgium</td>
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<td>• There are four LNG import terminals in place, with additional capacity planned</td>
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<th>Geology</th>
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<tbody>
<tr>
<td>• The EIA has estimated that the UK contains 20 billion MMBtu of technically recoverable shale gas, an amount that will not be a game changer for the country’s energy economics</td>
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<tr>
<td>• Recent test drilling by Cuadrilla in the portion of the Bowland Shale Group located north of Liverpool has indicated that there may be more shale gas in the UK than the EIA’s initial estimates</td>
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<tr>
<td>• Some formations may pose difficulties for fracking due to high clay content and relatively soft consistency</td>
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### The Business Landscape for Unconventional Natural Gas

<table>
<thead>
<tr>
<th>Argentina</th>
<th>Australia</th>
<th>Canada</th>
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<tr>
<td><strong>Regulations</strong></td>
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<tr>
<td>Highly regulated environment</td>
<td>Mineral rights held by state</td>
<td>Decisions made at provincial level</td>
<td>Moratorium in place</td>
<td>New legislation to facilitate shale gas exploration on the way</td>
<td>Resources owned by state</td>
</tr>
<tr>
<td>Foreign exchange restrictions</td>
<td>States make most important regulatory decisions</td>
<td>Regulatory framework under review</td>
<td>Complex regulations</td>
<td>EU regulations apply</td>
<td>Stricter regulatory oversight following small earthquakes</td>
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<tr>
<td>Price controls</td>
<td></td>
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<tr>
<td><strong>Politics</strong></td>
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<tr>
<td>Populist Kirchner’s administration</td>
<td>Upcoming election in November 2013</td>
<td>Government in support</td>
<td>Political and public opposition</td>
<td>Strong political and public support for shale gas</td>
<td>Ruling administration in support</td>
</tr>
<tr>
<td>Strive for energy independence</td>
<td>Some opposition to fracking</td>
<td>Quebec moratorium</td>
<td>Complete ban questioned by some politicians</td>
<td>No significant opposition</td>
<td>Debate over energy security versus environmental concern</td>
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<tr>
<td>No strong opposition</td>
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<td>Some environmentalist opposition</td>
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<tr>
<td><strong>Markets</strong></td>
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<tr>
<td>Uncertain costs</td>
<td>Gas production forecast to quadruple by 2035</td>
<td>Hub-based market</td>
<td>6th largest gas importer in 2010</td>
<td>Over 50% of gas demand met by Russian imports</td>
<td>Increasing reliance on imports, mostly from Norway</td>
</tr>
<tr>
<td>Ruling against Repsol</td>
<td>Growing LNG export market</td>
<td>Integrated with the U.S. market</td>
<td>Affected by the U.S. developments</td>
<td>Could potentially export to neighboring countries</td>
<td>Lack of economic incentives for large-scale fracking as the UK is an energy hub</td>
</tr>
<tr>
<td>Became net importer</td>
<td>Three separate domestic gas markets</td>
<td></td>
<td></td>
<td>Limited short-term export opportunities</td>
<td>High well costs, 3 higher than U.S.</td>
</tr>
<tr>
<td>Largest demand in South America</td>
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<tr>
<td><strong>Infrastructure &amp; Technology</strong></td>
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<tr>
<td>Existing infrastructure could be used for shale gas</td>
<td>Strong existing infrastructure</td>
<td>Well-developed infrastructure in the Central and Western parts</td>
<td>Well-developed infrastructure for conventional natural gas</td>
<td>Relatively low level of infrastructure development</td>
<td>Four pipelines and four LNG imports in place</td>
</tr>
<tr>
<td>Water supply challenges</td>
<td>Investments into LNG projects in place</td>
<td>Eastern part still in development</td>
<td></td>
<td>A lot of investments taking place, including LNG regasification plant</td>
<td>Further LNG capacity additions planned</td>
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<tr>
<td><strong>Geology</strong></td>
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<tr>
<td>Potentially third largest reserves in the world</td>
<td>Primarily coal bed methane</td>
<td>EIA estimates 388 billion MMbtu technically recoverable shale gas</td>
<td>EIA estimates 188 billion MMbtu technically recoverable shale gas</td>
<td>Downgraded estimates to 12.2 to 27.1 billion MMbtu technically recoverable shale gas</td>
<td>EIA estimates 20 billion MMbtu technically recoverable shale gas, not a game changer</td>
</tr>
<tr>
<td>Uncertainty over quantity and quality estimates</td>
<td>Carnarvon Basin (Western Aus.) is 99% of LNG exports</td>
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COUNTRY ANALYSIS

Regulations

Politics

Markets

Infrastructure and Technology

Geology
Argentina

Regulations

Summary: The regulatory environment in Argentina is complex, with different agencies spread across the national, provincial and municipal level. This leads to redundancies, overlapping jurisdiction, and confusing legal requirements. In fact, Argentina consistently ranks in the bottom of the World Bank’s “Ease of Doing Business” index. However, in regards to shale gas exploration, Argentina’s biggest hurdle is not regulatory in nature but rather political, with significant risk derived from the country’s unpredictable foreign capital constraints. After a long history of credit defaults, nationalization, and the consolidation of federal power, foreign parties are hesitant to invest in the country’s uncertain environment. The government’s recent nationalization of YPF stock from the Spanish oil and gas company Repsol has revived many of these fears and further complicated international financing of major energy projects.

To address domestic concerns about energy security and international concerns about regulatory capture, the Argentinian government is aggressively promoting shale gas development as a national policy. These long-term goals are defined in Presidential Decree 1277 or “Hydrocarbon Sovereignty,” which tasks the central government to increase gas production for self-sufficiency and eventual exportation. Under the stewardship of Deputy Economy Minister Axel Kicilloff, handpicked by President Kirchner to consolidate control over the industry and assess long-term planning goals, this process has already begun with loud actions, unsettling some parties while encouraging others.¹

Overall, the regulatory and political environment in Argentina remains uncertain despite immense reserve estimates, decent infrastructure and growing regional demand. Unresolved issues with YPF and Repsol, as well as the uncertain direction of the Minister Kicilloff’s strategy, have kept many foreign parties in a holding pattern before any decisions on investments can be made. In recent statements by Repsol, the company has threatened to sue any company that invests or works with YPF. This will impede efforts by YPF to seek funds for its 5 year $37 billion investment plan.

National Regulatory Structure – Federal, Provincial and Local Issues: In general, the federal government sets environmental standards and energy-related legislation; provinces then add further regulations as needed. The main players are the Ministerio de Energía (Ministry of Energy), Dirección Nacional de Economía de los Hidrocarburos (National Directorate of the Economy of Hydrocarbons) and Dirección Nacional de Exploración, Producción y Transporte de Hidrocarburos (National Directorate of Exploration, Production, Transport of Hydrocarbons). Energy-related activities are subject to environmental protection under the federal authority of the Secretary of the Environment, which along with numerous Provincial Environmental Authorities comprises the Environmental Federal Council. Of particular importance is the Energy Policy Planning Committee, which is under the leadership of Deputy

¹ (Pollock, 2012)
Minister Axel Kicilloff, who has been handpicked by President Kirchner to steer the future or Argentinian shale gas development.

In general, the province of Buenos Aires has the most stringent regulations, given that it is the population and industrial center of Argentina. Similarly, regions like Patagonia that depend on eco-tourism and natural reserves have been more resistant to hydraulic fracturing, with some municipalities banning shale gas exploration all together. However, the Neuquen Province, which contains the most promising fields, has not added stringent regulations.

Natural resource ownership is under the exclusive control of the provinces (according to a 1994 Constitutional Amendment). However, exploration and production of natural gas is subject to the 1967 hydrocarbons law (Law 17.319), which gives the Secretary of Energy jurisdiction over development. So despite relative autonomy on the provincial level, the strong central government has taken an active role in all energy-related issues, with relevant legislation and regulations coming from the national level. Currently, provinces control all onshore hydrocarbon activities while offshore activity is under federal jurisdiction. Since the state does not own the rights to the most promising onshore gas reserves, it is increasing its participation largely through Energia Argentina Sociedad Anonima, the state energy company, as well as through YPF, the recently nationalized energy company.

To date, most exploration has occurred in the Vaca Muerta formation in the Neuquen Basin in the Neuquen Province. This region is already active in shale oil production with numerous companies exploring natural gas as well. This includes YPF, ExxonMobil and Americas Petrogas, which just recently completed a successful hydraulic simulation well, facilitating the next steps to production.

Existing Laws and Permit Process: Natural gas development is largely regulated by Hydrocarbon Law 17319, which states that mineral rights belong to the Provinces, except for deposits located more than 12 miles from the coast. The National Authority for Gas Regulation is responsible for transportation, distribution and commercialization. Both public and private companies can conduct gas exploration but transportation and distribution activities are reserved for private companies.

Under the Hydrocarbon Law, private entities must request permits or concessions for surveys, exploration, and exploitation. Authorization can be granted by either the federal of provincial government, depending on the location of the deposit. The first step is to obtain a soil survey permit, which is granted for unexplored areas, but does not include the right to conduct economic activity. This along with the survey results must then be presented to the Federal Government. Next, an exploration permit must be obtained from the Provincial or Federal authorities to explore and build infrastructure. Lastly, an exploitation concession is obtained which allows the party to extract hydrocarbons, build and

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2 (Matze, 2013)  
3 (Monna, 1999)  
4 (Economist Intelligence Unit, 2013)  
5 (America Petrogas, 2013)  
6 (Baker & McKenzie, 2009)
operate facilities and connect to transportation. This requires that all rental and royalty fees be paid, as well as all committed investments.\textsuperscript{7}

Exploration permit-holders pay a rental fee and royalty once exploitation has begun. The rental fee is based on the size of the area and length of the permit. Exploitation concessions are based on any extension of that area. Both are paid annually at the beginning of each period. Royalties are calculated at 12 percent of the value of production (but can be negotiated to as low as 5 percent) and are required at the beginning of each month in cash. There have been instances when the State requested payment in kind (gas).\textsuperscript{8} However, this occurred during times of gas shortages and strong winters. With increasing reserves, this option may become less relevant.

**Environmental Regulations:**

**Environmental Impact Assessment:** An Environmental Impact Declaration must be issued before any major project can begin. Each Province has its own standards and rules for this assessment.

**Water Pollution:** Water pollution is regulated on the federal level under the Hazardous Waste Law, which sets permitting regulations and acceptable quality levels for watersheds. Each province has its own Water Code for water basins that do not cross provincial borders.

**Foreign Investment Restrictions:** Argentina has a long history of tension between foreign involvement and domestic interests, as well as private and public business activity. The Kirchner administration has taken bold steps to ensure government involvement in many aspects of economic activity, including a number of policies addressing foreign investment and capital restrictions. This trend continues as the administration adopts a more populist agenda responding to unemployment, inflation, high welfare standards and most importantly, a growing nationalism associated with energy independence.

One of the first actions as the newly re-elected head of state, President Kirchner announced that all energy companies are required to repatriate all their export profits with the country and keep them in pesos. Previously, companies were allowed to send up to 70 percent of their export profit abroad which were necessary to pay foreign debt and take advantage of currency arbitrage.\textsuperscript{9} This prompted Moody’s to quickly downgrade the country’s domestic energy companies.\textsuperscript{10} This was justified as a response to increasing capital flight as the peso depreciated against the dollar.

Additionally, capital controls were imposed in the form of foreign exchange restrictions. All banks and currency exchangers are now required to verify and confirm the origin of funds and submit customers’ identity and tax number.\textsuperscript{11} Although marketed as a step to curb black market exchanges, this has effectively slowed currency exchanges to a crawl. This is particularly problematic for gas exploration

\textsuperscript{7} (Baker & McKenzie, 2009)  
\textsuperscript{8} (Baker & McKenzie, 2009)  
\textsuperscript{9} (Orihuela, Russo, & Price, 2011)  
\textsuperscript{10} (Moody’s, 2012)  
\textsuperscript{11} (BBC News, 2011)
since the majority of the material and equipment must be imported, which forces companies to navigate the difficult currency exchange regulations.

**Other Relevant Legislation:** In February 2012, the Argentinian Congress passed legislation limiting foreign ownership of land.\(^{12}\)

In 2012, the central bank increased minimum capital requirements from 30 percent to 75 percent.\(^{13}\)

As of February 2012, companies are required to file sworn statements for import transactions which are then subject to approval. This has prompted numerous OECD countries to file complaints with the WTO.\(^{14}\)

Price controls remain on numerous products; especially those within the Consumer Price Index. Energy prices, specifically natural gas, have only recently been raised but still not free floating. This remains a popular policy inherited from the administration of Nestor Kirchner.\(^{15}\)

The Supply Law, another legal measure passed at a time of natural gas shortages, allows the government to penalize or even take over companies if it deems that the companies have failed to provide an adequate product supply to the national market. This law has been used on energy companies in the past (please see legal section below).

**Legal Issues and Lawsuits:** In May 2012, Argentina nationalized the remaining 51 percent of YPF controlled by the Spanish company Repsol. The government claimed that Repsol had acted against national interests in failing to invest sufficiently in shale gas. This has created an international dispute with Repsol demanding $10.5 billion in damages and ongoing suits by U.S. investors claiming fraud for hiding risks of nationalization.\(^{16}\) More importantly, this has scared foreign investors from entering the market. Companies already active in the country such as Exxon, Apache, Chevron and Shell are also limiting operations while awaiting a resolution.

In February of 2011, Argentina used the Supply Law to implement price freezes on oil and mandated oil companies maintain supply levels. This was in response to a 1.6 percent increase in price by Royal Dutch Shell.\(^{17}\) Interestingly, the Argentinian government has had a very open conflict with Royal Dutch Shell since the Nestor Kirchner administration. In 2007, Shell’s refineries were shut down on environmental grounds and banned from exporting petroleum products.\(^{18}\)

\(^{12}\) (Economist Intelligence Unit, 2013)
\(^{13}\) (Economist Intelligence Unit, 2013)
\(^{14}\) (Economist Intelligence Unit, 2013)
\(^{15}\) (Economist Intelligence Unit, 2013)
\(^{16}\) (Reuters, 2013)
\(^{17}\) (Economist Intelligence Unit, 2013)
\(^{18}\) (The Economist, 2010)
Policy Incentives: In 2008, the Argentinian government created the “Gas Plus” program that incentivizes private companies to explore unconventional gas fields. Gas produced under the Gas Plus program is not subject to the same gas tariffs as regulated in 2007 Natural Gas Agreement. The government has allocated roughly $1.5 million to invest in private companies.19

From 2003, there have been numerous price controls to limit CPI increases, including energy prices which have been frozen since 2002. This discouraged investment and created shortages in heating gas and electricity. However, in November of 2012 President Kirchner announced that the price ceiling for consumer natural gas prices would rise from $5 to $7.50. This should encourage producers that were once adverse to risky investments because of historically low prices.20

Politics

Political System: Argentina’s current government is headed by President Cristina Fernandez de Kirchner, part of the center-left Frente para la Victoria party (FV). She succeeded her husband Nestor Kirchner in 2007 and has largely continued his social populist agenda. Argentina’s Congress is comprised of a lower house (Chamber of Deputies) and an upper house (Senate). The FV controls nearly a majority of both houses and has strong coalitions for a majority. Legislative elections will be held in October of 2013, while the Presidential election is not until 2015.

Key Players: President Kirchner and the FV party: Although in power until 2015, her tendency to default to populist policy creates risks in the shale gas industry. She has stated more than once the importance of shale gas for Argentina’s future but her actions to ostracize foreign investors may undermine the country’s potential.

Deputy Economy Minister: Axel Kicillof (a former professor of Marxist economics) has launched a campaign targeting private-sector involvement in the oil and gas industry. He is charged with implementing the Presidential Decree of “hydrocarbon sovereignty”.21

Miguel Galuccio: CEO of YPF and the main actor in shale gas development in the Neuquen. He is courting foreign investment but still answers to Kicillof.

Political Stability and Upcoming Elections: It should be expected that political tensions will increase closer to the election. The opposition party is gathering themselves to increase seats in the house, but at barely 15 percent of the chamber, they are faced with an uphill battle. Additionally, there will probably be a rise in strikes, union tensions, and demonstrations. This may result in more populist policies by the Kirchner administration to quell any tensions with influential groups.

19 (Secretaria de Energia, 2008)
20 (La Nacion, 2012)
21 (Raszewski & Orihuela, 2012)
Although opposition parties are starting to build some stamina for the house election in 2013, no political party has expressed loud opposition to hydraulic fracturing or to the country’s “Hydrocarbon Sovereignty” strategy.

**Rule of Law / Corruption:** Argentina has a long history of tensions between public and private enterprises as well as foreign and domestic interests. The government is known for ad hoc intervention and enforcement of laws, and appears to be partial to using environmental concerns or national security as a pretext for strong unilateral actions.

Most relevant to gas exploration is the policy of “Hydrocarbon Sovereignty.” There is a significant risk that under the pretext of nationalism, the government will use this decree to further intervene in private enterprises and the centralization of LNG trade, and to limit market mechanisms such as open-market prices.

**National Movements:** There have been no significant national movements in opposition to hydraulic fracturing, although some local municipalities and the province of Rio Negro have banned it. However, there is a possibility that a more centralized anti-fracking movement, with influences from global and European groups, may develop. Water concerns in the arid Neuquén region will likely increase as extractive activities increase. Contamination and water usage is already an issue among the indigenous Mapuche, who have organized protests and collaborated with environmental groups. One such environmental group is the *Observatorio Petroleo sur*, an anti-fossil fuel group that has brought international attention to its mission. Other groups are replicating and connecting with France’s *collectif* movement, creating a network of anti-fracking groups.

On the other side of the spectrum is the nationalist “Hydrocarbon Sovereignty” movement which, under Minister Kicilloff, is commissioned to “increase and maximize investments employed to explore, exploit, refine, transport, and sell hydrocarbons with the goal of guaranteeing self-sufficiency and sustainability.” The Energy Policy Planning Committee has already intervened in YPF’s nationalization and centralized control of energy policy.

**Markets**

Argentina is the biggest gas consumer in South America. While it has historically been a net exporter of natural gas, it has recently become a net importer due to declining domestic production. Argentina imports gas primarily from Bolivia’s NOC Yacimientos Petrolíferos Fiscales Bolivianos (YPFB), with whom the Argentinian Energy SOE Energía Argentina Sociedad Anónima (ENARSA) has a long-term contract that extends to 2026.

Argentina started importing LNG in 2008 after the completion of Bahia Blanca Gas Port re-gasification terminal. Most of the imports to the facility come from Trinidad & Tobago, an exporter that has been

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22 (La Politica, 2013)
23 (Control Risks, 2012)
24 (El Decreto N 1277)
known for its high degree of flexible sales. Argentina’s geographical position is also beneficial to its demand, in that gas demand shrinks in the summer in the Atlantic Basin at the same time that Argentina needs it the most, since seasons are inverted between the Northern and Southern hemisphere.

**Price Environment:** As mentioned in the section on Policy Incentives, the government tightly regulates the price environment in Argentina. Since the 2002 economic crisis, the price was kept at an average of $2.30/MMBtu for gas supplies from existing wells and $4-$5/MMBtu for new supplies. In the last quarter of 2012, the price of gas averaged $2.40/MMBtu. But on November 2012, the Argentinian government announced that all new production (supplies beyond current production levels) will now be priced $7.50/MMBtu regardless of the producer; there will be no special regime for YPF. The results of the policy remain to be seen.

However, the policy change greatly benefits gas transporters Transportadora de Gas del Sur SA and Transportadora de Gas del Norte SA: the higher price for gas will be offered only to the producers transporting their gas through those companies’ pipelines.

**Extraction costs:** Argentina is still in the early phases of shale development, with the majority of the drilling activity happening in Vaca Muerte, Neuquén Basin. Gas transportation and field services infrastructure are already in place, making Argentina attractive for further development. However, the aridity of the central Neuquén Basin is complicated; water needs to be brought in trucks, adding a considerable expense. Estimates by the regional oil company Gas y Petróleo del Neuquen indicate the need for approximately 850 lorry trips at a cost of US$200,000.

Argentina’s foreign currency exchange regulations create additional costs. The development of unconventional gas requires specific rigs for horizontal drilling (and sometimes for pad drilling), sand, and a cocktail of water and chemicals to fracture the shale. The majority of these sources and equipment need to be imported, forcing companies to deal with the complications of Argentina’s foreign exchange restrictions. Even the sand in Argentina is of the wrong consistency and needs to be imported from Brazil.

The breakdown of hydraulic fracturing and drilling costs is not readily available. YPF, who is the main operator of Vaca Muerte together with EOG Resources, only provides an aggregated expense for exploration of 464 million pesos (or $91.7 million USD) for their 3rd quarter of 2012, a 20.8 percent increase from the same quarter last year (384 million pesos or $76 million USD) when the shale drilling

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25 (YPF S.A., 2012)
26 (Platts, 2012)
27 (Gonzalez, 2013)
28 (Hunt, Argentina’s Shale Gas Dilemma, 2012)
29 (Economist Intelligence Unit, 2012)
30 (Economist Intelligence Unit, 2012)
had not yet commenced.\footnote{YPF S.A., 2012, p. 13} Credit Suisse uses an assumption of $7 million USD per well for vertical drilling and $13 million USD for horizontal drilling when analyzing the prospects of Vaca Muerte Shale.\footnote{Credit Suisse, 2012}

**Export opportunities:** Argentina has historically been an exporter of gas, but its importance as an exporter has fallen dramatically in recent years and it now exports only 15 million MMBtu, in contrast its peak export level of 274 million MMBtu in 2004. Argentina currently supplies Chile, and to a lesser extent Uruguay, with natural gas through pipelines. The EIA also notes that its reliability as an exporter has been undermined by occasional supply disruptions during times of domestic peak demand.\footnote{US Energy Information Administration, 2012}

**Updates: Recent Deals:** Chevron signed a $1 billion exploration pilot program with YPF for 100 wells in Vaca Muerta. The concession will last for 12 months but can be expanded for 2,000 wells.

Bridas, an Argentinian company with a 50 percent ownership from CNOOC, will invest $1.5 billion for a two-year, 130 well project in Vaca Muerta.

PAE (partially owned by the CEO of YPF Carlos Bulgheroni and BP), will invest $3.4 billion over four years for exploration and production. The government has given explicit support to this project and recently announced that PAE will be allowed to raise the price of gas at the wellhead to $7.5/MMBtu.\footnote{Ceifedas Group, 2013}

**Infrastructure & Technology**

Argentina has a total of 18,269 miles of natural gas pipelines.\footnote{Ceifedas Group, 2013} There is significant excess pipeline capacity following a decline in conventional gas production. Given that the potential shale gas extraction sites correspond with traditional gas locations, most of the required pipeline infrastructure is already in place.\footnote{US Energy Information Administration, 2012}

As mentioned before, the majority of Argentina’s shale gas exploration efforts are concentrated in the Neuquen Basin. At the moment, approximately 75 wells have been drilled and YPF is hoping to raise funds for more than 100 additional shale gas wells.\footnote{Stratfor Global Intelligence, 2012} Recent deals with PAE, Bridas and Chevron will most likely increase the number of wells to 2,000 over the course of two years.\footnote{Webber, 2012} However, several infrastructure and logistical challenges remain, such as water and road infrastructure.

Because of the lack of water in the central Neuquen Basin, water must be brought in via trucks at extra cost (see Markets section). In addition to the cost of the water, this also creates an urgent need for new
roads and an army of trucks and drivers. The fact that Argentina is currently reliant on imported rigs and fracturing materials further increases infrastructure risk and uncertainty.

On the other hand, there are several rivers close to the Neuquen Basin that could reduce the travel distance required to provide fresh water for hydraulic fracturing. The Neuquen Basin is also similar to several basins in the U.S., which enables existing extraction technology to be adapted to Argentina’s needs.

Geology

Available Resources: According to EIA estimates, the quantity of technically recoverable shale gas resources in Argentina is 774 billion MMBtu, which is the third largest in the world. The bulk of these resources are located in the Neuquen Basin as part of the Vaca Muerta and the Loma de Lata shale formations. The second largest shale gas deposits are located in the Golfo San Jorge Basin in the southeastern part of the country. However, these cannot be corroborated as few wells have actually been drilled.

Other Physical Characteristics: Based on preliminary results from test drilling, the rock is potentially twice as rich in organic matter as the best portions of the Eagle Ford shale formation in Texas. At this point, however, there is still a high degree of uncertainty surrounding the geologic qualities of the shale gas resource in Argentina due to the relative lack of test wells that have been drilled. There are currently many new projects under review or development that seek to explore Argentina’s unconventional gas reserves, so more information about the quality of the shale plays will likely become available within the coming years.

Natural Obstacles: The arid climate of the regions where Argentina’s shale gas resources are located may create water shortages.
Australia

Regulations

National Regulatory Structure: Australia is unique in that mineral property rights are neither conferred on the federal government nor the individual landowner. Instead, they are enshrined on the state and largely governed by state laws.

The Australian government does not own any shares in its domestic oil and gas industry, but it still supports privately held Australian companies, the largest of which are Woodside Petroleum and Santos. The sector is regulated by the Department of Resources, Energy and Tourism (RET) and the Ministerial Council of Energy (MCE), which attempts to reconcile the overlapping fragments of regulatory responsibility by housing energy ministers from the Australian government, states, and territories under the same institution.\(^{48}\)

But while these overarching bodies help coordinate macro policies among the different regions, some of the most important regulatory decisions are still made at the local level. For example, even residential gas prices are regulated separately: in South Australia, the retail price regulator is the Essential Services Commission of South Australia, but in New South Wales, prices are regulated by the Independent Pricing and Regulatory Tribunal.\(^{49}\)

Legal Jurisdiction – Federal versus Local Laws: Australia is organized as a federal Commonwealth housing six individual state governments: New South Wales (NSW), Queensland (Qld), South Australia (SA), Tasmania (Tas.), Victoria (Vic.) and Western Australia (WA). Each state has its own governor (or “premier”), constitution, legislature, executive, and judiciary. Outside state boundaries, Australia is also divided into 10 territories, of which the largest two, the Australian Capital Authority (ACT) and the Northern Territory (NT), have locally-elected parliaments.

Legal jurisdiction is divided as follows: the Commonwealth is responsible for income and company taxation; interstate and foreign trade; foreign investment; and the ratification and implementation of international treaties. The states, on the other hand, have primary authority over energy production; transport; land-use; mineral-rights; and any environmental assessments. Importantly, as mentioned previously, resources are considered the property of the state in which they are found, and not the federal government. Because some states are more resource-rich than others, regulations are far from uniform and political conflicts persist. Having said that, in the event that a state regulation or verdict conflicts with the national code, the Commonwealth takes legal precedence.

Whether a resource falls within federal or state jurisdiction has important implications for the regulation and taxation of the project. Under the 1979 Offshore Constitutional Settlement (OCS), for example,

\(^{48}\) (Economist Intelligence Unit, 2013)
\(^{49}\) (da Silva, 2012)
projects located outside the three nautical mile sea coastal waters zone are wholly owned by the Commonwealth, and unlike onshore projects, pay no royalty to the state.

**Laws and Permits:** The *Clean Energy Future Plan* legislative framework, which constitutes 18 environmentally-conscious bills, including the landmark *Clean Energy Bill 2011*, was passed on October 2011, marking a significant move toward green policies and away from environmentally harmful coal seam gas (CSG). Most notably, the law institutes a Carbon Price Mechanism (CPM), making Australia the second largest economy behind the European Union to implement legislation in support of a carbon tax and an Emissions Trading Scheme (ETS). The CPM penalizes high-emitting stationary or industrial sources producing in excess of 25,000 tons of CO\(_2\) per year but excludes transportation fuels. It also shifts the legal liability for pollution to the facility operator, as opposed to the “controlling entity” or owner of the plant. Liable entities are required to acquire and surrender permits, tradable as personal property and regulated as financial products, even during the initial “tax” phase of the two-part plan.

This hybrid mechanism combines a fixed carbon tax in the first phase, effective July 2012, with a cap-and-trade component that will follow in the second phase, beginning July 2015. The tax, currently fixed at A$23 (US $24) per ton of carbon emitted, is set to increase year-on-year, jumping to A$24.15 per ton in July 2013 and then again to A$25.40 per ton in July 2014. As of July 2015, the pricing scheme will change from fixed to flexible and the carbon penalty will adjust to market conditions, within certain constraints.\(^{50}\) The government plans to set the first five years (2015-2020) of caps in 2014, via regulation passed by parliament and following the recommendations of the Climate Change Authority, a newly formed independent body. In addition, the ETS will set a carbon price ceiling at A$20 above the expected 2015-2016 international rate, and a price floor starting at A$15 and rising at 4 percent in real terms each year.\(^{51}\)

The Australian government expects the carbon price to increase average household energy bills between 8 to 10 percent in the first year, yet the tax is modest and, by all accounts, inconsequential. Its terms apply to just 500 companies in Australia, and the regulation is only projected to generate a 5 percent reduction in emissions by 2020, over 2000 levels. More than anything else, the impact of the bill is symbolic. It represents a victory by the Green Party and a loss by Gillard, who succumbed to parliamentary pressure after having repeatedly promised not to impose a carbon tax.\(^{52}\)

Another even more divisive recent regulatory action against the extractive industry is the Minerals Resource Rent Tax (MRRT), designed to contain corporate profits by redistributing high resource rents to the federal government. The measure imposes an additional 22.5 percent levy on profits from coal and iron-ore mining, which exceed the threshold rate of return (set at the long-term government bond interest rate plus 7 percent). The MRRT, like the carbon tax, took effect in July 2012 and directly

\(^{50}\) (Energy Australia, 2012)  
\(^{51}\) (Higgins & Venuti, 2011)  
\(^{52}\) (Economist Intelligence Unit, 2013)
impacts the upstream exploration and production of unconventional gas as it explicitly applies to CSG producers.\textsuperscript{53}

Because of its negative and “highly discriminatory” impact on resource-rich states in Western Australia and Queensland, the MRRT has caused a rift between the Liberal Party administration in those states and the federal government. In fact, one of Australia’s largest mining companies Fortescue has already brought a legal case to the country’s High Court, alleging that the MRRT is unconstitutional. The case will be heard later this year.\textsuperscript{54}

\textbf{Politics}

\textbf{Prime Minister}: Julia Gillard, Labor Party

\textbf{Main Political Parties}: Labor Party; Liberal Party and National Party (in long-term coalition)

\textbf{Elections}: The next federal election, for the House of Representatives and one-half of the Senate (the upper house), will be held in November 2013, unless there is an early poll, which is unlikely. An election in the next few months would not suit Gillard, Labor, the coalition, or several independents, all of whom are currently unpopular. Labor trails the opposition Liberal-National coalition in the polls, given general dissatisfaction with the current administration. The carbon tax has been and continues to be a controversial political issue, and Gillard has been criticized for flip-flopping. The opposition coalition, led by Tony Abbott, initially benefited in opinion polls by vigorously opposing the tax, but may now be harmed by its original stance, as public opinion on the tax has softened following evidence that it does not significantly increase utility bills.\textsuperscript{55}

\textbf{National Movements}: An ongoing environmental protest movement against CSG and hydraulic fracturing, centered in NSW and Queensland, may threaten the development of Australia’s LNG industry. Farmers and activists are reacting against explicit government support of CSG extraction, the onslaught of new CSG wells and LNG projects, and red flags such as UNESCO’s warning in June that the current management of the Great Barrier Reef area could threaten its World Heritage status.\textsuperscript{56} The nonprofit Climate Emergency Action Network (CLEAN) staged a mass protest in December, with the mantra “no to unconventional gas, yes to renewables,” in front of Santos company headquarters (Santos leads the Gladstone LNG project, for which 3,200 CSG wells have already been drilled).\textsuperscript{57} So long as hydraulic fracturing is legal, these movements have a limited impact. In fact, Santos just took on Australia’s first commercial production of shale gas, which is thought to be even more risky than CSG, since the gas is trapped deeper underground.\textsuperscript{58}

\textsuperscript{53} (Heggart, Rider, Spence, & King, 2012)
\textsuperscript{54} (Economist Intelligence Unit, 2013)
\textsuperscript{55} (Economist Intelligence Unit, 2013)
\textsuperscript{56} (da Silva, 2012)
\textsuperscript{57} (Koh, 2013)
\textsuperscript{58} (Bergin, 2012)
Markets

Overview: The Australian government projects that national gas production will quadruple to 7.6 billion MMBtu by 2034-2035, driven primarily by the growth of the LNG export market, and secondarily, by increasing domestic demand. The expectation is that, in the short to medium-term, accelerated demand growth, project start-up risks, and transitional pressures particularly in the eastern gas markets, will manifest themselves in tighter supply and higher prices. But once the market adjusts, in the long-term, the government is confident that prices will fall. Although rising gas prices are a concern, the government explicitly states in its 2012 White Paper that it wants to avoid imposing “discretionary or constrictive regulation” to minimize price pressures, instead ascribing to free market mechanisms for the adjustment. But the problem with a free market strategy is that trading in the Australian gas markets is largely through confidential long-term bilateral contracts, which means that transparency is limited. Spot market trading has increased in volume in recent years, but it is still a comparatively small proportion of the overall market. Thus, the economic viability of upcoming gas projects in Australia hinges on whether or not the market turns to free trade, and the rate at which it transforms.\(^59\)

Contracts and LNG: Gas to the domestic market is sold through long-term contracts to utility companies. Several of these long-term contracts are up for renegotiation.\(^60\) Since Australian gas producers now can sell their gas on the Asia-Pacific market with a premium price to the Australian domestic market, it is expected that domestic gas prices will rise starting in 2013 as a result of this.\(^61\) The renegotiation process has revealed that gas suppliers are no longer willing to offer long-term supply contracts as they believe gas prices will significantly rise in the future. LNG export contracts are primarily long-term contracts with Asian buyers, with some degree of spot cargoes.

Price environment: As mentioned before, the Australian market is shifting from confidential, long-term contracts to shorter-term contracts and spot market transactions. According to the Australian Energy Regulator, a wholesale spot market has existed in Victoria since 1999; the industry and the government also recently established the National Gas Market Bulletin Board and a short term trading market in major hubs in eastern Australia. Further, in 2012 the standing Council on Energy and Resources commenced consultations to try to design a natural gas trading market in Wallumbilla in Queensland.\(^62\)

These long-term contracts have managed to keep the Australian gas prices relatively low by international standards, at the range of A$3–4 per gigajoule, or $3.26-4.35 USD/MMBtu, through 2012. However, the renegotiated contracts saw prices increase to $5.44 USD/MMBtu, while spot market prices increased significantly in the winter of 2012 to over $6.53 USD/MMBtu, and even over $7.61 USD/MMBtu on some days.\(^63\)

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\(^{59}\) (RET, 2012)
\(^{60}\) (da Silva, 2012)
\(^{61}\) (Government of Queensland, 2011)
\(^{62}\) (Australian Energy Regulator, 2012, p. 93)
\(^{63}\) (Australian Energy Regulator, 2012, p. 94)
This increase was associated with an expected price spike during the winter, yet prices above $4.35 USD/MMBtu were very rare until winter 2012. According to the Australian Energy Regulator, “A step change in prices occurred at this time, with monthly averages in all cities rising to $5.44-8.70 USD/MMBtu. Compared with July 2011, average prices in July 2012 were around 85 percent higher in Sydney, 69 percent higher in Adelaide and 62 percent higher in Victoria.”

Prices are expected to continue to rise for a variety of reasons, especially since existing low-priced contracts are expiring (contract replacement activity is expected to peak in Queensland in 2015–2016 and in New South Wales and Victoria in 2018), in a market exposed to global prices and evolving LNG projects. Different projections place emphasis, and project price pressure, in different regions of Australia, with ACIL Tasman forecasting the highest prices in southern Queensland ($10.22 USD/MMBtu by that time) and Goldman Sachs expecting New South Wales to link closely with Queensland.

The following tables offer extensive details on the historical, dominant and forecasted prices of Australia. All figures are in USD/MMBtu unless stated otherwise. The conversion rate from A$/GJ to USD/MMBtu is 1.0876.

### Average Daily Spot Gas Prices

<table>
<thead>
<tr>
<th>BRISBANE</th>
<th>SYDNEY</th>
<th>MELBOURNE</th>
<th>ADELAIDE</th>
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<tbody>
<tr>
<td>2011-12</td>
<td>3.82</td>
<td>3.75</td>
<td>3.97</td>
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<td>2010-11</td>
<td>2.58</td>
<td>2.98</td>
<td>3.45</td>
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Notes:
Volume weighted ex ante prices. Sydney, Adelaide and Brisbane data are short term trading market prices in each hub. Melbourne prices are estimates for the metropolitan area, based on Victorian wholesale spot gas prices plus APA Group’s current transmission withdrawal tariff ($0.4 per MMBtu) for the two Melbourne metropolitan zones.

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64 (Australian Energy Regulator, 2012, p. 96)
65 (Australian Energy Regulator, 2012, p. 95)
66 (Australian Energy Regulator, 2012, p. 95)
67 (Australian Energy Regulator, 2012, p. 96)
Spot Gas Prices – Winter 2011 and 2012

Indicative composition of residential electricity and gas bills, 2012

<table>
<thead>
<tr>
<th>JURISDICTION</th>
<th>WHOLESALE ENERGY COSTS</th>
<th>NETWORK COSTS</th>
<th>CARBON COSTS</th>
<th>GREEN COSTS</th>
<th>RETAIL COSTS</th>
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</thead>
<tbody>
<tr>
<td><strong>ELECTRICITY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Queensland</td>
<td>34%</td>
<td>44%</td>
<td>10%</td>
<td>4%</td>
<td>8%</td>
</tr>
<tr>
<td>New South Wales</td>
<td>26%</td>
<td>52%</td>
<td>8%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>South Australia</td>
<td>36%</td>
<td>44%</td>
<td>4%</td>
<td>4%</td>
<td>12%</td>
</tr>
<tr>
<td>Tasmania</td>
<td>35%</td>
<td>48%</td>
<td>5%</td>
<td>4%</td>
<td>8%</td>
</tr>
<tr>
<td>ACT</td>
<td>29%</td>
<td>43%</td>
<td>11%</td>
<td>7%</td>
<td>10%</td>
</tr>
<tr>
<td><strong>GAS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New South Wales</td>
<td>32%</td>
<td>45%</td>
<td>5%</td>
<td></td>
<td>18%</td>
</tr>
<tr>
<td>South Australia</td>
<td>15%</td>
<td>60%</td>
<td>5%</td>
<td></td>
<td>20%</td>
</tr>
</tbody>
</table>

Note: Solar PV feed-in tariff costs are included within the network component.

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(Australian Energy Regulator, 2012, p. 97)
(Australian Energy Regulator, 2012, p. 127)
### Projection of natural gas prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Prices (2011-12 $/MMBtu)</th>
<th>Conventional View</th>
<th>Optimistic View</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-08</td>
<td>$4.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011-12</td>
<td>$5.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2019-20</td>
<td>$9.79</td>
<td>$7.61</td>
<td></td>
</tr>
<tr>
<td>2029-30</td>
<td>$14.14</td>
<td>$10.88</td>
<td></td>
</tr>
<tr>
<td>2039-40</td>
<td>$16.31</td>
<td>$11.96</td>
<td></td>
</tr>
</tbody>
</table>

**Extraction Costs:** According to Wood Mackenzie, Australian shale gas comes at a higher cost than CSG. Shale gas needs a clearing price of $6.53 to $9.79 USD/MMBtu to be economic, or else it needs to be combined with the production of condensates to be competitive.\(^{71}\)

Core Energy Group also attempted to estimate reserves and costs for Eastern Australia. They found 96 billion MMBtu of coal seam gas to be recoverable at $3.39 USD/MMBtu at a zero percent return, which is the best approximation for the costs.\(^{72}\) The 35 billion MMBtu of shale of the Cooper basin were evaluated at $3.32 USD/MMBtu at zero percent return, and $9.03 USD/MMBtu at a 10 percent return.\(^{73}\)

The pricing-to-the-market costs may or may not be included in the above calculation. In any case, there are surely costs associated with pipeline tariffs. For a new pipeline the National Institute of Economic and Industry Research estimated tariffs of $0.0020/MMBtu/km, while the research estimated the tariff of the Eastern Gas Pipeline to be $0.0015/MMBtu/km.\(^{74}\)

**Export opportunities:** Australia is the fourth largest LNG exporter in the world but will overtake Malaysia and Indonesia (and may even overtake Qatar as the largest exporter in the world) before the end of the decade. Australia’s three operating liquefaction plants have a nameplate capacity of 24.1 metric tons per annum (mtpa), but with the addition of 8 new liquefaction plants to be delivered during the coming 3-4 years Australia’ nameplate capacity will increase by 57.1 mtpa.

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\(^{70}\) (National Institute of Economic and Industry Research, 2012)  
\(^{71}\) (Wood Mackenzie, 2012)  
\(^{72}\) (National Institute of Economic and Industry Research, 2012, p. 38)  
\(^{73}\) (Core Energy Group, 2012, p. 21)  
\(^{74}\) (National Institute of Economic and Industry Research, 2012, p. 37)
### Australian LNG Plants Under Construction

<table>
<thead>
<tr>
<th>Name</th>
<th>Delivery</th>
<th>Cost ($ bn)</th>
<th>Capacity (mtpa)</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gladstone LNG Plant</td>
<td>2014</td>
<td>3.5</td>
<td></td>
<td>Australia</td>
</tr>
<tr>
<td>Queensland Curtis LNG Plant</td>
<td>2014</td>
<td>20.4</td>
<td>8.4</td>
<td>Australia</td>
</tr>
<tr>
<td>Gorgon LNG Plant</td>
<td>2015 Q1</td>
<td>52</td>
<td>15.6</td>
<td>Australia</td>
</tr>
<tr>
<td>Australia Pacific LNG Plant</td>
<td>2015</td>
<td>9.0</td>
<td></td>
<td>Australia</td>
</tr>
<tr>
<td>Prelude Floating LNG Plant</td>
<td>2016</td>
<td>3.6</td>
<td></td>
<td>Australia</td>
</tr>
<tr>
<td>Wheatstone LNG Plant</td>
<td>2016</td>
<td>29</td>
<td>8.6</td>
<td>Australia</td>
</tr>
<tr>
<td>Ichthys LNG Plant</td>
<td>post-2016</td>
<td>12</td>
<td>8.4</td>
<td>Australia</td>
</tr>
</tbody>
</table>

As the Australian government highlighted in its recent Energy White Paper:

“By the end of this decade, Australia may rival Qatar as the world’s largest exporter of LNG. Around 70 percent of the world’s LNG capacity currently under construction is in Australia, and the benefits of those projects will continue for decades.”

### Infrastructure & Technology

There are three separate gas markets in Australia: the Eastern States market, the Western Australian market, and the Northern Territory gas market. Australia has a long track-record of gas production, so it already has developed infrastructure for gas production in eastern portions of the country. On the other hand, the size of the country and harsh weather conditions present challenges to gas developers. Several other potential problems include bottlenecks in the service sector, skilled labor shortages, remote locations, and limited infrastructure in undeveloped areas. There are also some location-specific issues such as water availability or distance to the markets.

Given the large distances between Australia and its trade partners, all gas exports are in the form of LNG. At the moment, two LNG export facilities are in place: the North West Shelf Venture (five offshore LNG trains with a total capacity of 761 million MMBtu per year) and the Darwin LNG (production train capacity of 140 million MMBtu per year). The potential for LNG exports is high and this is reflected in the preponderance of new LNG projects: there are currently a total of eight LNG projects under construction (of which four are tied to conventional gas and four are tied to coal seam gas). Furthermore, there are ten additional LNG projects under consideration. Looking further ahead, innovative LNG projects can also be expected; for example, a floating LNG terminal is currently being planned off of Australia’s northwestern coast.

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75 Australian Government, Energy White Paper 2012 - Australia's energy transformation, p.134
76 (da Silva, 2012)
77 (Wood Mackenzie, 2012)
78 (US Energy Information Administration, 2011)
79 (White, 2011)
Geology

Available Resources: According to EIA estimates, the quantity of technically recoverable shale gas resources in Australia is 396 billion MMBtu. In addition to this shale gas resource, Australia also has 110 billion MMBtu of proven natural gas reserves. Ninety six percent of Australia’s conventional gas comes from the Carnarvon Basin off the western shore of Australia, the Cooper/Eromanga Basin in central Australia, and the Gippsland region in southeastern Australia. A significant source of Australia’s natural gas is coal bed methane from Queensland’s Bowen and Surat Basins and New South Wales. In 2010, this accounted for 13 percent of Australia’s gas production.

Other Physical Properties: Because a large portion of Australia’s unconventional gas is coal seam gas, the distance required to drill tends to be less than what would be required for shale gas deposits; typically this distance is between 200 and 1,000 meters for coal seam gas. Additionally, the extent of hydraulic fracturing required for coal seam gas extraction is usually less than what is required for shale gas extraction. Coal seam gas is essentially dry gas, and therefore does not contain a high concentration of hydrocarbons other than methane.

Natural Obstacles: Many of the large shale gas plays in Australia are located in remote areas of the country, or in some cases, in deep water offshore. Coal seam gas fields currently under development are located in Queensland and New South Wales near several of Australia’s population centers, which create a potential for friction between extraction companies and the local population.

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80 (US Energy Information Administration, 2011)
81 (US Energy Information Administration, 2011)
82 (US Energy Information Administration, 2011)
83 (US Energy Information Administration, 2011)
84 (US Energy Information Administration, 2011)
85 (Australia Pacific LNG, 2013)
86 (Australia Pacific LNG, 2013)
87 (Australia Pacific LNG, 2013)
88 (White, 2011)
89 (White, 2011)
Canada

Regulations

Summary: Unlike its southern neighbor, commercial shale gas production has not yet gotten under way in Canada. However, many of the country’s provinces show promising resources and have begun development and exploration, including Alberta, British Columbia, Nova Scotia and New Brunswick.\(^{90}\)

Legal Jurisdiction – Federal vs. Provincial: Canada is divided up into provinces and territories and laws and jurisdictions are divvied up between the federal government and the provinces. According to Section 92 of the Constitution Act, public land is managed and sold under the jurisdiction of the province. In 1982 the Constitution was amended granting the provinces the right to enact laws for the development, conservation, management, taxation, and export (within Canada) of non-renewable natural resources.\(^{91}\) The jurisdiction over environmental policy is shared between the federal and provincial level. The Canadian Environmental Protection Act of 1999 gives jurisdiction to the federal government to regulate harmful substances and the database of these substances is kept by Environment Canada, a department within the Canadian government that strives to preserve Canada’s natural environment and renewable resources, as well as provide weather information and coordinate environmental policies and programs.\(^{92}\) Any parties found to be emitting these harmful substances are assessed fines and face possible imprisonment. Currently, Environment Canada is working to assess the risks on surface and water resources, greenhouse gas emissions, and air pollution. They are also working in collaboration with Natural Resources Canada to review the regulatory framework for shale gas, especially the treatment of wastewater.\(^{93}\)

The federal government also presides over international air quality and climate negotiations.\(^{94}\) On the provincial level, they are responsible for the regulation of air, groundwater, waste disposal, and the use of pesticides.

The Fisheries Act gives the federal government jurisdiction over fish and fish habitat and prohibits altering, disrupting, or destroying fish or their habitat. Specifically, it is unlawful to kill fish for any other reason than fishing and those found to be depositing “deleterious substances” will be in violation.\(^{95}\) This Act could potentially have great effects on industries looking to extract natural gas using unconventional methods, since such methods often threaten surface water habitats.

\(^{90}\) (Canadian Association of Petroleum Producers, 2012)
\(^{91}\) (Natural Resources Canada, 2011)
\(^{92}\) (Environment Canada, 2012)
\(^{93}\) (Oviedo, 2012)
\(^{94}\) (Economist Intelligence Unit, 2013)
\(^{95}\) (Fisheries and Oceans Canada, 2013)
The Canadian provinces regulate minerals below the ground and in most cases the sub-surface minerals, including oil and gas, are the property of the province. Individuals and corporations must lease the mineral rights from the province. Also, surface rights and mineral rights are allocated separately and just because you own the land does not mean you own the minerals below your land and both owners usually have equal access to the land. In Nova Scotia, permission must be granted by the landowner for the mineral owner to gain access, but in other provinces such as British Columbia there is no obligation to even notify the landowner.96

The provincial Crown owns the majority of oil and gas reserves, but sometimes they are held by freehold owners. Throughout Canada 78 percent of oil and gas rights are owned by the provincial Crown, including 81 percent in Alberta.97

A prospector’s license must be obtained in order to explore for minerals in the Northwest Territories, British Columbia, Manitoba, Ontario, Quebec, New Brunswick and Nova Scotia. However, in the other provinces a license is only needed to obtain the rights.98

Policy Incentives for Natural Gas: Incentives for natural gas include a $104.5 million program by the Ministry of Energy and Mines in British Columbia. The program gives incentives for natural gas-fueled vehicles and infrastructure investment for CNG fueling stations and LNG stations. The program hopes to rely on the provinces’ abundance of natural gas resources and use a less carbon-intensive fuel.99 Also, there has been a longstanding 10 percent investment tax credit in many of the Atlantic Provinces for oil, gas and mining industries. However, as part of the 2012 federal budget this is slowly going to be phased out and will be completely gone by 2015.100

Politics

Political Structure – Conservatives in Power: Canada is a constitutional monarchy with a bicameral federal parliament. The House of Commons has 308 representatives elected by constituencies and the Senate has 105 representatives who are selected by Canada’s prime minister. Canada’s last national election was in May of 2011 and the next national election is not until 2015.101 Canada has four main political parties consisting of the Conservative Party, the Liberal Party, the Bloc Québécois, and the New Democratic Party. The Conservative Party is currently in power and can pass legislation without support from opposing parties.

Key Political Players: The Conservative Party appears to be largely behind the development of Canada’s unconventional natural gas resources, which should bode well for those industries involved in gas development. Stephen Harper, the current Prime Minister, met with Chinese leaders in early 2012 to

96 (Canadian Geographic, 1997)
97 (Global CCS Institute, 2012)
98 (Natural Resources Canada - Mining Regulations, 2011)
99 (Crowe, 2012)
100 (McGonnell, 2012)
101 (Economist Intelligence Unit, 2013)
talk about how to exploit Canada’s oil and gas resources and generate more trade between the two countries;\textsuperscript{102} he also met with the Polish Prime Minister to discuss cooperating on the development of each country’s shale gas resources.\textsuperscript{103}

Even Peter Kent, who is Canada’s Environment Minister, has been understood as being mildly in favor of unconventional gas development in New Brunswick:

“I would say there has been a little bit of, again, exaggeration, misrepresentation and even scare journalism in terms of overstating the risk [of fracking],” Kent says in an interview. “... The technology and the chemicals – the cocktails or the soups that have been used – the technology has improved significantly in recent decades.”\textsuperscript{104}

Natural Resources Minister Joe Oliver met with Japan and South Korea in September of 2012 to encourage trade in LNG and give an outlet to Canada’s export opportunities that have been created by LNG export terminals in Kitimat and Prince Rupert in British Columbia.\textsuperscript{105}

\textbf{Conservatives support oil & gas through regulatory reform:} In January of 2013, letters were obtained by the environmental group Greenpeace under freedom of information laws. The letters show how the Canadian federal government is catering to the lobbies of the oil and gas industry by changing environmental laws to the benefit of oil and gas development. The most controversial letter was written in December of 2011 by the Energy Framework Initiative (EFI), which consists of the Canadian Association of Petroleum Producers, the Canadian Energy Pipeline Association, the Canadian Fuels Association and the Canadian Gas Association, and was sent to Peter Kent and Joe Oliver, the Environment and the Natural Resources Minister. The letter’s authors wanted to reform regulations on energy development in Canada and specifically attacked the following regulations: the National Energy Board Act, the Canadian Environmental Assessment Act, the Fisheries Act, the Navigable Waters Protection Act, the Species at Risk Act and the Migratory Birds Convention Act. Coincidentally (or perhaps not so coincidentally), less than a year after this letter was written, the Canadian Environment Assessment Act was reconfigured, Joe Oliver accused environmentalists of hurting Canada’s economy in an open letter to the public, and it was even proposed that the Navigation Protection Act replace the Navigable Waters Protection Act to remove protections from waterways.\textsuperscript{106} This latter change would mean that thousands of waterways would lose the federal protection that they currently enjoy; many First Nations Chiefs, who also have constitutional rights, have objected to this change.\textsuperscript{107,108} So it would appear that the Conservatives are in favor of developing Canada’s oil and gas resources.
The Canadian Environment Assessment Act of 2012 reduces timelines and the need for outside consultations in order to push projects through quicker.\(^{109}\) It streamlines the permitting needed for the development of new pipelines, accelerates the scheduling of environmental hearings with the public, and it only allows those who are directly affected by the development to participate and have a say in the process.\(^{110}\) Some may see this as less red tape to obstruct business while others may see this as sidestepping necessary precautions that are needed to protect the environment. This act updated a previous law enacted in 1995 and it also gives authority to the Minister of Environment to require public infrastructure projects conduct environmental assessment if the projects are believed to have significant effects on the environment.\(^{111}\)

Canada also has a record of being weak on regulating greenhouse emissions. It has reset its base year when trying to reach emission reduction targets. The new target that was set in Copenhagen in 2009 is weaker than what was set in Kyoto over ten years earlier and it appears that Canada will still fail to achieve the Copenhagen targets.\(^{112}\) Canada also withdrew from the Kyoto Protocol, choosing not to extend it past 2012\(^{113}\), which the executive branch has power to do without judicial review.\(^{114}\) Also, Canada often aligns its emission reductions with that of the U.S. to stay competitive with American industries.\(^{115}\) However, last year Guy Saint-Jacques, who serves as Canada’s chief negotiator and climate change ambassador, said that the government intends to target the oil and gas sector for greenhouse gas emission reductions.\(^{116}\)

In 2007, British Columbia set greenhouse gas emission targets (33 percent reduction by 2020 and 80 percent by 2050), but it has been seen that this looks like it will be increasingly difficult to meet considering the projections for increased natural gas development. A report conducted by the Canadian Centre for Policy Alternatives simply looked at three LNG projects (BC LNG Cooperative, Kitimat LNG Partnership, consortium led by Shell) that were being planned and the annual greenhouse gas emissions (CO2 equivalent) that would result. The report found that the LNG projects could handle a total production of 23.8 million tonnes of gas per year leading to 22.4 Mt of CO2e per year, which is more than half of the target for total greenhouse gas emissions under the 2020 target.\(^{117}\) This could mean that British Columbia may be effectually taking away its ability to meet its own law with its natural gas development.

**Pending lawsuit against CBM driller:** Although many at the level of the federal government may be behind hydraulic fracturing as a means to tap more of Canada’s unconventional natural gas resources,

\(^{109}\) (Economist Intelligence Unit, 2012)  
\(^{110}\) (Economist Intelligence Unit, 2013)  
\(^{111}\) (Economist Intelligence Unit, 2013)  
\(^{112}\) (Green Party of Canada, 2012)  
\(^{113}\) (Economist Intelligence Unit, 2013)  
\(^{114}\) (Columbia Law School, 2012)  
\(^{115}\) (Economist Intelligence Unit, 2013)  
\(^{116}\) (Postmedia News, 2011)  
\(^{117}\) (Canadian Centre for Policy Alternatives, 2012)
this sentiment is not shared by all. Jessica Ernst from Alberta filed a $33 million lawsuit in 2012 against Encana Corporation. She alleges that the coal bed methane drilling has led to methane in her water supply and has made her sick. Encana retorted that their extraction methods are safe and necessary precautions have been taken. She has also accused the Energy Resources Conservation Board of not doing enough to regulate drilling. Disputes such as these are not uncommon and have cast a shadow over Canadian drilling practices.

Rule of law/corruption & Environmental Opposition: There have also been questionable practices by security and police agencies in Canada, who, according to documents obtained by environmental groups under freedom of information laws, have been monitoring environmental activists as though they were terrorists. Environmental activists who are opposed to hydraulic fracturing and petition the government for more environmental protection are sometimes monitored out of fear that they may take part in terrorist activities; Canada’s Anti-Terrorism Act has been invoked to justify monitoring those activists. Jeffrey Monaghan, who works at the Queen’s University’s Surveillance Studies Centre, said that opposition to oil and gas production in Canada can be viewed as a threat to national security. Referring to an upcoming protest in DC, he said, "Any Canadians going to protest the Keystone XL pipeline in Washington DC on Sunday had better take precautions." The Government of Canada has even listed environmentalists in its report on counter-terrorism Strategy. In the report, under the heading of Domestic Issue-based Extremism, it lists environmentalism as one form of extremism, along with animal rights, white supremacy and anti-capitalism. The executive director of Sierra Club Canada, John Bennett, said that “This is just one more step in their attempt to marginalize the environmental movement and to quiet its voice...It’s an indirect suggestion that somehow environmentalism is attached to terrorism and that’s just wrong.” Megan Leslie, the MP of the Democratic Party, indicated that it is just the government’s attempt to demonize environmentalists and aboriginals who are in opposition to the Northern Gateway pipeline that has been proposed in western Canada.

Ms. Leslie cites the First Nations as one of the key groups that opposes many plans for oil and gas development. Unlike, the U.S. where Native Americans often have limited rights and special privileges, the First Nations have significant rights and leverage at the bargaining table. Due to this strong opposition that could threaten the future of many oil and gas projects, Prime Minister Stephen Harper

118 (Gray & Vanderklippe, 2012)
119 (Leahy, 2013)
120 (Leahy, 2013)
121 (Leahy, 2013)
122 (Leahy, 2013)
123 (Government of Canada, 2011)
124 (Government of Canada, 2011)
125 (McCarthy, 2012)
126 (McCarthy, 2012)
has recently appointed a specific representative to look into why First Nations are opposed to oil and gas projects, such as the Northern Gateway pipelines.\(^\text{127}\)

Control Risks, a global risks consultancy organization, performed a comprehensive study of many of the top countries with shale gas reserves and found Canada to have a low level of political and security risk; while there is significant anti-fracking activism, the policy trend going forward will be neutral.\(^\text{128}\)

**Quebec – current moratorium:** In Quebec, there is a stark difference of opinion between the Conservative Party at the federal level and the Bloc Québécois on the provincial level. In March of 2011, the provincial government of Quebec placed a moratorium on chemical fracturing. The threat of groundwater contamination was cited as the primary reason for the moratorium, especially the St. Lawrence valley.

Quebec’s Natural Resources Minister Martine Ouellet has been quoted as saying, “Our position is very clear on shale gas: we want a complete moratorium, not only on extraction but also on exploration of shale gas. We haven’t changed our view.” Then when asked about the permanence of the ban she said “I don't foresee a day when there will be technology that will allow safe production.”\(^\text{129}\) The success of this moratorium could be partly attributed to the foundation “Moratoire d’une Generation,” the goal of which is to obtain a twenty year moratorium on exploration and production of any fossil fuels or nuclear energy in the province of Quebec.\(^\text{130}\) The foundation’s Schiste 911 program is set up to alert citizens when development is planned, imminent, or taking place near them.\(^\text{131}\)

Currently, Quebec is undergoing an environmental assessment of hydraulic fracturing and the moratorium will not be lifted until it is finished.\(^\text{132}\) However, Control Risks saw the move in September of 2012 to extend the moratorium by the separatist government as a strategy to give it time to study hydraulic fracturing and come up with a comprehensive ban.\(^\text{133}\)

In response to this moratorium, Lone Pine Resource Inc., a U.S. company is suing the Canadian government for $250 million as the ban canceled their permit for gas exploration. One of the key laws cited is the North American Free Trade Agreement, which they say is being violated. They are demanding that their case be reviewed and they are compensated for their losses, which includes the cost of the permits and the time and resources spent to obtain those permits.\(^\text{134}\)

**Premiers – British Columbia vs. Alberta:** The debate between environmental protection and economic development has also been seen in the battle between British Columbia and Alberta. In October of

\(^{127}\) (Cattaneo, Tories aim to divide, conquer with envoy who will canvas First Nations on energy projects, 2013)

\(^{128}\) (Control Risks, 2012, p. 14)

\(^{129}\) (Reuters, 2012)

\(^{130}\) (Moratoire d’une Génération, 2013)

\(^{131}\) (Moratoire d’une Génération, 2013)

\(^{132}\) (Oviedo, 2012)

\(^{133}\) (Control Risks, 2012, p. 4)

\(^{134}\) (Lone Pine Resources, 2012)
2012, British Columbia Premier Christy Clark and Alberta Premier Alison Redford squared off over Enbridge’s Northern Gateway, which Ms. Clark says will cause her province to bear the environmental risk and all of the benefits will go to Alberta. However, this pipeline is needed to get the bitumen from Alberta’s oil sands region to Canada’s west coast where it can be exported. The Northern Gateway project proposes to bring the bitumen west from Edmonton to Kitimat and condensate east in the opposite direction.

**Geopolitical Implications:** Recent shale gas developments in the U.S. and Canada could have major repercussions on international markets and geopolitics. It may be that the U.S. and Canada no longer have to rely on the Persian Gulf for energy resources. A recent paper by the Indian Council on World Affairs pointed out that this could have a few profound effects including (1) a dampening effect on natural gas prices throughout the world and (2) the creation of independent pricing for natural gas that is no longer tied to oil prices. This lower price will be hard-felt in countries that rely on the revenues to help fund national spending and the well-being of their citizens. This could result in the creation of cartels as producers try to organize in order to stabilize prices. The paper hypothesized a few scenarios, such as cooperation between major gas producers, such as Russia and Iran, or the possible alignment of the U.S., Canada, Australia, the E.U. and Qatar to align against Russia and Iran. This will then have important implications on China’s policy as it struggles to secure energy supplies. This dynamic could also allow the U.S. and Canada to use their resources as a sort of weapon to exert influence throughout the world. One important consideration is that hydraulic fracturing technology is currently only available in certain countries, which would prevent many countries from replicating the success of the U.S. and other more technologically advanced countries.

**Markets**

The Canadian gas market is hub-based, with the most important hub being the AECO-C hub in Alberta. Contracts are not as important in the North American market; instead it is access to transport, hubs, and storage facilities that determine success in sales.

**Export opportunities:** Canada is already exporting natural gas; this occurs primarily through pipelines to the U.S., but to make up for declines in exports to the U.S. stemming from the shale gas revolution that is currently taking place in the U.S. Canada needs new trade partners. To remedy this, Canada has increasingly been promoting LNG exports to Asia. To date, three LNG export projects have been given federal approval: LNG Canada, Kitimat LNG and BC LNG Cooperative. However, none of these projects have taken the Final Investment Decision (FID).

**Price environment:** Due to the extensive pipeline connection and railway availability, the Canadian natural gas market and the U.S. natural gas market operate very close to an integrated market, yet they

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125 (Cattaneo, Fresh start needed after Redford and Clark dig in heels over pipeline, 2012)
136 (Enbridge, 2013)
137 (Hussain, 2012)
are still subject to infrastructure constraints and thus bottlenecks. On the other hand, Canada’s extensive LNG program coming online soon will provide access to the high-value markets of Asia, especially Japan. It is thus essential when analyzing the price environment for Canadian unconventional gas to look at all of these markets.

The following graphs therefore follow the price of natural gas in the local AECO-C hub in southeast Alberta (the main Canadian pricing point), the Dawn Hub at Ontario, and the Henry Hub fluctuations. LNG price in Japan is not provided, yet these last 2 years it has increased from approximately $11 USD/MMBtu to $17.3 USD/MMBtu.

We can see from the numbers in these graphs and tables that the Canadian prices have been intensely affected by the shale gas revolution in the U.S., following a similar downward trend.

AECO-C Hub and Henry Hub
### Natural Gas Prices at Major North American Hubs\textsuperscript{139}

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>($US/MMBtu)</td>
<td>Average</td>
<td>Average</td>
<td>Outlook Range</td>
</tr>
<tr>
<td>Intra-Alberta</td>
<td>2.71</td>
<td>2.54</td>
<td>2.86 - 3.38</td>
</tr>
<tr>
<td>Dawn</td>
<td>3.56</td>
<td>3.26</td>
<td>3.75 - 4.25</td>
</tr>
<tr>
<td>Henry Hub</td>
<td>3.06</td>
<td>2.93</td>
<td>3.50 - 4.00</td>
</tr>
</tbody>
</table>

Note: The conversion rate from CAN$/GJ to USD/MMBtu is 1.04.

### 3-Day Average Natural Gas Price\textsuperscript{140}

Average household and industry price in Canada:

\textsuperscript{139} (National Energy Board, Winter Outlook 2012-13, 2013), modified
\textsuperscript{140} (National Energy Board, 2013)
While most of the Canadian gas production is currently not destined to end up in Canada, we have seen a growing reverse in the trend with the use of natural gas for the extraction in tar sands and shale fields; therefore the following analysis of the Canadian market was deemed necessary. The Canadian price itself is defined by natural gas commodity prices, transportation costs and delivery costs.

Commodity prices are the only segment that is subject to market conditions. Nevertheless, even at this level government control, the commodity price asked by local distributors must be authorized at the provincial level; even though it reflects only the cost of purchasing the gas on behalf of customers with no markup.\(^{141}\)

Transportation tolls and tariffs for both interprovincial and international levels are thoroughly regulated by the National Energy Board (NEB) through a public hearing process or through negotiations between pipeline companies and shippers, and approved by the NEB.\(^{142}\) Delivery costs are under the jurisdiction of regional governments or of provincial regulatory boards and commissions.\(^{143}\)

Below is a chart of the price of natural gas in British Columbia provided by FortisBC (denominated in 1 Canadian $/GJ, or 0.928 USD/MMBtu), also following a downward trend.\(^{144}\)

![FortisBC residential variable rate (per GJ)](image)

**Extraction Costs:** EnCana Corporation, which is currently operating in Canada, has calculated that supply costs at the Bighorn shale are currently about $2.00 per MMBtu (aided by significant associated liquids

\(^{141}\) (National Energy Board, NEB-FAQ, 2013)  
\(^{142}\) (National Energy Board, NEB-FAQ, 2013)  
\(^{143}\) (National Energy Board, NEB-FAQ, 2013)  
\(^{144}\) (FortisBC, 2013)
volumes). They also expect the supply cost at Cutbank Ridge to be $2.70/MMBtu on an unleveraged basis. Including the capital carrying costs, supply costs are expected to come in below $2.00/MMBtu.\(^{145}\)

It is very important to note that different provinces carry different regulations and royalty demands, which affect supply costs. Alberta, where Bighorn is located, asks for a maximum 5 percent royalty rate (lasting 36 producing months for shale and 36 months/or until 750,000 MMBtu is produced for coal bed methane) for every well that:

- Has a fluid code of "Shale Gas/Coal Bed Methane Only" when it commences production, and
- Has no production prior to May 1, 2010, and
- Has a Crown interest greater than zero when it commences production.\(^{146}\)

**Infrastructure & Technology**

Canada benefits from a well-developed infrastructure in the central and western parts of the country where natural gas has been developed for several decades. There is an integrated network linking production to North American markets. According to the EIA, TransCanada operates the largest network of natural gas pipelines in North America, including thirteen major pipeline systems and approximately 37,000 miles of gas pipelines in operation.\(^{147}\) Moreover, Canada has a well-developed storage infrastructure. In eastern parts of the country, infrastructure is still in the development phase, since natural gas production has only been introduced in the last decade.

The largest new infrastructure project currently under consideration is aimed at processing and delivering Mackenzie Delta gas to the western Canadian pipeline system.\(^{148}\) However, the prospects for the pipeline are uncertain, in light of further permitting requirements, competition and uncertain future prices.\(^{149}\)

Overall, given high natural gas generation forecasts for Canada, it is reasonable to expect new infrastructure projects to facilitate access to supply and improve flexibility to meet demand through storage and service enhancements. Many of these projects are likely to be regional in nature and integrated with the infrastructure already in place. For example, TransCanada’s North Central Corridor project is already under construction.\(^{150}\)

Market forces could lead to more exports of Canadian gas, and that would require further infrastructure adjustments, such as additional LNG export terminals.\(^{151}\) For instance, the Kitimat LNG facility was originally designed for import, but is now being developed as an export terminal and the optimistic

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\(^{145}\) EnCana Corp, 2013

\(^{146}\) Alberta Energy, 2013

\(^{147}\) US Energy Information Administration, 2012

\(^{148}\) National Energy Board, 2009

\(^{149}\) US Energy Information Administration, 2012

\(^{150}\) National Energy Board, 2009

\(^{151}\) National Energy Board, 2009
forecast for the start of operations is 2015. There are other proposals in place to exploit western Canada’s unconventional natural gas resources.\textsuperscript{152}

**Geology**

**Available Resources:** The EIA estimates that Canada has 388 billion MMBtu of technically recoverable shale gas resources.\textsuperscript{153} Most of this is found alongside conventional gas reserves in large sedimentary basins in British Columbia, Alberta, and (to a lesser extent) Saskatchewan, although additional shale plays can be found in Quebec, New Brunswick, and Nova Scotia.\textsuperscript{154} The resource in Quebec is part of the Utica Shale and the resource in New Brunswick and Nova Scotia is the Horton Bluff and Frederick Brook Shale.\textsuperscript{155} However, the most shale gas is found in the Horn River Basin in northern British Columbia, which is estimated to contain 165 billion MMBtu of technically recoverable reserves.\textsuperscript{156} Interestingly, between 2009 and 2011, the British Columbia Oil and Gas Commission discovered that hydraulic fracturing caused low-level seismic events and in the Horn River Basin.\textsuperscript{157} Although the small tremors did not harm anyone or any infrastructure it does send warning signs for future development. British Columbia also has the Cordova, Liard and Deep Basin, which contains the Motney and Doig Phosphate plays. All of these areas seem to be suitable for hydraulic fracturing, except for the Liard basin, which does not have the significant quartz to clay ratio that is needed.\textsuperscript{158}

**Other Physical Properties:** Because of extensive U.S. exploration of the Utica shale, the geologic properties of the shale resource in Quebec can be reliably estimated.\textsuperscript{159} It is relatively shallow and has a very limited amount of impurities.\textsuperscript{160} The Frederick Brook Shale in New Brunswick is approximately 10 miles long and 25 miles across, and the concentration of the gas has been estimated by GLJ Petroleum Consultants to be between 370 and 625 million MMBtu per square mile.\textsuperscript{161} The shale gas that is found in British Columbia and Alberta is believed to be at high pressure deep within the ground, making it a very good candidate for hydraulic fracturing.\textsuperscript{162} In the Colorado Shale, which is found in Alberta and Saskatchewan, the rock conditions are relatively poor, which means only vertical wells can be safely drilled into the shale\textsuperscript{163}. Also, the Colorado shale appears to be underpressured, which can make drilling
difficult. Furthermore, the shale in Saskatchewan is highly sensitive to water, meaning alternative fracking fluids must be used.

**Natural Obstacles:** The shallower, softer shales in Alberta and Saskatchewan decrease the potential penetration ability of hydraulic fracturing, which could negatively impact the productivity of the shale plays. On the other hand, because these poor rock conditions necessitate vertical wells instead of horizontal ones, the wells are much cheaper to drill than they would be otherwise. In British Columbia, the Horn River Basin Shale is located deep within the ground, which could increase extraction costs. Finally, several of the shale basins in Alberta and British Columbia are located in regions that are either remote, mountainous, or both.

One the following page is a summary from the EIA of an assessment conducted of Canada’s shale gas resources. The table lists the reserves of the various regions, how susceptible they are to hydraulic fracturing, what companies are active in the area and other pertinent information.

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164 (US Energy Information Administration, 2011)
165 (Johnson, Davidson, & Mortensen, 2009)
166 (Johnson, Davidson, & Mortensen, 2009)
167 (Johnson, Davidson, & Mortensen, 2009)
168 (Johnson, Davidson, & Mortensen, 2009)
169 (Johnson, Davidson, & Mortensen, 2009)
170 (US Energy Information Administration, 2011)
<table>
<thead>
<tr>
<th>Shale Gas Basin</th>
<th>Horn River</th>
<th>Cordova</th>
<th>Liard</th>
<th>Deep Basin/Motney</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location (province)</td>
<td>Northern British Columbia</td>
<td>Northeastern British Columbia, Northwest Territory</td>
<td>Northern British Columbia</td>
<td>Central Alberta &amp; British Columbia</td>
</tr>
<tr>
<td>Risked Recoverable Resource (MMBtu)</td>
<td>165 billion</td>
<td>29 billion</td>
<td>31 billion</td>
<td>69 billion</td>
</tr>
<tr>
<td>Area (mi^2)</td>
<td>8,100</td>
<td>4,290</td>
<td>4,300</td>
<td>54,000</td>
</tr>
<tr>
<td>Main Shale Gas Target</td>
<td>Middle Devonian Muskwa/Otter Park black shale</td>
<td>Middle Devonian Muskwa/Otter Park Shale</td>
<td>Lower Besa River</td>
<td>Montney Shale and Doig Phosphate Shale</td>
</tr>
<tr>
<td>Favorable for hydraulic stimulation?</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Active companies</td>
<td>Nexen</td>
<td>West/Mitsubishi</td>
<td>Nexen</td>
<td>Not listed</td>
</tr>
</tbody>
</table>

1. Would be suitable for Kitimat LNG terminal and the West Coast Pipeline system.
2. Sometimes difficult to discern between the shale gas and the tight gas areas, west of Deformation.
3. But a significant number of wells have been drilled. Also, extensive pipeline system available.

<table>
<thead>
<tr>
<th>Shale Gas Basin</th>
<th>Colorado Group</th>
<th>Appalachian Fold Belt</th>
<th>Windsor Basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location (province)</td>
<td>Southern Alberta &amp; Southeastern Saskatchewan</td>
<td>Quebec</td>
<td>North-central Nova Scotia</td>
</tr>
<tr>
<td>Risked Recoverable Resource (MMBtu)</td>
<td>61 billion</td>
<td>31 billion</td>
<td>2 billion</td>
</tr>
<tr>
<td>Area (mi^2)</td>
<td>124,000</td>
<td>2,900</td>
<td>524 (prospective)</td>
</tr>
<tr>
<td>Main Shale Gas Target</td>
<td>Second White Speckled and the Fish Scale shales</td>
<td>Utica</td>
<td>Horton Bluff</td>
</tr>
<tr>
<td>Favorable for hydraulic stimulation?</td>
<td>Yes</td>
<td>Data not available</td>
<td>Data not available</td>
</tr>
<tr>
<td>Active companies</td>
<td>Has seen only limited exploration and development</td>
<td>Talisman, Forest Oil, Questerre, Junex, Gastem and Molopo</td>
<td>Triangle Petroleum and Forent Energy</td>
</tr>
</tbody>
</table>

1. Much of the Colorado Group Shale appears to be under pressured.
2. The Utica Shale in Quebec is structurally much more complex than New York. However, pipelines give good access to Quebec City and Montreal.
3. Primarily in the shallower eastern portion

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171 (US Energy Information Administration, 2011)
France

Regulations

Summary: Hydraulic fracturing and unconventional natural gas development in France is all about the politics. The political opposition to hydraulic fracturing and the regulatory barriers that have accompanied that sentiment appear to be the largest obstacles towards unconventional natural gas development in the country. However, there has been recent political activity in support of coal bed methane (CBM) extraction, which it is argued will strongly contribute to France's economic recovery.

Existing Laws: Loi n° 2011-835, which imposed a moratorium on hydraulic fracturing, also established a national commission charged with tracking developments in extraction and exploitation of liquid and gaseous hydrocarbons. This commission gives recommendations to the government and the parliament. In their latest report from February 2012 they suggested that a lack of strict supervision over conditions for exploration and experimentation has been damaging to the national economy and has been preventing job growth; they suggested that France should:

- Launch a scientific program, nationally or through the EU, to explore hydraulic fracturing and it's environmental impact
- Increase knowledge of the functioning of aquifers in the concerned regions to improve management of water resources
- Promote a small number of experimental wells under strict supervision

Permitting for Natural Gas: The permitting process for natural gas extraction in France is overseen by the Ministry of Environment, Energy, and Sustainable Development (DGEC), but the process is directed by the Directorate General of Energy and Climate. Two separate permits grant exploration activities and production activities. During the exploration phase companies compete against other potential candidates during a quasi-tender procedure as defined in Article 3, §2 (b) of the Hydrocarbons Directive. The application is sent to the minister who consults with the prefect to ensure the application is complete. The prefect then has three months to reply to the minister. The minister then makes sure a notice is posted in the Official Journal of the EU and the Official Journal of the French Republic. This procedure applies both to exploration and exploitation permits. In Article L 122-1 of the New Mining Code, anyone performing exploration activities must conduct all inspection activities regardless of what the landowner gives consent to. Also, Article 552 of the Civil Code dictates that the landowner does not own the minerals and resources under the land, which is the property of the State.

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172 (Legifrance, 2011)
173 (Philippe & Partners, 2011, p. 25)
174 (Philippe & Partners, 2011, p. 28)
175 (Philippe & Partners, 2011, p. 25)
176 (Philippe & Partners, 2011, p. 26)
After a company is granted an exploration permit and the exploration yields a positive result, the company has the exclusive right to apply for an exploitation permit. The company is given the exclusive right to exploit the resources provided that the application approved and a permit is granted. Unlike the exploration permit, the exploitation permit requires public inquiry to be conducted by an independent commissioner-investigator and may or may not include experts.

To be granted exploitation rights, a company needs to get two authorizations: one from the DGEC (General Directorate for Energy and Climate) and one from the prefect of the region in question. Several governmental bodies advise the DGEC on the applications including: the General Council of Industry, Energy and Technology (CGIET), the Regional Division of Industry, Research and Environment/Technology (DRIRE), the Regional Directorate of Environment, Development and Housing (DREAL), the Departmental Council of Environment and Risks on Health and Technology (CODERST) and the Bureau for Exploration-Production of Hydrocarbons.

The permits granting exploration are then published in the respective municipalities, thereby making the community aware of the activities. Decisions granting exploration are legally binding and not challengeable. However, as seen with the recent events in 2011, permits are sometimes revoked per Loi n° 2011-835, creating some legal ambiguity for how binding an exploration permit actually is. After an exploration permit has been granted any stakeholder adversely affected by the decision has two months to file an appeal.

The fact that there is no public inquiry during the exploration permit process was seen as adversely affecting the public opinion toward shale gas. Many French communities felt that their voice was not being heard and organized themselves to influence national politics.

Politics

Geopolitical backdrop: Europe’s strained relationship with Russia: Europeans in general have long been worried about the share of gas imported from Russia. This sentiment can likely be traced back hundreds of years as Russia (and formerly the Soviet Union) has been viewed as a threat to Europe. This was shown most recently though the natural gas disruptions of 2006 and 2009 when Russia shut off natural gas being piped through Ukraine because of pricing disputes. This highlighted the European dependence on natural gas. Both disruptions occurred during times of cold weather in January, which meant that average Europeans were hit very hard. Many Europeans felt that Russia was playing politics and bullying Ukraine after the Orange Revolution. Therefore, in terms of a diversification of supplies away from Russia, many Europeans would like to rely on other supplies of natural gas or supply it themselves. Russia is a major supplier of natural gas to Europe, but how big is its share of natural gas consumption in

177 (Philippe & Partners, 2011, p. 13)
178 (Philippe & Partners, 2011, p. 31)
179 (Philippe & Partners, 2011, p. 21)
180 (Philippe & Partners, 2011, p. 28)
181 (Nye, 2006)
The Business Landscape for Unconventional Natural Gas

Europe? In 2011, which are the most recent figures available, Russia accounted for approximately 24.5 percent of total natural gas consumption in the EU, 27. 31.8 percent of all European gas was produced within EU countries and 21.2 percent came from Norway. The remaining 20 percent came from LNG imports. However, these numbers have shifted since 2011. Russian gas is perceived as being too costly and importers are renegotiating contracts to import the smallest volumes possible.

**National sentiment brings about moratorium:** When considering the relations between Europe and Russia, it may seem that Europeans would want horizontal drilling and hydraulic fracturing to give them more of their own natural gas. However, in France it appears that the citizens’ concern for the environment and the water supplies overrides the desire for greater energy security. In February of 2011, France suspended all shale gas activities. Then, in July of 2011, a moratorium on hydraulic fracturing was imposed through *Loi n° 2011-835*, which even includes experimental hydraulic fracturing performed for research purposes. Of the 64 exploration permits that were held at the time of the moratorium, 61 are still outstanding. However two companies, Schuepbach Energy LLC and Total, had permits retracted. They were given two months to come up with alternative extraction methods to hydraulic fracturing. Ultimately, the companies failed to do so and two permits were revoked from Shuepbach and one permit was revoked from Total.

The moratorium was the culmination of an increase in national sentiment against hydraulic fracturing that intensified during the first half of 2011, coinciding with the Academy Award nomination of Josh Fox's *Gasland*. The film was used by several environmental groups in France to raise awareness of risks associated with the extraction of shale gas. The debate in France, at least on a grass roots level, was very one-sided. For example, *Gasland* was screened in large universities by environmental groups without any representation from proponents of shale gas.

**Key Players:** The current ruling party, *La Partie Socialiste*, is committed to maintaining the status quo on shale gas. However, several prominent politicians and thinkers have been questioning the complete ban on hydraulic fracturing suggesting that drilling for research purposes should be allowed if it can be done safely. In a report from November 2012 the Commissioner General of Investment Louis Gallois proposed that research on alternative extraction methods should be allowed and that a partnership with Germany should be pursued. This was rejected by President Francois Hollande, reiterating the opposition to the extraction method at the national level.

Francois Hollande in a November 2012 article in *Le Monde* in which he answered the question “what is the position of the government on the issue of shale gas?” in the following manner:

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182 (Natural Gas Americas, 2011)
183 (Legifrance, 2011)
184 (Patel, 2011)
185 (Commissariat Général à l’Investissement, 2012)
“Research is possible on alternative extraction techniques to hydraulic fracturing. This research has not yielded any results, I can’t outlaw it, it is not forbidden by the law. [...] If no new technique is discovered I have said that during my term in office there will be no new shale gas exploration permits.”\textsuperscript{186}

Therefore, assuming no major change in public perception or a dramatic development in new extraction techniques that does not involve hydraulic fracturing, the political support of shale gas development in France is not likely to change until at least the next election in 2017.

**Markets**

France was the 6\textsuperscript{th} largest gas importer in the world in 2010 with the bulk of the imports coming from long-term contracts.\textsuperscript{187}

**Natural Gas Contracts:** Natural gas import contracts in France have historically been long-term, oil-indexed contracts. Gaz de France, the biggest importer, is currently in the process of renegotiating these contracts; gas contracts currently being renegotiated come from Statoil, Gasterra and Gazprom. The renegotiation of these take-or-pay contracts pertains specifically to two factors: changes in the formulas for oil versus spot-indexation and off-take obligations. Gazprom does not seem to want an increase in the relative weight of the spot market, but Gasterra and Statoil seem to have been giving some concessions. Changes in off-take obligations have been made to accommodate over-supply, but the total off-take during the contract period has not changed. The changes include modifications to carry-forward and make-up provisions, i.e. if the buyer has taken more during a period than what it has contracted it can carry this forward to avoid taking the same in the future. Make-up provisions are the inverse; when a buyer has not taken enough it will have to contract more in the coming years.\textsuperscript{188} This has always been a feature in natural gas contracts, but it has been made more flexible to accommodate the buyers’ needs.

France has been importing gas from Russia since the mid-1970s when two contracts were signed for delivery at Baumgarten. A third contract was signed in 1983 for delivery at the Czech-German border. On December 19, 2006 Gazprom and GDF Suez signed a comprehensive set of natural gas import contracts. This included extensions of the existing contracts until 2031. These are the contracts currently in contention. The central questions in this current contention are how to index the gas prices to oil and what should be the level of off-take commitments.

It is important to recognize that these contracts are not public and we can therefore only speculate on the specifics. In general the Norwegian and Russian oil-indexed contracts represent 70 percent of the price of substitutes on a calorific value-equivalent basis. This is calculated through a basket of substitutes, including heating oil, coal and other similar products. The contracts provide for some flexibility in off-take volume, for example ranging from 85-110 percent of the contracted volume. Some

\textsuperscript{186} (Le Monde, 2012)  
\textsuperscript{187} (Index Mundi, 2012)  
\textsuperscript{188} (PricewaterhouseCoopers, 2008)
buyers in Europe managed to introduce a larger share of spot prices in their contracts. Jean Francois Cirelli has publicly stated that GDF will renegotiate 80 percent of its imported European volume by the end of 2013. According to Carnegie Endowment, “on December 19, 2006, Gazprom and Gaz de France signed an agreement to extend the existing contracts for 423 million MMBtu/year of Russian gas supply to France until 2030. The agreement also increased the annual volumes by 88.3 million MMBtu/year, with the additional volume being sold at Griefswald, Germany via the Nord Stream pipeline.”

Export opportunities: Even though France has no domestic natural gas production and consumes 1.5 billion MMBtu, it could theoretically export to neighboring countries. This seemingly nonsensical statement is based on the fact that the primary sources of gas to France are Norway (519 million MMBtu) and Russia (304 million MMBtu). These gas imports are based on long-term contracts. GDF’s Russian contract will expire in 2031. GDF’s Norwegian contracts will expire in 2015 (142 million MMBtu), 2021 (71 million MMBtu) and 2023 (284 million MMBtu); therefore import obligations fulfill already a large part of French consumption regardless of unconventional gas developments. Contingent to the production volumes and France’s consumption, unconventional gas could open the possibility for exports and expand the pipeline network already in place.

Price environment: The following table presents the retail household and industry price in the French market. France trends around the average both for households ($22 USD/MMBtu) and for the industry ($16 USD/MMBtu) on a 2012 EU 27 axis of comparison, probably due to the relative diversification of importers.

2009-2012 Natural Gas Prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural gas household price (USD/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$22.23</td>
</tr>
<tr>
<td>2010</td>
<td>$21.92</td>
</tr>
<tr>
<td>2011</td>
<td>$24.63</td>
</tr>
<tr>
<td>2012</td>
<td>$20.70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural gas industry price (USD/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$12.09</td>
</tr>
<tr>
<td>2010</td>
<td>$13.31</td>
</tr>
<tr>
<td>2011</td>
<td>$14.41</td>
</tr>
<tr>
<td>2012</td>
<td>$15.79</td>
</tr>
</tbody>
</table>

Note: conversion rate used is 1 € to 1.3 USD.

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189 (Deutsche Bank, 2006, p. 27)
190 (Platts, 2012)
191 (Melling, 2010)
192 (Europe’s Energy Portal, 2012)
193 (Europe’s Energy Portal, 2012)
Nonetheless, northern France was been rapidly expanding spot trades in 2010. GDF Suez, France’s biggest electric utility company, has been purchasing its long-term natural gas from the Netherlands, Norway, and Russia at prices similar to or slightly above the German border price; and from the UK, the Netherlands, Norway, and the Zeebrugge LNG terminal at market prices.\textsuperscript{194} In January 2013, Germany Natural Gas Border Price was $14.74 USD/MMBtu.\textsuperscript{195}

**Extraction costs:** The cost of extraction is not known because of the current moratorium on both exploration and production drilling. If there were no moratorium, France would probably face the same problems as Poland: an insufficient amount of rigs and a high cost of services.

However, France is already a moderate producer of natural gas (25 million MMBtu in 2010),\textsuperscript{196} so a significant amount of infrastructure is already in place, reducing the anticipated costs of production. Total, an oil and gas company, operates a 5,000-kilometer transmission pipeline and two underground storage facilities with a combined capacity of 85 million MMBtu.\textsuperscript{197} Further research should be conducted for any publicized research of Total on extraction costs.

**Infrastructure & Technology**

Overall, France has a well-developed infrastructure in place for conventional natural gas. Transportation of gas is divided into three categories: the major network, the regional network, and the distribution network. The major network connects with all foreign points of entry and exit. It is also connected to storage facilities and the LNG re-gasification plants.

**Geology**

**Available Resources:** The EIA estimates that France has 180 billion MMBtu of technically recoverable shale gas resources.\textsuperscript{198} Most of this gas is located in the northern part of France in the Paris Basin and near Aquitaine in the Southeast Basin.\textsuperscript{199}

**Other Physical Properties:** The Paris Basin is composed of two shale formations: the Toarcian black shale formation and the Permian-Carboniferous shales.\textsuperscript{200} Because of the high oil content of the Toarcian shales, the Permian-Carboniferous shales are likely to be more suited for development, but the moratorium on drilling in France means that many of the features of this shale are still unknown.\textsuperscript{201} The Southeast Basin also features two shale formations: the Terres Noires shales and the Liassic shales.\textsuperscript{202} The Liassic shales are thought to have a higher resource content and are more thermally mature than

\textsuperscript{194} (Melling, 2010)  
\textsuperscript{195} (YCharts, Germany Natural Gas Border Price, 2013)  
\textsuperscript{196} (CIA, 2010)  
\textsuperscript{197} (Total, 2013)  
\textsuperscript{198} (US Energy Information Administration, 2011)  
\textsuperscript{199} (Boyer, Clark, Jochen, Lewis, & Miller, 2011)  
\textsuperscript{200} (Boyer, Clark, Jochen, Lewis, & Miller, 2011)  
\textsuperscript{201} (Boyer, Clark, Jochen, Lewis, & Miller, 2011)  
\textsuperscript{202} (Boyer, Clark, Jochen, Lewis, & Miller, 2011)
the Terres Noires shales.\textsuperscript{203} The western portions of the Terres Noires shales consist of very wet gas, to the extent that in some cases they may be unsuitable for gas development.\textsuperscript{204}

**Natural Obstacles:** The Terres Noires shales in the Southeastern basin have a relatively high clay content, which makes hydraulic fracturing more difficult.\textsuperscript{205}

\textsuperscript{203} (Boyer, Clark, Jochen, Lewis, & Miller, 2011)
\textsuperscript{204} (Boyer, Clark, Jochen, Lewis, & Miller, 2011)
\textsuperscript{205} (Boyer, Clark, Jochen, Lewis, & Miller, 2011)
Poland

Regulations

Summary: The Polish government is aggressively promoting exploration and development of unconventional natural gas resources. Currently, the most promising areas in these basins are at various stages of exploration and development ranging from the survey to drilling stages.

As part of these continued efforts to promote shale gas, the current administration has promised to pass new legislation addressing shale gas specifically to revive interest in domestic exploration. This is further aided by a favorable political environment and a relatively straightforward regulatory process that includes national regulation on hydrocarbon development and environmental standards set by the European Commission. However, there are a number of obstacles within the regulatory environment that pose challenges, especially to new entrants. Backlogs in obtaining licenses for exploration, transfer of rights, and securing land rights continue to worry new entrants.

National Regulatory Structure: As a member of the European Union and subject to the rules and regulations of the European Commission, Poland has a stable and well-defined regulatory and legal structure. There are numerous protections for private property and Foreign Direct Investment, as well as incentives for large-scale investments. The Code of Commercial Companies (2000) and the Act on Freedom of Economic Activity (2004) streamline many of the legal obstacles facing investors and bring the country in line with the standards of its European neighbors.

Shale Gas Laws and Environmental Standard: The Ministry of the Environment is tasked with regulating, approving licenses and permits and enforcing laws pertaining to shale gas development. There are currently no laws that specifically address shale gas, however a draft of current legislation was released this past February. The administration has promised legislation by May of this year, but realistically it may not pass both houses until later in the year. Nonetheless, there are comprehensive legal frameworks for hydrocarbon exploration, environmental protection, and water management that are applicable for shale gas development.

Until January 2012, the Geological and Mining Law of February 4th, 1994 regulated shale gas exploration. However it was replaced by the Geological and Mining Law of June 9th, 2011. This update included specific rules for geological and mining aspects of hydrocarbon exploration but does not address water and environmental issues. It also incorporates a number of applicable rules from the EU Hydrocarbon Directive.

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206 (Financial Times, 2012)
207 (Natural Gas Europe, 2012)
208 (Rutkowska-Subocz, 2012)
Since May of 2004, Poland has been subject to the EU’s environmental laws (please see section on EU). Additionally, there are a number of environmental laws passed over the course of the past decade that align Poland to European standards. The most significant is the Environmental Protection Law of April 27th, 2001 which regulates the emission of gas and dust into the atmosphere, extraction and of water and discharge into soil.

**Other relevant legislation:** The Water Law further regulates the extraction and use of water. The Environmental Impact Assessment Law requires new projects and investments to undergo an environmental assessment. The Environmental Damage Law requires the “entity using the environment” (i.e. drilling company) to prevent, remedy and be fiscally responsible for environmental damage.\(^\text{209}\)

**Possible New Legislation:** As mentioned earlier, there is currently a movement to pass regulations specifically for shale gas development that will consolidate rules and regulations and expedite the permitting process.

There is also talk of passing a shale gas tax, but the current administration is vehemently against this, asserting that current legislation is sufficient and any loopholes can be addressed with one-off executive orders.\(^\text{210}\) This issue will most likely resurface in the 2015 election for Prime Minister and Parliament.

Just recently, the Polish legislature announced that the following bill will be brought to a vote in mid-2013:\(^\text{211}\)

a) Loosened environmental requirements  
b) Potential tax burden of up to 40 percent (this has not been released yet)  
c) Required concessions reduced from 3 to 1  
d) Current concession holders will have priority in obtaining production licenses  
e) Companies will be able to create partnerships  
f) State company NOKE will become a minority shareholder of a maximum of 5 percent of equity.  
g) Profits will be invested into a newly created “Generation Fund”, which will fund R&D, pensions and other social causes.  
h) Modernization and simplification of environmental procedures  
i) Guaranteed revenue and profit to be allocated to communities  
j) Companies must be transparent and publish information on websites  
k) 5 percent tax on gas extraction, 10 percent tax on crude oil extraction, 25 percent tax on income after expenses and an exploration tax of 20-24 PLN per 1000 cubic meters, in addition to 19 percent CIT and property taxes.

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\(^{209}\) (Dimireva, 2012)  
\(^{210}\) (Rutkowska-Subocz, 2012)  
\(^{211}\) (Poland Ministry of the Environment, 2013)
It is worth noting that because of low funding and few regulators, environmental laws are not vigorously enforced. Enforcement officers usually impose administrative sanctions rather than criminal penalties. These often come in the form of fines and fiscal sanctions. Only serious cases are prosecuted through criminal proceedings.\footnote{Practical Law, 2012}

**Land and Mineral Rights:** Although there are no mineral rights in Poland, the European business model allows companies to acquire mineral rights for large concessions of land. The largest concessions in Poland are equal to about 290,000 acres and are acquired with work commitments to conduct a certain amount of seismic testing and to drill one or two wells.\footnote{E&P Mag, 2011} In summary, the mineral rights belong to the government or large corporations that can afford to purchase large tracts of land; individual landowners are frequently overlooked.

According to the Geological and Mining Act, hydrocarbons are state-owned and upstream activities require a mining usufruct. The mining usufruct allows entities to operate, profit, and benefit from the property. It is not clear whether such rights can be shared, but the Ministry of the Environment has permitted transfer of shares in mining usufruct agreements (MUAs), provided that the acquirer gets only a 49 percent interest in the MUA. This has allowed the existence of farm-in, farm-out agreements and joint operation agreements (JOAs).

**Permits and Licenses:**

**Concessions and Usufructs:** The State Mining Authority (SMA) and the Regional Mining Authorities supervise and approve all geological and mining operations. Apart from local consent, the grant for exploration requires the consent of the Minister of Economy and the Mining Authority.

In order to perform mining activities, investors must sign an agreement with the State Treasury to create a usufruct for mining activities and then obtain a concession from the Minister of the Environment with the assistance of the Department for Geology and Geological Concessions. A separate concession is needed for prospecting and exploration, which can be obtained later.

The concession for prospecting/exploration or production of hydrocarbons must go through a public procurement procedure. The winner of the tender then signs a mining usufruct agreement which allows it to explore a certain area (GML2011).

In reality, it is not strictly necessary to put the concession out to tender since there is a grandfathered priority right for existing entities. In other words, companies that are already operating or exploring a region have a 5 year arrangement to sign a mining usufruct.

There is an associated fee for the establishment of the mining usufruct and a royalty for shale gas development. Additionally, under GML2011 and the Environmental Damage Law, the enterprise is

\footnote{(Practical Law, 2012)} \footnote{(E&P Mag, 2011)}
responsible for any mining-related damage and must return the property to its former condition or provide substitute, like-new facilities.214

**Environmental Licenses:** All companies must go through the process outlined in the Environmental Impact Assessment before obtaining an exploration permit, concessions, or a water permit. Shale gas activities are not specifically cited, but some mining-related activities are subject to the law. Specifically, any mining that uses explosives, that is located near maritime territory, drills holes deeper than 1000m, produces natural gas or its derivatives exceeding 500 tonnes/day, or that requires the installation of aboveground storage facilities must undergo the assessment.215

Polish laws allow different channels for public participation. In the case of shale gas, public participation should be expected in larger projects that require an Environmental Impact Assessment before a decision can be made. In the case of smaller exploratory projects, public participation can vary and depend on circumstances. The public participants are assured access to files and information as well as the opportunity to file comments and proposals.

**Water and Waste Management:** It is necessary to obtain water permits to use water either from local sources through an agreement with the water provider or direct intake surface or underground sinks. The permit is an “administrative decision” that is dependent on the authorizing officer in the Ministry of the Environment.216 There are added regulations for cleaning, disposing of, and storing water. These may take the form of a waste management permit.

There is NO permit required for the injection of hydraulic fluid nor are there any Polish laws that require the disclosure of the chemicals being used. However, Poland is subject to REACH Regulations (see EU Section), that require certain fracking operators (deemed downstream users) to prepare a chemical safety report.

**Noise Pollution:** Under the Environmental Protection Law, noise levels must be maintained below a locally-determined maximum. The local environmental authority determines appropriate noise levels and issues warnings and fines.

**Politics**

**Political System:** Poland has a parliamentary republic with the Prime Minister as the head of state and a lower and upper house. The current administration is a center-right party that enjoys a strong coalition and majority power in the parliament. This allows for a stable regulatory environment until the next election in 2015, and since there is currently no strong opposition, perhaps further into the future.

**National Movements and Upcoming Elections:** It is worth noting that the Polish people generally support shale gas development. There has been a culture of associating shale gas development with

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214 (Rutkowska-Subocz, 2012)
215 (Rutkowska-Subocz, 2012)
216 (Rutkowska-Subocz, 2012)
Polish nationalism, which is a clear reference to the country’s dependence on Russian gas. These attitudes may change as more development encroaches on population centers and agricultural land, especially as the election cycle begins. Some opposition parties have already begun a movement against hydraulic fracturing, but these are quiet voices among an overwhelming national consensus. In fact, polls from last year suggest that 73 percent of the country’s nearly 40 million people support shale gas development.

**Key Players Views:** Prime Minister Donald Tusk: He is a member of the Center Right Civic Platform (PO) party, which is pro-fracking and has taken steps to encourage foreign involvement in its development. The government has already granted 111 exploration concessions on an area of 35,000 square miles, or about a third of the territory of Poland.

Environment Minister Marcin Korolec: He is very proactive in the development of shale gas and has been aggressively pushing for new regulations specifically for hydraulic fracturing.

“Our goal is to start shale gas production as soon as possible and that requires regulation that will be friendly for investors.”

The Polish Geological Institute: Although its recent report downgraded the potential recoverable reserves, its report stated that hydraulic fracturing has no significant public safety or environmental impacts.

Kashubian Ethnic Minority: It is an ethnic minority with its own culture and language that is concentrated in the Pomerania region. The area is a center of exploration and thought to have the highest potential to become a major gas-producing region. The community is concerned with environmental impacts as well as proper compensation for land use.

**Markets**

Poland imports around 50 percent of its 625 million MMBtu of natural gas demand from Russia through the Yamal-Europe pipeline, which later feeds into Germany. Poland benefits from the transit of gas to Germany through lower prices of gas and transit fees, yet is significantly dependent on Russian gas and vulnerable to network disruptions, as in 2006 and 2009.

To that end, Poland commissioned a LNG re-gasification plant, scheduled to finish construction in 2014, and signed a contract with Qatargas in 2009. Yet as natural gas prices have changed it is now attempting

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[217](National Energy Board, Winter Outlook 2012-13, 2013)
[218](Anderson, 2013)
[219](Anderson, 2013)
[220](Strzelecki, Poland to Ease Environmental Rules Slowing Shale Search, 2013)
[221](KPMG, 2012)
[222](Strzelecki, Poland to Ease Environmental Rules Slowing Shale Search, 2013)
[223](US Energy Information Administration, 2013)
[224](Strzelecki, Poland to Ease Environmental Rules Slowing Shale Search, 2013)
This contract renegotiation later resulted in Tymoshenko being imprisoned for abuse of office.
to renegotiate it. The existing gas contracts were signed in 1993 between Gazprom and PGNiG S.A. and EuRoPol GAZ S.A.

Domestic gas production could place Poland in a better negotiating position with Gazprom. The current long-term contract ends in 2022.

**Price environment:** As mentioned earlier, Poland is currently importing gas from Gazprom through a long-term, take-or-pay contract, with an annual volume of 307 million MMBtu until 2022, partly indexed to oil prices. Starting from 2014, the long-term, take-or-pay contract with Qatargas for LNG supplies will also come into effect for 1 million tons of LNG annually; this contract is also indexed to oil, thus defining the Polish gas price environment as a by-product of the oil price environment.

The following table presents the retail household and industry price in the Polish market; in the case of future gas exports the price environment would also be dependent on the markets described in the market sections of France and UK. The Polish market itself is below the average both for households ($22 USD/MMBtu) and for the industry ($16 USD/MMBtu) on a 2012 EU-27 axis of comparison, probably due to relatively favorable terms on the Gazprom contract.

### 2009-2012 Natural Gas Prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural gas household price (USD/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$17.54</td>
</tr>
<tr>
<td>2010</td>
<td>$19.25</td>
</tr>
<tr>
<td>2011</td>
<td>$19.06</td>
</tr>
<tr>
<td>2012</td>
<td>$16.93</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural gas industry price (USD/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$11.48</td>
</tr>
<tr>
<td>2010</td>
<td>$12.39</td>
</tr>
<tr>
<td>2011</td>
<td>$12.12</td>
</tr>
<tr>
<td>2012</td>
<td>$13.08</td>
</tr>
</tbody>
</table>

Note: conversion rate used is 1 € to 1.3 USD.

Unconventional production is not predicted to have a strong effect on domestic prices, at least not before 2020. The awaited market liberalization might play a bigger role in the determination of future prices, as Poland will be more linked to European spot prices. According to Fitch Ratings, it will be mostly external factors that will affect the price environment. The rating agency identified the basic parameters as being: the “European spot gas prices, a gas supply-demand balance in Europe (which is unlikely to be

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225 (Natural Gas Europe, 2012)  
226 (Natural Gas Europe, 2012)  
227 (Europe’s Energy Portal, 2012)  
228 (Natural Gas Europe, 2012)
significantly affected by Polish shale gas before 2020), a further growth of U.S. shale gas production, potential gas exports from the U.S. to Europe, and potential further re-negotiations of prices under the long-term supply contracts between European utilities and OAO Gazprom ('BBB'/Stable)."\(^{229}\)

**Extraction costs:** The Polish Geological Institute calculates the drilling costs for shale in Poland to range from $10 to $15 million USD, while production costs are expected to average around $8.57 USD/MMBtu; roughly three times the cost of a well in U.S.\(^{230}\) When taking these costs projections as cost assumptions, the break-even price for shale will be $9 USD/MMBtu.\(^{231}\)

According to consulting company KPMG, one part of the cost spread between the two countries is adjunct to all European countries that possess unconventional shale. The European soil possesses different qualities that necessitate more powerful rigs and pumps. Also, the industry in Europe is in its infancy. In February 2012 there were only 72 rigs in total in Europe, most of which were not capable of reaching the European depth requirements. By comparison, the U.S. boasted nearly 2,000 rigs at that time.\(^{232}\)

However, rigs are not the only example. The slow development of unconventional natural gas in Europe keeps the cost of services high. In 2010, the costs were estimated to be approximately 20 percent higher than in North America.\(^{233}\) This spread has likely increased since due to new technologies employed by American oil and gas companies and an experience curve that has been dramatically decreasing extraction costs in the U.S.

For Poland in particular, a large part of the spread can be explained by the water supplies, or lack thereof. Hydraulic fracturing uses a considerable amount of water and Polish water supplies can cost up to 10 times what the same quantity of water would cost in the U.S. Also, there is an estimated 77 percent less renewable water per capita in Poland than in the U.S.\(^{234,235}\)

Finally, these numbers do not include provisions for unexpected challenges that appear in the birth of any new industry and cannot always be initially accounted for, especially in a country with a developing regulatory framework like Poland. KPMG provides an illustrative exploration cost example that showcases how far the projected numbers can be from reality: PKN Orlen spent more than $33 million (PLN 100 million) on the preliminary stage of exploration, far off from the anticipated $10-15 million for actual drilling costs.\(^{236}\)

\(^{229}\) (Natural Gas Europe, 2012)  
\(^{230}\) (Poprawa, 2011)  
\(^{231}\) (Poprawa, 2011)  
\(^{232}\) (KPMG, 2012, p. 24)  
\(^{233}\) (Gény, 2010)  
\(^{234}\) (Gény, 2010)  
\(^{235}\) (Schlumberger, 2011)  
\(^{236}\) (KPMG, 2012, p. 89)
Export opportunities: In the short term, Poland is not likely to export gas. Production-scale shale gas development will not start for another two years, and production will not meet domestic demand prior to 2020, at which point several gas-fired power plants may be built. Overall, export opportunities depend on the future unknown production levels of Poland’s shale gas; it is therefore difficult to speculate if or when Poland could export gas.  

However, Poland is also surrounded by countries that are projected to increase their gas demand. If Poland were to start exporting, it could export gas to Germany through the Jamal pipeline. A second option would be to deliver to Baumgarten, Austria, which is a major trading center for European natural gas.

Infrastructure & Technology

The KPMG study mentioned earlier indicates that there has been a high degree of cooperation among the private sector, scientists, state labs, geological services, and regulators in order to develop the industry. However, despite the large reserves potential in Poland, there is a substantial concern that Poland doesn’t have sufficient infrastructure in place to cope with large-scale production; a high level of investment would likely be needed to close this gap. This lack of gas-related infrastructure comes as no surprise given that Poland has historically relied primarily on coal. For example, studies show that only about half of Polish households are connected to gas distribution networks. Towards the end of 2012, only 33 wells were completed. The Environment Ministry is expecting 309 wells to be functional by 2021.

As was also mentioned earlier, there is a shortage of drilling rigs in Europe. GBI research indicates the shortage of drilling contractors, pressure pumping equipment, and land rigs for shale development. Geographically, most pipelines are in the southwest of the country. In contrast, shale gas reserves are likely to be located only in the north, east-central, and southeast parts of the country. Large parts of resources overlap with densely populated areas, agricultural land, and tourist destinations. In addition, concerns have been raised about the capacity and technical capability for wastewater treatment in Poland.

The overall level of transport infrastructure in Poland may also impede shale development. For instance, access for heavy equipment is limited. In general, Poland has a reputation for poor road conditions.

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237 (Natural Gas Europe, 2012)  
238 (KPMG, 2011)  
239 (Kemp, Johnson, & Boersma, 2012)  
240 (Peixe, 2012)  
241 (Strzelecki, Fracking Boom Delayed by Kites as Poland Seeks Gas Independence, 2013)  
242 (KPMG, 2012)  
243 (Kemp, Johnson, & Boersma, 2012)  
244 (Kemp, Johnson, & Boersma, 2012)  
245 (Accenture, 2012)
Railroad capacity is also facing restrictions. Concerning LNG, Poland will finish construction of an LNG re-gasification plant in 2014.

In light of these limitations, Poland, backed by the European Commission, is heavily investing to develop its natural gas markets. This includes investments to improve interconnectivity with surrounding markets. Even more, Poland is benefitting from the U.S. shale experience curve through the “Unconventional Gas Technical Engagement Program,” a program designed to bring technical expertise and regulatory experience to countries with significant shale resources, like Poland.

**Geology**

**Available Resources:** Estimates from the EIA place Poland’s technically recoverable shale gas reserves at 187 billion MMBtu. However, recent studies are less optimistic. In 2012 the Polish Geological Institute estimated that Poland’s onshore and offshore recoverable resources are between 12.2 billion and 27.1 billion MMBtu. Most of these resources are found in the Baltic-Podlasie-Lublin Basin, which cuts across the center of Poland from Gdansk to Lublin, although there are some smaller basins that could potentially hold a small quantity of additional gas resources. In an effort to further explore the offshore resource, Polish gas company PGNiG recently drilled a test well on the coast of the Baltic Sea and will present the results in the near future. Test wells drilled last year by ExxonMobil and other oil and gas companies have yielded results that indicate that Poland’s shale gas resources may not be commercially viable.

**Other Physical Properties:** Most of this shale is located at an average depth of 2,500 to 4,000 meters. This is relatively deep compared to other shale basins and could result in higher drilling costs. The thermal maturity of the shale ranges from immature (in the northeastern portions of the basin) to over-mature (near the western edge of the basin). The area in between these extremes has both wet gas and dry gas.

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246 (Mainwaring, 2012)
247 (Natural Gas Europe, 2012)
248 (Kemp, Johnson, & Boersma, 2012)
249 (US Department of State, 2012)
250 (US Energy Information Administration, 2011)
251 (Polish Geological Institute, 2012)
252 (Polish Geological Institute, 2012)
253 (Reuters, 2013)
254 (Carroll, 2012)
255 (Polish Geological Institute, 2012)
256 (Polish Geological Institute, 2012)
257 (Polish Geological Institute, 2012)
**Natural Obstacles:** The depth of Poland’s shale resources may increase drilling costs, but on the other hand this depth would likely prevent fracturing fluids from contaminating drinking water aquifers, which tend to be located at much shallower depths.258

258 (Accenture, 2012)
United Kingdom

Regulations

National Regulatory Structure: In the United Kingdom, natural resources are not legally owned by landowners per individual property rights. Instead, ownership is conferred on the state.

Legal Jurisdiction – Federal versus Local Laws: The UK is comprised of four separate countries with unique legal entities: England, Scotland, Wales, and Northern Ireland. European Union law takes precedence over UK law.

Each country in the UK has its own environmental regulatory agency: the Environment Agency (EA) serves England and Wales; the Scottish Environmental Protection Agency (SEPA) serves Scotland; and the Northern Ireland Environment Agency (NIEA) serves Northern Ireland.

Permitting Process: In England, Scotland, and Wales, licenses to exploit hydrocarbons are issued by the Department of Energy and Climate Change (DECC) through Petroleum Exploration and Development Licenses (PEDL) rounds. In Northern Ireland, licenses are granted by the Energy Division of the Department of Enterprise, Trade, and Investment.

PEDL licenses grant exclusivity to an operator and the operator must then negotiate with the landowner for access and the appropriate regulatory agency (e.g. The Coal Authority for coal) for consent for particular activities and controls. Licenses specific to hydraulic fracturing or directional drilling are not awarded per se. Rather, a PEDL license is issued with “consent” for hydraulic fracturing, and “controls” for mitigating its impact. In addition, local planning permissions must be obtained from the Minerals Planning Authority (England, Wales, Scotland), which then determines whether an Environmental Impact Assessment is necessary or required. The local MPA is also responsible for monitoring the operator and implementing environmental standards and best practices.  

Existing Laws and Standards: Shale gas extraction was not considered when regulations for conventional gas production were formulated in the 1990s. In fact, there is no specific mention of shale gas in the UK’s flagship resource law (Petroleum Act 1998). However, a stand-alone moratorium was temporarily issued against hydraulic fracturing in November 2011, after a government investigation linked recent seismic activity in Blackpool to the practice. In April and May 2011, small earthquakes of magnitudes 2.3 and 1.5, respectively, occurred when Cuadrilla Resources Ltd. fracked for shale gas at its Preese Hall site in Lancashire in northwest England. A Cuadrilla-commissioned report by the Department of Energy and Climate Change (DECC) detailed that injection or circulation of fluids changed stress patterns in the rock, and prescribed a threshold magnitude of 1.7, at which injection must be stopped.  

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259 (Royal Academy of Engineering, 2012, pp. 52-55)
260 (Royal Academy of Engineering, 2012, p. 44)
Investigations and reports notwithstanding, the British government has since lifted the ban on hydraulic fracturing. Basing his decision on “the evidence,” on December 13, 2012, Edward Davey, Secretary of the DECC, announced that exploration for shale gas can resume, subject to new controls to prevent seismic risk. These new mandated controls include precautionary measures, such as:

- A survey of faults near the proposed well site.
- Real-time seismic monitoring before, during, and after hydraulic fracturing operations.
- Transparency requirements, through submission of a hydraulic fracturing plan to the DECC detailing the duration and volume of fluids to be used, and disclosure of any chemicals to be approved by the government.

In addition, an “Office for Unconventional Gas and Oil” will be created within the DECC specifically to monitor and responsibly develop the shale industry. The work of this new governmental body will be supplemented by a DECC-commissioned study directly exploring the impacts of shale exploration on greenhouse gas emissions and climate change.\(^{261}\)

As a proof of the effect of regulation on drilling, Cuadrilla Resources announced on March 2013 that it would delay testing at a site in northwest England until 2014. The reason is the company’s decision to conduct a full environmental assessment, as required by the EU regulations (see EU section), before any drilling activity from now on; a decision that is set to delay the development of the UK unconventional resources.\(^{262}\)

**Politics**

**Political System:** The UK is a parliamentary democracy. Queen Elizabeth II is the head of state and David Cameron is Prime Minister of coalition government, composed of members of both the Conservative Party and the Liberal Democrats. Except for these elections and a one-term (four year) resurgence by the right-of-center Conservative party in 1997, the center-left Labour party has ruled consistently since the 1980s. Cameron’s cabinet is also the first coalition government since the Second World War, signaling the turbulence that has gripped Europe’s politics since the beginning of the financial crisis.

**Ongoing Hydraulic Fracturing Debate:** Two counteracting arguments, energy security versus environmental health, compete for support in the Parliament.

The ruling administration generally seems to be in favor of shale development, especially after having performed its due diligence in 2012. On December 5, 2012, the Secretary of State presented the government’s *Gas Generation Strategy* before Parliament, which notably points to discussions between Treasury and industry to create new tax incentives for shale gas production. The Chancellor later confirmed the UK’s push for shale in his autumn Statement: “We do not want British families and business to be left behind as gas prices tumble on the other side of the Atlantic.” What’s more, the

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\(^{261}\) (Alessi & Kuhn, 2012)

\(^{262}\) (Bakhsh, Cuadrilla Delays Shale Gas Testing at U.K. Site Until Next Year, 2013)
Energy Bill 2012, currently before Parliament, includes an Emissions Performance Standard (EPS) set at a level which allows new gas generating plants to be built.

On the other hand, the Committee on Climate Change (CCC) has lobbied for a de-carbonization target on the face of the Energy Bill, without which it says the current EPS proposal would cause a mad dash toward gas, in effect locking the UK into a high carbon system. However, prominent Conservatives like Charles Hendry have noted that a sprint toward shale development is unlikely, as it will be years before the UK sees commercial production given the lack of economic incentives.

Markets
The country has increasingly been relying on natural gas imports, mainly from Norway. The graph below showcases the gradual switch from local production to imports; the UK imports 766 million MMBtu of gas from Norway and 226 MMBtu from the Netherlands.\(^{263}\) As can be seen in the graph, it also imports a substantial part of its natural gas imports through LNG, 86.5 percent of which comes from Qatar.\(^{264}\) Yet this year the LNG imports have fallen dramatically (from 4.2 million MMBtu/d to 177 thousand MMBtu/d)\(^{265}\) due to more attractive spot prices abroad, increasing UK’s reliance on Norwegian gas and intensifying the need for diversification.

![UK natural gas supply mix, January 2007 – May 2012](EIA, 2012)

Recently, as of March 2013, the U.S. has been added as a soon-to-be exporter of gas to the UK. Centrica, the British Gas owner, entered a 20-year agreement with Cheniere Energy Partners, under which the

\(^{263}\) (BP, 2012)
\(^{264}\) (BP, 2012)
\(^{265}\) (Chazan, 2013)
British agreed to purchase 91.25 million MMBtu of annual LNG volumes. The LNG terminal used will be terminal 5 of Sabine LNG Terminal, which is planned to come online as early as 2018.\(^{266}\)

**Price environment:** The UK trades most of its gas through the NBP virtual gas trading point. The following is an analytical display of the trends in the price environment of the UK, both for retail prices and the UK NBP hub. UK boasts some of the lowest prices in the EU of 27 for retail natural gas\(^{267}\). Accordingly, as can be seen in the “UK NBP hub” graph below, while the shale revolution has admittedly led to a collapse of the Henry Hub price, UK is still offering lower prices than Japan or Germany. The price may have been increasing (see tables for spot prices below), but not enough to avoid the redirection of the LNG cargos to the Asia-Pacific market.

### 2009-2012 Natural Gas Prices\(^{268}\)

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural gas household price (USD/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$16.24</td>
</tr>
<tr>
<td>2010</td>
<td>$16.09</td>
</tr>
<tr>
<td>2011</td>
<td>$19.94</td>
</tr>
<tr>
<td>2012</td>
<td>$15.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Natural gas industry price (USD/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>$8.31</td>
</tr>
<tr>
<td>2010</td>
<td>$8.69</td>
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<tr>
<td>2011</td>
<td>$10.56</td>
</tr>
<tr>
<td>2012</td>
<td>$10.90</td>
</tr>
</tbody>
</table>

Note: conversion rate used is 1 € to 1.3 USD.

**UK NBP hub\(^{269}\)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Spot natural gas price (US$/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>4.85</td>
</tr>
<tr>
<td>2010</td>
<td>6.56</td>
</tr>
<tr>
<td>2011</td>
<td>9.03</td>
</tr>
</tbody>
</table>

\(^{266}\) (Yahoo Finance, 2013)  
\(^{267}\) (Europe's Energy Portal, 2012)  
\(^{268}\) (Europe's Energy Portal, 2012)  
\(^{269}\) (BP, 2012)
Extraction costs: In the following page is an analytical breakdown of the unconventional drilling related costs of Cuadrilla. With a total of 10,446,000 pounds (approximately $16,190,000 USD with an £1/$1.55 exchange rate), these wells require almost 3 times the capital that a U.S. well requires (see Polish extraction costs for further justification on this spread).
### Costs of Test Well Operations

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost ($)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Preparation Works</td>
<td>914,500</td>
<td>Includes all preparatory work required to secure planning consent for the test well location. Also includes all initial earthworks, laying membrane</td>
</tr>
<tr>
<td>All Drilling and Related Costs</td>
<td>6,723,900</td>
<td>Includes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Payments made by third party suppliers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Drill fluids</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All costs incurred by internal drilling service companies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Allowance for depreciation of drilling rig</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provision of casing and tubes</td>
</tr>
<tr>
<td>All Fracturing &amp; Related Costs, and Testing</td>
<td>8,552,590</td>
<td>Includes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All costs incurred by internal fracturing company</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Allowance for depreciation of main fracturing equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Payments made third party suppliers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Technical testing throughout process (some on-site, some off-site)</td>
</tr>
<tr>
<td>Total (incl depreciation costs)</td>
<td>16,190,990</td>
<td></td>
</tr>
</tbody>
</table>

Notes:
(1) Exchange rate used is £1 to USD 1.55.
(2) The above total also includes an apportionment of Cuadrilla HQ time to test well activities of USD 465 per test well.
(Regeneris Consulting, 2011, p. 36)

### Disaggregation of Test Costs ($)

<table>
<thead>
<tr>
<th>Origin of Workers &amp; Suppliers</th>
<th>Lancashire</th>
<th>Rest of UK</th>
<th>Overseas</th>
<th>Total</th>
<th>Total UK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>469,650</td>
<td>3,073,650</td>
<td>847,850</td>
<td>4,391,150</td>
<td>3,541,750</td>
</tr>
<tr>
<td>Subsistence</td>
<td>596,750</td>
<td>119,350</td>
<td>79,050</td>
<td>795,150</td>
<td>716,100</td>
</tr>
<tr>
<td>Goods &amp; Services (including depreciation)</td>
<td>1,241,550</td>
<td>2,779,150</td>
<td>3,258,100</td>
<td>7,278,800</td>
<td>4,020,700</td>
</tr>
<tr>
<td>Overhead</td>
<td>178,250</td>
<td>1,071,050</td>
<td>534,750</td>
<td>1,784,050</td>
<td>1,249,300</td>
</tr>
<tr>
<td>Profits</td>
<td>193,750</td>
<td>1,165,600</td>
<td>582,800</td>
<td>1,943,700</td>
<td>1,359,350</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,679,950</td>
<td>8,208,800</td>
<td>5,304,100</td>
<td>16,191,300</td>
<td>10,887,200</td>
</tr>
</tbody>
</table>

Notes:
(1) Exchange rate used is £1 to USD 1.55. (Regeneris Consulting, 2011, p. 37)
Infrastructure & Technology
The UK has a well-developed, privately-controlled natural gas sector. According to the Royal Society and the Royal Academy of Engineering, there have been more than 2,000 onshore wells drilled in the UK over the last 30 years, 10 percent of which have been hydraulically fractured to enhance recovery.\textsuperscript{270}

There are four pipelines from offshore to the coast. These pipelines link the UK to Norway and Netherlands through incoming flows, Ireland through outgoing flows and reversible flows with Belgium.\textsuperscript{271} In terms of LNG capacity, there are four LNG import terminals in place, with additional capacity planned. Moreover, there are several gas storage projects under development that will increase the UK’s somewhat limited storage capacity.\textsuperscript{272}

Geology
Available Resources: The EIA has estimated that the United Kingdom contains 20 billion MMBtu of technically recoverable shale gas. Most traditional gas reserves are found in the UK continental shelf, the area adjacent to the Dutch sector of the North Sea, and the Irish Sea.\textsuperscript{273} The outcrop formations with the best potential for shale gas are the Bowland Shale Group (found roughly near the Pennines mountain range), the Lower Liassic Shales, the Kimmeridge Clay Formation, and the Oxford Clay Formation.\textsuperscript{274} Recent test drilling by Cuadrilla in the portion of the Bowland Shale Group located north of Liverpool has indicated that there may be more shale gas in the UK than the EIA’s initial estimates.\textsuperscript{275}

Other Physical Properties: The Bowland Shale Group is typically found at a depth of 2,000 to 2,750 meters.\textsuperscript{276} The high clay content and relatively soft consistency of the Kimmeridge and Oxford formations may pose difficulties for hydraulic fracturing. The Lower Liassic Shales are considering thermally immature and therefore unlikely to be suitable for development, although the Weald Basin may contain commercially viable quantities of wet gas, condensate and oil.

Natural Obstacles: Several seismic events occurred in 2011 in conjunction with test wells drilled by Cuadrilla, resulting in public alarm and a yearlong moratorium on hydraulic fracturing.\textsuperscript{277} The moratorium has since been lifted and the Royal Academy of Engineering released a report in 2012 that includes mitigation strategies to reduce the potential for seismic activity with future drilling.\textsuperscript{278}

\textsuperscript{270} (Royal Academy of Engineering, 2012)  
\textsuperscript{271} (International Energy Agency, 2010)  
\textsuperscript{272} (International Energy Agency, 2010)  
\textsuperscript{273} (US Energy Information Administration, 2011)  
\textsuperscript{274} (PacWest Consulting Partners, 2011)  
\textsuperscript{275} (Bakhsh, Cuadrilla in ‘Advanced’ Talks with Energy Major on U.K. Shale, 2013)  
\textsuperscript{276} (Regeneris Consulting, Economic Impact of Shale Gas Exploration & Production in Lancashire and the UK, 2011)  
\textsuperscript{277} (Royal Academy of Engineering, 2012)  
\textsuperscript{278} (Royal Academy of Engineering, 2012)
EU Regulations for Unconventional Gas

Summary
Due to the relatively recent development of unconventional natural gas in Europe, the European Commission is still in the process of assessing the impact on the member-states. According to the Commissions’ official website,

“The European Commission remains neutral as regards Member States decisions' concerning their energy mix. It will oversee compliance with EU legal requirements, and ensure that an appropriate framework to enable sustainable shale gas extraction is in place. EU policy objectives towards a decarbonised and resource-efficient economy remain a key priority, together with EU commitments towards improving energy efficiency and further developing renewable energy sources.”

That can be read as a reluctant acceptance of unconventionals in the energy landscape of the continent and subsequent inclusion of shale gas in the regulatory framework. While the Commission has made clear their preference for renewables with the “20-20-20” targets (The EU Climate and Energy Package), recent studies on shale gas released by the Commission show that they are well aware of the financial benefits of unconventional natural gas. Those studies can be found in the next section.

Nevertheless, the EU holds the reins in environmental conservation. It can be expected that the Commission will, within its limitations, create the tightest possible regulation around the development of shale gas resources. E&P companies are already required to disclose the chemicals used for hydraulic fracturing and to follow a variety of other guidelines, many of which are listed in the following pages.

Any further decisions made by the Commission that relate to unconventional natural gas will be posted on the EC’s website at the following URL:


European Commission Studies on Unconventional Natural Gas
The Commission has already published three studies on unconventional gas that assess the effects of the unconventionals for the EU citizens:

1. The study on energy market impacts shows that unconventional gas developments in the U.S. have led to greater LNG supplies becoming available at the global level, indirectly influencing EU gas prices.

279 (European Comission, 2013)
280 (Philippe & Partners, 2011)
281 (European Comission, 2013)
2. The study on climate impacts shows that shale gas produced in the EU causes more GHG emissions than conventional natural gas produced in the EU, but if well managed, shale gas from the EU has less emissions than imported gas from outside the EU, be it via pipeline or by LNG due to the impacts on emissions from long-distance gas transport.

3. The study on environmental impacts shows that extracting shale gas generally imposes a larger environmental footprint than conventional gas development. Risks of surface and ground water contamination, water resource depletion, air and noise emissions, land use, disturbance to biodiversity and impacts related to traffic are deemed to be high in the case of cumulative projects.

Existing Regulations

In the EU, there are a variety of legal acts with different binding powers. A Regulation is a legislative binding act that all EU countries are obliged to implement in its entirety. A Directive sets a goal, but individual member countries independently decide how to achieve that goal.


This directive reaffirms the sovereignty rights of the member states over hydrocarbon resources within their territories by stating that it is “up to each Member State to determine the geographical areas in which the rights to prospect, explore for and produce hydrocarbons may be exercised and to authorize entities to exercise those rights.”

Yet the true purpose of the directive is to protect effective competition. It stipulates that a single entity cannot have exclusive rights over an area “whose prospection, exploration and production can be carried out more effectively by several entities,” thereby contradicting the notion of exclusive rights for any single entity. It also regulates, together with Directive 2004/17/EC, procedures for granting authorizations and procurement procedures, to ensure a transparent and efficient market.

   Directive 2009/147/EC (the Birds Directive)

The Environmental Assessment Directive requires the conduct of an environmental assessment by the developers before the start of any project that might affect natural habitats. The assessment needs to identify direct and indirect effects of a project on:

- Human beings, fauna and flora
- Soil, water, air, climate and the landscape
- The interaction between the factors mentioned in the first and second indents

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282 (Philippe & Partners, 2011)
283 (European Commission, 2013)
284 (European Commission, 2013)
285 (European Commission, 2013)
286 (European Commission, 2013)
The Business Landscape for Unconventional Natural Gas

• Material assets and cultural heritage

The Habitats Directive and the Birds Directive serve to regulate the assessment so as to be in accordance with the principles of the two directives. 287, 288

3. Regulation 2006/1907/EC concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH)

REACH requires the disclosure of the chemicals used in hydraulic fracturing and establishes a European Chemicals Agency. 289

4. Legislation transposing directive 2003/4/EC

This environmental legislation requires all environmental information held by governmental authorities to be systematically available and distributed to the public. 290


According to the Commission, “the directive establishes a framework for environmental liability based on the ‘polluter pays’ principle, with a view to preventing and remedying environmental damage.” 291 If a developer is responsible for any environmental liability that has already occurred or is in imminent threat of occurring, then this directive forces the operator to take the appropriate measures and also recover any incurred cost.

6. Three water directives for the protection of the continent’s water resources:

   a. Directive 2000/60/EC, framework for Community action in the field of water policy

7. Directives on noise:

   a. 2002/49/EC relating to the assessment and management of environmental noise

This directive serves to protect the European citizens from noise pollution. It is based on “using common methods to map noise, on providing information to the public and on implementing action plans at local level.” 292

287 (European Comission, 2013)
288 (European Comission, 2013)
289 (European Comission, 2013)
290 (European Comission, 2013)
291 (European Comission, 2013)
292 (European Comission, 2013)
b. Noise Directive 2000/14/EC on the emission in the environment by equipment for use outdoors

This directive “requires noise marking for 57 types of equipment used outdoors. For 22 of these equipment types, the directive also sets noise limit values.”


It regulates the design, manufacture, testing, and conformity assessment of pressure equipment and assemblies of pressure equipment. The guidelines laid out for these types of equipment are described below.

Pressure equipment and assemblies above specified pressure and/or volume thresholds must:
- Be safe.
- Meet essential safety requirements covering design, manufacture and testing.
- Satisfy appropriate conformity assessment procedures.
- Carry the CE marking and other information.

Pressure equipment and assemblies below the specified pressure / volume thresholds must:
- Be safe.
- Be designed and manufactured in accordance with the sound engineering practice of a Member State.
- Bear specified markings (but not the CE marking).

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293 (European Comission, 2013)
294 (European Comission, 2013)
Scenarios for Select Countries
Scenario Methodology

Argentina, Australia and Canada were preselected by Crédit Agricole as having the highest potential for unconventional gas development. These promising country cases were then imagined in a scenario analysis, with a five-year time horizon. Below, find a brief description of the process used to construct those scenarios:

**Step 1: Country research:** The country-specific research into unconventional gas development, as summarized above, informed the scenarios, forecasted five years into the future. The analysis focused specifically on near-term economic and political variables such as existing contracts, developing or planned infrastructure projects, current legal structures, electoral cycles and activities of various stakeholders.

**Step 2: Uncertainty/Impact matrix:** From this body of information, key variables were derived that would impact the development of unconventional gas in each country. These were graphed along the continuums of impact and uncertainty with the objective to determine “key uncertainties,” or significant variables which had a high degree of impact on unconventional development. Two of the most essential uncertainties were extracted from the “two forces” analysis. Scenarios were then informed by the potential changes in these forces. Underlying drivers and key actors were also identified.

**Step 3: Two-Forces matrix:** The two key uncertainties were then charted on a two-by-two matrix, denoting weak-to-strong or favorable-to-unfavorable continuums, along the axis. (Please find the forces matrices for each country below.) Hypothetical events were then categorized in the quadrants of the country matrix, depending on where they fell along the two continuums.

**Step 4: Narrative of three scenarios per country:** A narrative was created for each quadrant representing a “scenario” that falls between strong or weak opposition and good and bad business environment. Three states of the world, one best-case for investment, and two middle-cases, were then imagined and narrated into a story. Each scenario is intended to alert investors to negative or positive possibilities previously unimagined. To note, there is no narration for a worst-case scenario assuming Crédit Agricole would not invest in such environments.

**Step 5: Conclusions and recommendations:** The different scenarios were then examined and analyzed to extract common drivers among them. After those factors for change were determined, “leading indicators” or “signposts”, which may point to or hint at those factors today, were identified. The purpose of highlighting indicators is to advise investors to monitor or watch those events or items over the next few years, in order to make preemptive decisions.
# Argentina - Scenario Forces

## Business Environment

<table>
<thead>
<tr>
<th>Strong</th>
<th>Unfavorable Market Signals</th>
<th>Favorable Market Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kirchner wins presidency on populist agenda</td>
<td>Kirchner wins presidency, little populist rhetoric</td>
<td></td>
</tr>
<tr>
<td>Foreign exchange rates depreciate</td>
<td>Foreign exchange rates appreciates</td>
<td></td>
</tr>
<tr>
<td>Capital constraints removed</td>
<td>Capital constraints removed</td>
<td></td>
</tr>
<tr>
<td>Lower reserve estimates</td>
<td>Higher reserve estimate</td>
<td></td>
</tr>
<tr>
<td>Political instability/strong opposition party</td>
<td>Political stability</td>
<td></td>
</tr>
<tr>
<td>Competition policy less restricting</td>
<td>Competition policy less restricting</td>
<td></td>
</tr>
<tr>
<td>International gas supply increases</td>
<td>International demand for gas grows</td>
<td></td>
</tr>
<tr>
<td>Stagnant growth in Latin America</td>
<td>Growth in Latin America</td>
<td></td>
</tr>
<tr>
<td>LNG facilities delayed</td>
<td>LNG development</td>
<td></td>
</tr>
<tr>
<td>Gov’t energy pricing stagnant</td>
<td>Gov’t energy pricing increase</td>
<td></td>
</tr>
<tr>
<td>Weather: creates water scarcity</td>
<td>Weather: cold winter</td>
<td></td>
</tr>
<tr>
<td>Repsol legal issues resolved</td>
<td>Repsol legal issues resolved</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kirchner wins presidency, little populist rhetoric</td>
</tr>
<tr>
<td>Higher reserve estimate</td>
</tr>
<tr>
<td>Competition policy more restricting</td>
</tr>
<tr>
<td>Growth in Latin America</td>
</tr>
<tr>
<td>Gov’t energy pricing increase</td>
</tr>
<tr>
<td>Nationalization</td>
</tr>
</tbody>
</table>
Argentina Scenarios

GOAL!
This scenario finds Argentina heading towards a much friendlier business environment for foreign operators and a robust unconventional gas industry. Kirchner has won reelection in 2015 and her party controls a healthy majority of the legislature. The political climate is stable as economic growth and a calm region create a cooperative environment. The opposition party has made some gains but fails to win a majority and continues to be too disorganized, lacking support to offer an opposing voice in domestic politics. Kirchner, with no mismanaged budget, does not resort to jingoistic rhetoric and a populist agenda to quell the population.

Unconventional gas growth is strong, primarily driven by domestic and regional economic growth. Particularly important, are the strong economies of Brazil and Chile. On the domestic front, demand will be driven by a stable economic environment as well as continuous cold weather. Cold winters have historically put strain on Argentina as it scrambles to obtain sufficient gas supplies from LNG imports or though pipelines from Bolivia. This usually results in high prices and political unease as the population worries about heat supply during the winter. However, in this scenario, Argentina has been able to develop its domestic natural gas industry to provide efficiently for its domestic consumers. Continued drilling has reaffirmed Argentina’s gas reserves or perhaps upgraded estimates, making the country even more attractive for development.

LNG facilities are just beginning to operate and export off the continent is still in its infancy. However, strong global demand will facilitate financing of new LNG facilities. Argentina will trade with high demand economies in Asia but the main destination will be Europe and Africa. Argentina, in an effort to maintain geopolitical neutrality will refrain from trading with rogue governments such as Iran. They will continue to trade with Venezuela.

Additionally, Argentina makes a few strong gestures that encourage foreign actors to invest and do business in Argentina. First, Argentina continues its policy to raise gas prices to encourage drilling and loosen restriction on price controls. However, it is doubtful that Argentina will remove all gas price controls but it could for example set a floor of $7.50/MMBtu and allow it to float within a band. Secondly, the trial of Repsol is resolved in favor of Argentina, giving no ammunition to Repsol to hinder FDI. Lastly, capital controls are relaxed and anti-competition regulations are rarely enforced (it is doubtful they will be amended) in an effort to court new international companies. On the market level, gas prices remain high and the Argentinian exchange rate appreciates. With less capital controls, foreign companies will be able transfer huge earnings abroad.

It’s Messi
As in the previous scenario, demand for gas remains high in Argentina, Latin America and the world. The natural gas industry in Argentina is ripe for development with strong reserves and growing demand.
However, Kirchner does not change course in regards to international participation. This is further exacerbated by volatile exchange rate and slow economy, which pushes Kirchner to use her modus operandi: a populist agenda. Wellhead gas prices will most likely stay around $7/MMBtu but subsidies will be offered to consumers. This will create a large burden on the account balance of the country and force monetary action such as further capital restraints.

The situation for international companies continues to deteriorate as the Repsol ruling winds up being in favor of Repsol, and the Spanish company sues any international enterprise that does business with YPF. Because of this, development is slow to progress and Argentina resorts to stronger anti-competitive regulations and more nationalization, perhaps wells from Chevron and Exxon. Since these are larger global brands, the news in the global media and business world is impactful. This further slows development because national companies will have difficulty in obtaining the proper equipment and technology.

Nonetheless, the resource base and infrastructure in Argentina is attractive for gas development. The government invests more resources into the national companies, such as YPF and pipelines. LNG facilities will continue to be constructed, albeit with no trade occurring until after 2015. Any international companies that have successfully dodged the myriad of regulatory and capital restrictions will benefit from abundant opportunities. However, the general climate for international companies will be low.

**Benched**

This scenario finds Argentina on the path of nationalized gas development, similar to the second scenario, but domestic and natural elements have severely decreased the opportunities for shale gas development. Kirchner has won the presidency but opposition leaders have gained ground during the legislative elections. A more cohesive opposition opinion has formed that has hindered the President’s ability to push through her agenda. This creates an air of political instability, manifested through street protests and strikes. Additionally, with central control of the media loosening, anti-fracking groups, sponsored by European compatriots, have gained a stronger voice in the public. Although this movement is still small in comparison to the consensus on hydraulic fracturing, small disruptions and perhaps stronger environmental policy may follow. Beyond even Kirchner’s iron grip, nature has also been unkind to the country. Issues of water scarcity continue to plague development in the Noruquen region, which further emboldens environmental groups. And perhaps, the resource base is downgraded because the slow drilling schedule cannot confirm more potential reserves.

Bowing to populist pressure, Kirchner decreases the price for natural gas below the current $7.50/MMBtu. This discourages development from domestic and international firms. With less supply, the country will not be able to handle the cold winter, spending foreign reserves to import gas from neighboring countries at higher prices or even LNG from Iran, which has been a consistent cheap supplier in the past. The consequences of this are two-fold. First, with LNG facilities still importing this
will impede their refurbishing into export facilities. Second, with continued dealing with Iran, Argentina further isolates itself from the international community.

Kirchner will continue her populist agenda with capital restraints and anti-competitive regulation that further depreciate the currency and scare off potential investors. This will cause technology transfers and development to slow to a crawl. As other international actors ramp up supply, Argentina will become less attractive and less competitive despite growing international demand. This delay will also give Brazil the opportunity to be a regional leader in production.

**Conclusion and Recommendations**

In Argentina, investment determinations rest almost entirely on sociopolitical factors. Though Kirchner is poised for re-election in 2015 under every scenario, it is instructive to monitor “signposts” or leading indicators which may inform her policy decisions and legislative power. Specifically, any indications of political unrest or popular disfavor with Kirchner’s administration, as evidenced through protests or opinion polls, could predict her party’s inclination to institute or renew populist legislation, such as the hugely significant price caps on natural gas. Alternately, a growing opposition movement could impede Kirchner’s ability to pass and implement politically-motivated bills, mitigating the party’s capacity to further her agenda. To determine the weight of these countervailing forces, Credit Agricole should watch any shifts in power in the parliament, regulatory and court systems, as well as trends in popular opinion toward the administration and environmental issues in general.

Another important and tangible leading indicator of the future business environment in Argentina is the legal verdict in the Repsol-YPF trial. If international courts determine that the renationalization of YPF was in fact lawful, international investor confidence will be restored in the country, and foreign capital will likely follow, bolstering more unconventional gas development. From this positive market signal, a domino effect could ensue, whereby the administration enacts business friendly policies, such as favorable competition laws and the removal of capital constraints, to invite foreign direct investment. Conversely, if the verdict is against Argentina, the country could either isolate itself further from international markets, through such actions as importing gas from Iran, or it could, under a less likely scenario, admit wrong and reform. Regardless of the Argentinian government’s response, however, the YPF-Repsol legal case is highly indicative of IOC and investor attitudes toward Argentina, and should be closely followed.

Exogenous variables to track are natural gas demand and supply dynamics in the major export regions of Asia and Europe, and Latin America in general.
# Australia - Scenario Forces

## Business Environment

<table>
<thead>
<tr>
<th>Unfavorable Market Signals</th>
<th>Favorable Market Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas development stagnates due to market signals</td>
<td>Gas development increases</td>
</tr>
<tr>
<td>Planned LNG export terminals scrapped</td>
<td>Planned LNG export terminals built</td>
</tr>
<tr>
<td>Foreign supply to Asia-Pacific increases</td>
<td>Foreign supply to Asia-Pacific remains stable, Australian competition crowds the market</td>
</tr>
<tr>
<td>Asia-Pacific gas prices fall</td>
<td>Asia-Pacific gas prices increase</td>
</tr>
<tr>
<td>China-Russia gas pipeline</td>
<td>No China-Russia pipeline</td>
</tr>
<tr>
<td>China shale gas sees fast development</td>
<td>China shale development slow</td>
</tr>
<tr>
<td>Lax regulation on hydrocarbon industry</td>
<td>Lax regulation on hydrocarbon industry</td>
</tr>
<tr>
<td>Liberal Party in power</td>
<td>Liberal Party in power</td>
</tr>
<tr>
<td>Domestic gas prices increase less than expected</td>
<td>Domestic gas prices increase significantly</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Strong</th>
<th>Unfavorable Market Signals</th>
<th>Favorable Market Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas development stagnates due to social opposition</td>
<td>Foreign supply to Asia-Pacific up slightly but still a large market share available for Australia</td>
<td></td>
</tr>
<tr>
<td>Planned LNG export terminals scrapped</td>
<td>Asia-Pacific gas prices increase</td>
<td></td>
</tr>
<tr>
<td>No China-Russia pipeline</td>
<td>China shale development slow</td>
<td></td>
</tr>
<tr>
<td>China shale development slow</td>
<td>Stringent regulation on hydrocarbon industry</td>
<td></td>
</tr>
<tr>
<td>Labor Party in power</td>
<td>Labor Party in power</td>
<td></td>
</tr>
<tr>
<td>Domestic gas prices increase significantly</td>
<td>Domestic gas prices increase significantly</td>
<td></td>
</tr>
</tbody>
</table>
Australia Scenarios

Rivals
This scenario sees gas development stagnating in Australia due to worsening market signals. Australian
gas developers face a worsening market for their product abroad and the currently planned LNG export
projects are scrapped. The weak market stems from a significant increase in supply to the Asia-Pacific
market in combination with a reformulation of the oil-indexation of LNG supplies which has significantly
lowered prices.
The supply comes primarily from:

- **South East Asia**: Indonesia (Abadi 12 mtpa), Malaysia (expansion of Petronas LNG Complex
  3.6mtpa and the building of an FLNG plant 1.2mtpa) and Papua New Guinea (Gulf LNG 4mtpa)
  have all made FIDs since 2013. This 20 mtpa increase in supply also has lower production costs
  than Australian gas which decreases utilization of Australia’s existing plants as they find it harder
to find buyers for their flexible supply.

- **North America**: Sabine Pass (18mtpa 3.5 mtpa Gail, 3.5mtpa Korea Gas) Kitimat LNG (5 mtpa all
  of which is going to the Asia-Pacific market) Freeport LNG (13 mtpa, 4.4 of which is dedicated to
  Japan).

- **Mozambique**: Mozambique LNG produces 20 mtpa and exports primarily to the Asia-Pacific
  basin.

Between Mozambique, North America, and South East Asia, the Asia-Pacific market sees a 60 mtpa
increase. In 2011 the Asia-Pacific market bought 207bcm (153mtpa), with 69mtpa of capacity under
construction to serve the market. Thus the Asia-Pacific market is now slated to accommodate twice as
much LNG as it did in 2011. Needless to say this weakens the bargaining position of Australia’s planned
LNG projects who have found it increasingly difficult to find buyers at competitive prices. Existing plants
also find it harder to find buyers for their spot cargoes and utilization rates decrease across Australia.

Demand in the Asia-Pacific basin has also gone down as China and Russia have finalized a natural gas
contract for a gas pipeline to be built by the end of the forecast period. China’s shale gas exploration is
also developing faster than predicted and while the production volumes are still negligible in the grand
scheme of things expectations of faster growth in the years after the forecast period is influencing
investment decisions and weakening producers bargaining position vis à vis China.

Meanwhile, gas enjoys a privileged political position with lax regulation and support from civil society,
especially labor unions. The Liberal Party of Australia has won the federal election in 2013 as well as the
Western Australian state election, sparking a wave of election victories in the resource-rich states of
New South Wales and Queensland.

Australia sees an increase in domestic gas prices as its domestic prices start tracking international prices.
However, this increase is not as significant as many observers were predicting, due to lower
international prices. The increase in prices has also lowered natural gas demand in Australia and sparked
The Business Landscape for Unconventional Natural Gas

competition from competing energy sources, primarily coal which has lamented its already dominant position in the electricity mix.

**Gas Gas Gas**

This scenario sees Australia increase its natural gas production significantly, both through design and through competitiveness in the market. The political climate is supportive of natural gas development as the Liberal Party of Australia wins sweeping victories and promotes natural gas development through tax incentives. The government’s rationale for this preferential treatment is that the backward linkages associated with investments in the energy sector create so much value that tax breaks are recouped elsewhere as the economy keeps growing. Regulation of unconventional gas is lax, which has lowered production costs since many developers now take short-cuts. This also means that the government and the natural gas developers are playing a high stakes game. If a major accident or spill is brought to the public's attention, Australia’s privileged position may end.

The cap-and-trade system slated to follow the carbon tax system currently in place is seen as a failure. It has actually favored natural gas development, thanks to a combination of grandfathering clauses and a large supply of price-depressing emission rights. The price on carbon is largely inconsequential, as it is too low to act as a barrier to entry for producers. It is simply incorporated as a marginal extra cost of doing business, and does not inspire any real effort to reduce the carbon footprint. Australian politicians either failed to learn a lesson from the European Emissions Trading Scheme (ETS) or wanted the scheme to fail.

Coal producers however see the ETS as a greater hindrance as coal is at a disadvantage relative to natural gas. This has meant that new efficient combined cycle gas turbines are being built and Australia’s overall carbon footprint goes down.

Demand, both endogenous and exogenous, increases substantially. Australian export competitors are struggling to develop as fast as Australia. A series of Final Investment Decisions (FIDs) have meant that finding LNG buyers in the Asia-Pacific basin has become more challenging. Australia has locked in a large part of the incremental demand increase.

The exogenous demand increase comes from continued economic growth in Asia, namely from China and India. China's growing pains mean it is willing to accept high gas prices. Negotiations with Russia over pipeline gas breaks down and China is no longer able to use the prospect to improve its bargaining position. Japanese demand remains consistently high and Korea has increased its imported volumes.

Shale gas development is now in its early production stage, which has brought about a wave of announcements about expansions to existing LNG projects. The government has promised a swift regulatory process to get these supplies online as quick as possible.
Green Revolution

In this scenario gas development is halted by a combination of social opposition stemming from a variety of actors that normally are not in the habit of working in the same direction, such as the agricultural lobby (agitated by what they see as a threat to their water supply and soil) and the environmental lobby. Social awareness of climate change has heightened after worrying reports of degradation of the Barrier Reef and a series of extreme weather events have highlighted the cost of emitting carbon into the atmosphere.

Underlying market conditions are still positive for gas, but the industry's image is tarnished. This leads to a bitter division between civil society and natural gas developers. This means that existing natural gas developers continue to reap benefits from the strong market but now have to deal with more stringent regulations. The proactive players fare the best. This scenario is all about anticipating changes to come and realizing what risk management tools to use to mitigate this risk.

The Liberal Party's support of the natural gas industry has also been seen as a negative influence in its electability, which has forced it to create some distance between itself and the industry. The manufacturing industry has successfully branded natural gas as a commodity of national and strategic interest, and has managed, through lobbying efforts, to implement reservation policies in several states. This move is in part due to quickly rising natural gas prices that have evoked anti-trade sentiments in the electorate. The lobby by the manufacturing industry is welcomed by the consumers, who want to see lower natural gas prices.

Cap and trade policy develops on Green Party political momentum with a high focus on reducing carbon emissions, which limits the supply of emission rights, increases its efficacy in turn. Gas producers place a higher focus on methane leakage. Proactive players fare best as the cost of non-compliance can be high.

Exogenous supply of gas to the Asia-Pacific basin still leaves a large market share for additional players and Australian developers are frustrated by what they see as a conscious move to block entry to the market. Some are now bringing cases to the WTO to abolish reservation policies and create a level playing field. This has negatively affected the FDI climate in Australia, previously a major source of outside capital, primarily from China. Many observers are predicting lower growth rates for the Australian economy during the years after the forecast period.

Domestic demand for natural gas has increased, but since many developers now have a harder time to bring natural gas to the international market the differential between domestic gas prices and international prices is larger than in other scenarios.

This scenario has the added benefit of increasing natural gas market share in domestic electricity generation at the expense of coal. However the cost of this undertaking is high as several gas turbines have had to be retro-fitted to comply with more stringent environmental regulations.
Conclusion and Recommendations

A scenario analysis confirms that the promise of increasing Australian unconventional gas development depends heavily on factors external to the country itself. The key signposts to monitor are indications of shifts in the current supply and demand dynamic in the global gas regime. In particular, the supply-side variables to watch are U.S. LNG, Canadian LNG, Chinese gas pipeline and shale infrastructure, Mozambique LNG, and on the buy-side, Japan, Korea and China's long-term contracts and projected demand. Because of the many moving parts, Australia's unconventional gas potential is difficult to predict, especially given the long lead time for any appreciable change in the world gas landscape. However, in the near-term five-year time horizon, positive investment indicators include planned LNG projects progressing to FID, existing LNG terminals contracting their supply before construction is complete, and fixed volume and price terms which guarantee a stable revenue stream for these high-cost projects.

Under every scenario, we can reliably predict a domestic price increase from the export volumes already contracted, but the speed and degree to which prices rise have important implications for the economic viability of shale gas. For this reason, it is important to watch trends in the world and Asia-Pacific region’s gas pricing mechanisms, insofar as they indicate movements toward spot pricing or, alternately, oil-indexed long-term contracts. Australian domestic legislation should also be tracked, in particular to determine whether gas pricing is localized, as it is presently, or uniformly instituted, in the event of a federal reform. A national pricing policy would be conducive to lower prices, since non-resource rich states do not benefit from unconventional development or export revenues like Queensland or New South Wales, for example.

The unfolding of the cap-and-trade phase of Australia’s recently instituted emissions trading scheme is also important to monitor legally and politically, not so much because it will have significant bearing on the feasibility of unconventional development, but because it will be telling of national attitudes and perceptions toward hydraulic fracturing, CBM and shale. It can be a useful proxy for measuring the strength of the environmental lobby, as well as the political parties.
# Canada – Scenario Forces

## Business Environment

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<td>Chinese economy slows, new generation met with coal</td>
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<td>Agreements made with First Nations</td>
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<td>Conservatives lose power, Liberal party takes over at federal level</td>
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<td>GHG regulation tightened, lifecycle of natural gas included</td>
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Canada Scenarios

Free Market Revolution

Growth in unconventional natural gas development in Canada is driven by the increased use of natural gas over coal for electricity generation, increased levels of demand from the Asia-Pacific region and support from social and political leaders.

Environmental opposition, emboldened by fears of extreme weather and damage to urban centers, successfully pushes for tougher provincial greenhouse gas regulations in British Columbia, Alberta, Manitoba, Quebec, and Ontario. However, this tougher legislation only accounts for power plant emissions; it ignores full lifecycle emissions, which would hinder natural gas due to methane leakage, venting and flaring.

Furthermore, due to concerns over public health, the Canadian government publishes non-binding targets for stricter regulation of other aspects of coal generation, such as coal combustion residuals and emissions of NOx, SO2 and particulate matter. Due to public pressure, most of the provinces adopt these stronger measures, which further hinder the use of coal power generation and also discourage new coal plants, even forcing some early coal plant retirements. Also, environmental concerns make new hydroelectric plants difficult to site, resulting in most new dispatchable generating capacity to be powered by fossil fuels, the default of which being natural gas, either a combustion turbine or a combined cycle plant depending on the need of the load profile.

Growth in unconventional natural gas development is also driven by a new demand source for Canadian gas. This is needed to make up for declining demand for natural gas from the U.S., one of Canada’s main trade partners, who due its own high growth in unconventional natural gas no longer needs as many imports from Canada. After receiving Final Investment Decisions for its three LNG terminals that are currently under way in British Columbia, companies are then able to contract with Asian markets, including China, Japan and South Korea. Long term contracts are established to give Canada certainty over future exports. The demand in Asia is driven by Japan continuing to shift away from nuclear power and being constrained by environmental regulations against coal use. The growth of China’s economy continues to outpace its domestic energy supply, and imported LNG begins to compete with coal for new power plant investments. China also institutes carbon legislation in its next five year plan that further disincentivizes coal generation, but because domestic shale gas production isn’t technologically feasible yet, China must rely on imported natural gas, a portion of which is now contracted to come from Canada.

295 (British Columbia Ministry of Environment, 2013)
296 (Alberta Environment and Sustainable Resource Development, 2013)
297 (Government of Manitoba, 2013)
298 (Government of Quebec, 2013)
299 (Ontario Environmental Registry, 2013)
Supporting these exports, agreements with First Nations and environmentalists are met for the necessary pipelines to be built to connect gas to the LNG terminals, such as the Pacific Trail Pipelines project, which will connect the Kitimat LNG terminal with Spectra Energy’s transmission pipeline system. This is accomplished through agreements with a unified body of First Nations. Engaging the First Nations directly allows them to become more important figures in the process and helps to alleviate some of their concerns, allowing new routes to be developed to minimize the impact on environmentally-sensitive areas. First Nations are also given revenue-sharing incentives for the use of their land, which helps their own economic prosperity but allows Canada to take advantage of its abundant natural resources. Once the First Nations are on board with the pipeline plan, the environmentalists lose a significant ally, and become much more willing to compromise. Also, to promote mutually beneficial development, agreements are reached between provinces along the route to optimize risk to the environment and economic reward.

Conservatives maintain their power at the federal level, which places pressure on provinces to continue to develop their natural resources to provide jobs and economic prosperity. To incentivize development, British Columbia and Alberta lower their royalty on unconventional natural gas production and British Columbia lowers their royalty on exported LNG. The federal government maintains the relaxed requirements for environmental assessments and encourages lowered royalty rates on production and LNG export. Domestic natural gas demand is also assisted by high international oil prices and the eventual agreement to build the Keystone XL pipeline to Canada’s southern neighbor, the United States. This causes much more development of the tar sands, which increases demand for natural gas to “cook” the bitumen in the ground and pump it out. This also incentivizes natural gas from Canada’s western region to reduce the distance for pipeline transportation.

As demand for natural gas grows, so does the propensity for unconventional gas development, which spurs technological innovation and allows unconventional gas to become more competitive with conventional resources. There is a steep learning curve for unconventional resources, but this innovation is helped by knowledge transfer for unconventional natural gas extraction from the United States and a high demand for jobs is met by the international community and a nation that is hungry for new work.

Development Derailed

Similar market conditions persist as were seen in the Free Market Revolution scenario. While demand from the U.S. continues to decline, demand is strong both domestically and internationally, especially in the Asia-Pacific region. Japan continues to generate electricity without much of its nuclear fleet putting a high demand on imported LNG and China’s economy continues to grow, along with its share of natural gas used in power generation, which is driven by tougher regulation on coal-fired generation and a

300 (Pacific Trail Pipelines, 2013)
difficulty in using its own vast shale gas resources. Domestic demand is also sufficient as gas is demanded more for power generation and tar sands production.

However, social and political opposition hinder development and prevent Canada’s natural gas from reaching global markets and increasing significant volumes in the domestic market. Agreements with First Nations prove to be more difficult than expected and there are too many demands for revenue-sharing and new pipeline routes that are acceptable to any of the pipeline developers. Although many members of First Nations are willing to negotiate and reach a compromise there is difficulty in developing a common voice among the various groups. Eventually, if becomes clear that some members within the First Nations only want to maintain their current way of life and the integrity of their land. Plans for the pipelines to connect natural gas to the new export LNG terminals, such as the Pacific Trail Pipelines project, are delayed, putting the economic viability of LNG export into question. This is also seen as a strong win for environmentalists.

In the federal election of 2015, Conservatives lose power. Part of this loss can be attributed to their lack of regard for the environment and unwillingness to successfully engage environmentalists and First Nations and take their concerns seriously. The failure of the pipeline projects dampen the enthusiasm of the Conservative base, and due to low Conservative voter turnout and moderate voters shifting to favor the opposition, the Liberal Party takes over at the federal level and encourages tougher environmental regulations. Royalties are also increased to discourage fossil fuel production and allow the public to gain more off the exploitation of the national, natural, non-renewable resources.

Because of concerns over the greenhouse gas emissions associated with natural gas production, regulations are expanded through British Columbia’s greenhouse gas program to also include flaring and venting. This proves to be quite costly and the economics of unconventional natural gas production worsen. Although, this does not affect all provinces, new pressure at the federal level for tougher environmental regulations and moves by British Columbia and Quebec for stricter regulation send a strong signal of possible future regulations, which has many unconventional natural gas developers concerned about future investments. This new regulation also starts to change the winds of public perception and natural gas is no longer seen as a “clean” fuel.

Because many of the new pipelines to LNG terminals have been delayed indefinitely, this then changes the economics for the LNG terminals that were planned in British Columbia. This delays the export terminals as well and Canadian natural gas cannot be exported to Asian markets. Instead, the U.S. and Australia gain significant market share for long term contracts with Japan, China and South Korea, who are still in need of gas to fuel their economies.

Also, the moratorium in Quebec on hydraulic fracturing remains. The environmental assessment is eventually completed and the results show that the risks to the environment and public health do not warrant development. It becomes apparent that Quebec never intended to lift the moratorium but just delay the decision.
Due to the increased regulation and restrictive action to limit natural gas extraction, the technological advancement of unconventional natural gas development is stifled. There is little knowledge or technology transfer and the employment that was hoped for in this new sector is not achieved. Also contributing is an unwillingness to travel to the remote locations where the natural gas is found by most workers, making the cost of labor very high. Furthermore, the domestic natural gas price rises as there is adequate demand, but production is stifled.

**Awaiting Demand**

Unconventional natural gas development is spurred by the promise of a shift to natural gas as the preferred global fuel for the 21st century, much as oil was for the 20th century, and a desire to replicate success seen in the United States. Canada wants to share in the economic success and with much support from the Conservative federal government, encourages policies to favor development, such as relaxed requirements for environmental assessments and lowered royalty rates on production and LNG export. As we saw in the “Free Market Revolution scenario,” disputes with environmentalists and First Nations over pipelines and unconventional extraction techniques are eventually settled. First Nations are brought in to be more significant players in the decision making process and the developers are able to negotiate with First Nations as a unified body, easing the negotiation process. Pipelines routed to minimize environmental impact and revenue-sharing agreements are made to compensate First Nations for the use of their land. Also, environmental assessments show that hydraulic fracturing for natural gas has benefits that far outweigh the costs and risks.

Canadian environmental policy also does not hinder natural gas development as life-cycle emissions, including methane leakage, venting and flaring, are not accounted for. Instead, emissions regulations are primarily relegated to large, stationary sources, which mainly hinder coal power plant generation. This allows natural gas to maintain its reputation as a “clean” fuel and still compete with coal for power generation.

However, given the relatively low level of opposition from the government, First Nations or environmentalists, the demand for natural gas both from Asia-Pacific and the domestic markets seem to be relatively low and does not make up for the declines in demand that Canada sees from the U.S. Canada continues to rely on hydroelectric power for much of its generating capacity and new hydroelectric sites are found to be suitable for development, which leads to the slow growth of natural gas in electricity generation.

The market for natural gas in the Asia-Pacific region also lacks demand. Japan decides that it can no longer risk being so vulnerable to importing so much of its energy and begins to repower many of its nuclear reactors that were shut down after the accident at Fukushima and begins building new, safer nuclear reactors. Also, the economy in China begins to slow in the short term and any incremental generating capacity is met primarily with coal. There are also concerns for the future of natural gas demand from China as the Chinese government begins to invest billions of dollars into trying to ramp up
its own natural gas infrastructure to begin hydraulic fracturing and extract some of its own significant unconventional gas reserves.

Eventually the LNG terminals which were planned in British Columbia reach Final Investment Decision and some minor contracts are established, but long term contracts are difficult to obtain and the volume in the spot market is lackluster. An inability to negotiate long term contracts is due to the uncertainty surrounding where LNG contracts should be priced given the lack of history for Canadian LNG exports. Some worry that investors acted too aggressively too quick and wasted billions to build the pipelines and LNG terminals for a market that just wasn’t there.

So although there is social and political support and the necessary infrastructure is in place to supply natural gas from Canada, the main issue appears to be demand. Canada continues to have low demand for natural gas in the power sector, declining demand from the U.S. and the demand is not sufficient in the Asia-Pacific region to support significant LNG export. For at least now, Canada waits for the demand to catch up.

**Conclusion and Recommendations**

Investment decisions in Canada are guided by demand variables, which are mostly external, and supply considerations, which are determined largely by the internal regulatory environment. From the scenario analysis, specific leading indicators or “signposts” can be extracted, signaling whether positive or negative supply-demand trends are likely to unfold in the near future. Going forward, Credit Agricole should monitor developments in these arenas to predict or preempt the direction of the trend.

On the demand-side, it is important to watch the Japanese, Chinese, Korean, Australian, and American natural gas markets, as well as the Canadian power sector. As key regions of interest, the Asia-Pacific and North America are significant in and of themselves and in interaction with each other. The terms and duration of long-term contracts can be an accurate indicator not only of the volume and price expected by the buyer and seller, but also the trade relationship between the two countries. Any LNG terminals, pipelines, or gas power plants—planned or under construction—can also reveal the ambitions and expectations of the domestic gas market in each individual country. Developments in the three ongoing domestic LNG projects, the pipelines connecting to the LNG terminals, and new electric generating capacity are of special consequence to the Canadian gas market. Progress, or lack thereof, can reveal industry and government expectations of national and international gas demand, and direct private investment.

On the supply-side, the chief concerns are sociopolitical and regulatory. For instance, the transport of supply hinges on the new export LNG terminals being fed by new pipelines connected to the main pipeline system, of which the development can often depend on environmentalist and First Nation opposition. Public attitudes toward hydraulic fracturing and tar sands; environmental campaigns or publicity efforts; and green lobbies are all important indicators of the likelihood and speed of deployment. The prevalence of the environmental movement is also telling of the probability of
enactment of future legislation limiting life cycle emissions, like methane leaks and flaring, to which gas is prone. Another important signpost, underlying the direction of the supply trend, is the campaign issues and results of the federal elections in 2015. If conservatives remain in power, it is much more likely that the three LNG projects in British Columbia receive Final Investment Decisions; the Keystone XL Pipeline to the U.S. is built; the moratorium in Quebec is lifted; and development incentives, like lower royalty payments, are written into law. For this reason, it is crucial to monitor political opinion polls and rhetoric leading up to the elections, which may indicate any shift of power to the less favorable Liberal party.

Broadly speaking, Credit Agricole should monitor long-term contracts and LNG efforts internationally, and the sociopolitical temperature for unconventional gas development inside Canada. These indicators should reveal the trend toward or away the ideal “Free Market Revolution” scenario, and help guide investment decisions.
The Business Landscape for Unconventional Natural Gas

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