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The Impact of low natural Gas Prices on renewable Energy Production

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Executive Summary

The shale gas boom that started in the United States is now spreading to Canada. Alberta's landscape displays substantial potential for the development of shale gas in this province. As a result of the exploitation of shale gas plays across North America, the price of natural gas plummeted in 2009. Natural gas is a significantly cleaner energy source than coal, which still makes up 41% of Alberta's energy mix. However, Methane emissions resulting from the natural gas extraction process diminish this advantage. If Methane emissions cannot be kept below a threshold of 2%, the environmental benefits of natural gas are entirely negated. Moreover, due to the low natural gas price, renewable energy sources are no longer sufficiently competitive to be developed in large quantities. Since natural gas in itself is not clean enough to eliminate the need for the future development of renewables, Alberta must ensure the continued entry of renewable energy into the power grid.

Analysis

This paper reviews literature regarding the relationship between low natural gas prices and renewable energy sources as well as policy measures aimed at developing renewables. The theoretical relationship is then reviewed in the Alberta context. Data sets released by the Alberta electric grid and natural gas exchange are analyzed to determine the correlation between electricity and natural gas prices and renewable capacity. The discussion then turns to an interview with a Shell representative which sheds some light on the company's decision to largely withdraw from the renewable energy field. Lastly, the Pembina Institute chaired a roundtable with energy companies discussing barriers to renewable energy investment. In a series of interviews, the environmental think tank elaborates on its

findings and discusses its take on the natural gas development.

Findings

The analysis results in several findings on the relationship between low natural gas prices and the development of renewable energy sources:

- There is no correlation between low natural gas prices and decreased renewable capacity in the electricity grid. However, because renewables operate under long-term contracts and the natural gas price only fell in 2009, it is likely too soon to observe an impact;
- The electricity price follows the natural gas price trend line closely, with the exception of a few peaks in the price of electricity which were caused by specific events;
- An interview with a Shell representative confirms that natural gas prices were a factor in the company's decision not to pursue renewable energy investments anymore. Oil and gas companies base their investment decisions mainly on "the economics" and the low natural gas price has decreased the competitiveness of renewable investments;
- Pembina's findings from its roundtable with oil and gas executives identify low natural gas prices as a significant barrier to investment in renewables.

Policy Recommendations

These findings suggest a policy recommendation that will aid Alberta in the continued development of renewable energy sources:

- A Renewable Portfolio Standard (RPS) implemented in Alberta, modeled after the Texas policy, would mandate a fixed percentage of electricity to be derived from renewable sources. The Texas electricity market, like the Alberta market, is deregulated. Both jurisdictions have

many opportunities for the development of wind power farms. These similarities coupled with the success the Texas policy has achieved make Texas a suitable model. With this policy in place, renewable energy producers would have an increased incentive to enter the market. An RPS fits in best with Alberta's economic and political landscape as it allows for competition among renewables.

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Introduction

In recent years, the development of shale gas has depressed the price of natural gas. While most of the shale gas activity is taking place in the United States, Canada is now developing its shale resources as well. Moreover, the Canadian and U.S. natural gas markets are integrated through a network of pipelines. Therefore, the U.S. developments impacted the Alberta natural gas price even before the province had begun developing its own shales.[1]

When used for electricity generation purposes, natural gas displaces coal. While this has benefits in terms of emissions reductions due to the relatively cleaner input source of natural gas, environmentalists are concerned with the impact of lower natural gas prices on renewable energy projects[i]. The increased competitiveness of natural gas reduces the economic viability of renewable energy projects. Alberta's Provincial Energy Strategy includes the objective to clean up energy production. One of the ways in which the province plans to do this is by "not only supporting renewable energy development, but promoting a market for its consumption"[2]. This paper analyzes the relationship between low natural gas prices and renewable energy projects in Alberta. In particular, it asks the question: does the low natural gas price pose a threat to renewables and if so, how could this impact be effectively mitigated?

The paper is organized as follows. The first section reviews relevant literature on the relationship between natural gas and renewable energy first. The literature review is organized in three segments: material arguing natural gas and renewables are substitutes for one another, followed by articles stating that they are instead complements and concluding with proposed remedies to mitigate the relationship. The analysis will then turn to a discussion of data, historical prices and interviews with experts in the energy field. The paper will then review the findings of the analysis

[1] National Energy Board. "Natural Gas – how Canadian Markets work.", last modified May 17, 2013, accessed June 4, 2013, http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/prcng/ntrlgs/cndnmrk-eng.html

[2] Government of Alberta. "Launching Alberta's Energy Future, Provincial Energy Strategy", accessed June 4, 2013 http://www.energy.alberta.ca/Org/pdfs/AB_ProvincialEnergyStrategy.pdf

before proposing the implementation of a Renewable Portfolio Standard in the policy recommendations part. The analysis is largely qualitative in nature, based on a review of the existing literature and interviews with a leading energy company and environmental think tank.

Literature Review

The interplay between natural gas prices and renewable energy capacity is complicated by a multitude of confounding influences. Economic factors include government incentives to develop renewable capacity, fluctuations in the national economy, the tax environment and foreign investment. The political climate impacts the degree to which investors are willing to fund renewable energy projects. Government policies that govern the integration of electricity generated from renewable sources into the grid have a positive effect on the start up of additional projects. This host of variables clouds the relationship between natural gas prices and green energy entering the grid. In what follows, several bodies of literature are discussed with the intention of clarifying the relationship.

Natural gas and renewables as substitutes

Articles related to the price of natural gas or cancelled renewable energy projects appear in newspapers around the world regularly. Shell's 2012 cancellation of its proposed cellulosic ethanol plant in Canada was widely reported, and raised concerns over the environment in which renewable energy companies must operate. Despite a 2007 government initiative to allocate $500 million to the development of the biofuel industry, no projects are economically viable at present.[3] In 2009, right around the time natural gas prices had fallen, Shell withdrew from the wind and solar energy areas, stating that those energy sources were not competitive. In the period 1999-2006, Shell invested $1.25

[3] McCarthy, S. 2012. "Shell-Iogen Plant Cancellation Raises Doubts about New Biofuel Technology." *The Globe and Mail*, April 30, 2012

billion in renewables, but in the absence of political pressure and with renewables outcompeted by natural gas, the company abandoned the initiative.[4] But Shell is not the only company withdrawing support for green energy. In 2013, BP cancelled its solar programs. The move is representative of a growing hesitancy among oil companies to invest in renewable projects.[5] Statoil's cites lack of profitability as the main reason renewable energy is losing the support of big oil.[6]

A 2012 U.S. study by the National Renewable Energy Laboratory identified the challenge low natural gas prices pose for renewable energy markets due to the influx of shale gas. The authors describe the rapid growth of wind power and ethanol biofuels beginning in the early 2000s as gas prices rose and technological developments and economic incentives were introduced. The current low natural gas prices pose a challenge for renewable energy producers who are having difficulty signing power purchase contracts. These contracts are needed for the financing of projects and in their absence many projects may be shelved until the natural gas price rebounds. This trend has worsened with the expiry of U.S. policies stimulating the development of green energy, such as the renewable portfolio standard or tax credits.[7]

In an attempt to quantify the impact, the Massachusetts Institute of Technology conducted a simulation study in 2012. According to its models, the low price of natural gas will boost economic growth and aid in the reduction of GHG emissions. Natural gas provides flexibility and can replace coal base-load power. However, the authors warn that natural gas should be used as a bridge between the coal-fired electricity era and a time in which we can rely on renewables to a much greater extent. The gas boom will negatively affect the development of low-emission technologies including carbon

[4] Bergin, T. 2009. "Shell Goes Cold on Wind, Solar, Hydrogen Energy." *Reuters*, March 17, 2009
[5] Silverstein, K. 2013. "Oil Companies Sliding Out of Green Energy while Others are Venturing in." *Energy Biz*, April 8, 2013
[6] Kever, J. 2013. "BP Wind Sale Highlights Renewable Energy Struggles." *Fuel Fix*, April 3, 2013
[7] Lee, A., Zinaman, O. & Logan, J. 2012. *Opportunities for Synergy between Natural Gas and Renewable Energy in the Electric Power and Transportation Sectors*. Denver: National Renewable Energy Laboratory; The Joint Institute for Strategic Energy Analysis

capture and storage. The paper suggests more stringent GHG targets are needed to ensure a continued move towards green technologies, once those have become a more stable and economic energy source.[8]

Yale's Environment 360 blog paints a grim picture stating that the stream of new renewable energy projects has dried up. It also argues that wind used to be able to compete with natural gas but is now unable to do so in the new low price environment and with federal tax credits expiring. The authors argue for the need to leverage natural gas supplies to build a more sustainable future.[9]

In a National Public Radio article, the head of the American Wind Energy Association, Denise Bode, discusses the impact of lower natural gas prices on wind energy. She argues that wind power will be impacted in the long run, but not the short term. This delayed effect stems from the long-term contracts that lock in wind energy prices. Additionally, wind energy's stable prices and predictable production costs make it an attractive source of energy even if its price does increase slightly. In the long run, however, low gas prices will begin to undercut wind energy. She claims that in the short term abolishing tax incentives stimulating renewables will impact wind energy much more severely than low natural gas prices. This dependence on subsidies or tax credits also holds true for solar energy, which suggest that a lack of political is a much greater threat to renewable energy than natural gas.[10]

Ernst& Young and KPMG released reports analyzing investment decisions in renewable energy. KPMG sees little impact in the short term, also emphasizing the reliance on long-term contracts in the renewable energy industry. They forecast that most of the investment will be in Ontario as a result of its feed-in tariff. They also emphasize that the decentralized nature of Canadian politics and its vast land area has resulted in different conditions for renewables across the country.

[8] Jacoby, H., O'Sullivan, F. & Paltsev, S. 2012. "The Influence of Shale Gas on U.S. Energy and Environmental Policy." *Economics of Energy & Environmental Policy* 1 (1): 37-51

[9] Doran, K. & Reed, A. 2012. *Natural Gas and its Role in the U.S. Energy Endgame*. Yale Environment 360

[10] Harris, R. 2012. *Could Cheap Gas Slow Growth of Renewable Energy?* National Public Radio

British Columbia, for instance, is able to import energy from the Northwest United States. In the current low natural gas environment, analysts in British Columbia may believe importing additional energy from the U.S. is preferable to adding capacity in Canada. The report warns against this as the spot price of natural gas will fluctuate and should not guide long-term energy plans. Quebec's market for renewables is unique in the sense that wind energy in the province is driven by job creation considerations rather than a need for additional energy capacity. Every Request for Proposal issued by Hydro Quebec for wind energy specifies the requirement that a portion of the turbines be produced in Quebec. Ontario's feed-in tariff has resulted in an uptick in investment in renewables. The province now leads the nation in solar and wind energy capacity. Although Alberta comes in second in wind energy capacity, the majority of projects were built prior to the natural gas boom when wind was more competitive with natural gas.[11] Ernst & Young's analysis largely echoes KPMG's.[12]

The Conference Board of Canada issued a report analyzing the economic benefits that low natural gas prices will bring over the upcoming decades. The report indicates that shale gas development potential is greatest in British Columbia followed by Alberta. In its discussion of renewable energy technologies, the report points to the need for provincial policies. British Columbia requires the use of renewable energy sources for new electricity generation while Ontario operates under a feed-in-tariff ensuring access and a stable environment for renewables.[13] Mark Jaccard and Brad Griffin with the Pacific Institute for Climate Solutions undertook a study assessing the likelihood that British Columbia will be able to meet its climate targets in the new shale gas era. The authors note that shale gas development in B.C. will increase in intensity. The extraction of shale gas

[11] KPMG LLP, 2013*:* "A New Era for Clean Energy in Canada", accessed June 16, 2013 http://www.kpmg.com/Ca/en/IssuesAndInsights/ArticlesPublications/Documents/1455-clean-energy-report-fy13-web-v7.pdf

[12] Ernst & Young LLP, 2012. "Renewable Energy Investment: Canada", accessed June 16, 2013 http://www.ey.com/Publication/vwLUAssets/Renewable-energy-investment-Canada-April2012/$FILE/Renewable-energy-investment-Canada-April2012.pdf

[13] Unnamed Author. 2012. *The Role of Natural in Powering Canada's Economy.* 2012. Ottawa: The Conference Board of Canada

in BC will bring with it a rise in emissions, complicating the province's efforts to achieve its 2020 CO2 reduction target. The paper points out the importance of stimulating renewables alongside gas production to offset the additional emissions.[14]

In January 2013, the Pembina Institute reviewed the Canadian landscape for investment in renewable energy projects on the part of oil and gas companies.[15,16] Through a series of interviews with leading oil and gas companies, the authors compiled an overview of barriers for renewable energy investments. The report also took stock of the different dimensions related to renewable investment. Most of the oil and gas companies interviewed had either funded renewable activity within their own operations, ventured into stand alone renewable energy businesses, applied oil and gas related technologies to renewable energy projects or supported research and development into new green technologies and data collection. Only one company had invested in an external renewable energy business and none funded public policy advocacy. The authors conclude that oil and gas companies are predominantly interested in integrating renewable technologies into their own operations when they are able to project profits with such developments. The company representatives listed several barriers to further renewable energy investment, with capital returns leading the list. Innovation is greatest in the biofuels area as a result of government policy. While investment in wind energy has grown, the rate of return on such projects is lower than on oil and gas projects. Therefore, renewable energy projects are highly sensitive to a further reduction of the rate of return on investments by oil and gas companies. The low natural gas price is identified as the biggest

[14] Jaccard, M. & Griffin, B. 2010. *Shale Gas and Climate Targets: Can they be Reconciled?*. Victoria: Pacific Institute for Climate Solutions

[15] Severson-Baker, Chris, Managing Director Pembina Institute. Interview by Romy Yourex. Personal Interview. Calgary, June 19, 2013

[16] Weis, Tim, Director Renewable Energy & Efficiency Policy Pembina Institute. Interview by Romy Yourex. Personal Interview. Calgary, June 19, 2013

challenge for continued or increased investment.[17]

Although the natural gas boom may have a negative effect on investment in renewables, it could contribute to a greener future nonetheless. An article by Chu and Majumdar in Nature discusses the projected adoption of natural gas vehicles.[18] The paper emphasizes that electricity generation emissions will not decline even though natural gas has displaced a portion of coal-fired electricity. In order to achieve a reduction in emissions, the electricity grid must be redesigned to accommodate greater amounts of renewable energy sources.

While the Nature article and several others anticipate low natural gas prices for some time to come – some believing the era will last several decades – others are convinced the price levels are more temporary in nature. An energy researcher with ITG Investment Research stated that (nobody) "in their right mind thought $2 or $3 natural gas was here to stay".[19]

The Government of Alberta maintains records of fluctuations in the gas reference price. They show that the Canadian price tracks the U.S price closely, with a downward trend starting in 2009 and continuing to today. Although prices have rallied slightly from their all-time low of $1.58/GJ in May 2012, current prices are still markedly lower than they were prior to the gas boom. The price of gas in May 2013, the most recent data available, was $3.24/GJ, still well below the 2008 average of $7.46/GJ.[20]

The Alberta Utilities Commission provides an overview of installed capacity of electricity by type in Alberta. Energy derived from renewable sources as a percentage of total installed capacity fluctuated around 12% from 1985 to 2005. From 2005-2012, renewables grew to 17.5% of installed

[17] Switzer, J., Finigan, K., Lovekin, D. & Archer, N. 2012. *Renewable Energy Opportunities in the Oil and Gas Sector, Workshop on Renewable Energy Case Studies and Opportunities in the Oil and Gas Sector*. Calgary: The Pembina Institute

[18] Chu, S. & Majumdar, A. 2012. "Opportunities and Challenges for a Sustainable Energy Future." *Nature International Weekly Journal of Science* 488 (7411): 294-303

[19] Begos, K. 2013. "Natural Gas Prices Rise from Historic Lows." *Associated Press*, April 17, 2013

[20] Alberta Energy. "Alberta Gas Reference Price History.", last modified July 15, 2013, accessed July 18, 2013, http://www.energy.gov.ab.ca/NaturalGas/1322.asp

capacity.[21] However, as many studies and articles point out, most renewable energy projects rely on long-term contracts. Wind especially operates on contracts of 20-30 years, and it makes up the largest proportion of renewables today. Therefore, the upward trend of renewable capacity should not be interpreted as a sign that Alberta energy markets are not affected by the low price of natural gas.

Natural gas and renewables as complements

Several studies have investigated the potential for natural gas and renewable energy to operate in a complementary manner. Natural gas and renewable energy investments have different risk profiles and therefore can offer complementary portfolio options. The combined pursuit of both can significantly reduce overall portfolio risks in the electric power sector. A diverse electricity portfolio can be continuously adjusted and re-mixed to adapt to changing market conditions over the lifetime of portfolio assets.[22]

In a June 2013 industry brief, Energy Solutions representatives discuss the complementarity of natural gas and renewable energy in terms of investment portfolios. They argue that natural gas offers the flexibility to offset the intermittency of renewable energy sources while renewables bring a more stable price to the mix. Therefore, an optimal policy should include a mix of both to provide the most secure energy mix.[23] Echoing this sentiment is an Alberta Oil article discussing the ability of natural gas to fill the void whenever the variable nature of renewable supply causes a gap between supply and demand. The combination of natural gas and renewables produces a dependable base-load supply. Because gas prices will not remain stable, the cost of renewable energy may not continue to decline

[21] Alberta Utilities Commission. "Annual Electricity Data Collection, Alberta Electric Energy Net Installed Capacity (MCR MW) by Resource.", last modified December 31, 2012, accessed June 5, 2013, 2013, http://www.auc.ab.ca/market-oversight/Annual-Electricity-Data-Collection/Documents/2012/Installed%20Capacity.pdf

[22]Awerbuch, S. "Portfolio-Based Electricity Generation Planning: Policy Implications for Renewables and Energy Security." *Mitigation and Adaptation Strategies for Global Change* (11:3), 2006; pp. 693-710.

[23] Mercurio, A. 2013. *Natural Gas and Renewables are Complements, Not Competitors*. New York: Energy Solutions Forum Inc.

and the cost of coal-fired electricity may not continue to rise, policies mandating the natural gas/renewables mix are necessary.[24]

A Forbes journalist responds to the Yale blog discussed earlier; he disagrees with the notion that gas and renewables should not be left to compete. Instead the article says the Yale authors are not sufficiently aware of the full range of technologies that exist to produce electricity from natural gas. Rather than accepting Yale's assertion that renewables are always worth the increased cost of production, Forbes argues that the technology used to convert natural gas into electricity is what matters. When greener technologies such as fuel cells or micro turbines are used, natural gas might be preferable to a more expensive renewable alternative.[25]

An Associated Press article points to the ever-decreasing production cost of renewable energy, arguing that they may approach the production costs of conventional fuels in the near future. This would drive up demand for renewable energy. Since renewables are not yet able to mitigate their intermittent nature, natural gas is needed as a backup power source. As a result, natural gas would grow with renewables if the two energy sources were more competitive. Since there are no projections of a new gas boom and renewables' cost of production continues to decline, the hope is that this will become the new reality.[26]

New Geography published an editorial discussing the importance of complementarity. In analyzing the German energy field, the author finds that that nation's reliance on wind energy has led to a lack of load following capacity, which has resulted in grid instability. The country relies on imports to fill the demand gap when needed, but this diminishes Germany's independence from neighbouring countries. As a result, German electricity prices have soared, leading some

[24] Zilnik, D. 2013. "Cheap Gas and Renewable Energy make for a Beautiful Love Story." *Alberta Oil*, January 5, 2013
[25] Pentland, W. 2012. "Memo to Renewable Energy Industry: Natural Gas is Good, Bad and Ugly." *Forbes Magazine*, August 15, 2012
[26] Unnamed Author, 2013. "Natural Gas Prices Rise from Historic Lows, Easing Pressure on Renewable Energy and Coal." *Times Colonist*, April 17, 2013

manufacturers to outsource energy intensive manufacturing processes to countries with more favorable energy environments.[27]

Others, however, have a contrary view. In Ontario, the Conservatives have criticized the province's Feed-in Tariff, speculating that wind energy drives up electricity prices. But Canadian Wind Energy Association President Robert Hornung refutes these claims. He asserts that wind energy is only responsible for 6% of the increase in electricity prices with taxes; delivery charges and electricity generated from nuclear, hydroelectricity natural gas sources responsible for most of the price jumps. Furthermore, renewables are projected to become cheaper than natural gas generation in the future.[28]

A European wind energy publication breaks down the economics behind the price dynamic of wind energy. It describes two ways in which wind energy affects electricity prices. Because wind has a low marginal cost in the absence of fuel costs, it shifts the electricity supply curve to the right, which brings down the price. The more wind power that enters the grid, the lower the price will be. Additionally, if wind power influx exceeds grid capacity at any given moment, the established power sources must adjust their production since wind power production cannot be scaled back. This too will result in a lower price. The authors quantify the effect of wind power on Danish power costs and conclude that wind power lowers electricity prices.[29]

Proposed Remedies

A group of U.S. energy consultants investigated options to hedge risk for renewable energy projects. They describe the combination of low natural gas prices and cutbacks in renewable portfolio

[27] Smith, E. 2013. *Natural Gas Boom: The "Janus" Effect*. New Geography
[28] Morden, P. 2013. "Tory MPP Says High Electricity Costs Kill Job Creation." *The Observer*, March 4, 2013
[29] European Wind Energy Association. "The Impact of Wind Power on the Power Market, Illustrated by the Case of Denmark.", accessed June 8, 2013, 2013, http://www.wind-energy-the-facts.org/en/part-3-economics-of-wind-power/chapter-5-wind-power-at-the-spot-market/the-impact-of-wind-power-on-the-power-market-dk-case.html

standard policies. The authors point out that areas with aggressive government incentive programs are still growing and will continue to do so as long as government programs are not scaled back.[30]

The Center for Resource Solutions discusses three eras of renewable energy policies and markets in the U.S.[31] The authors describe the third phase as having started in 1997, when renewable energy policies began to take effect. Such policies range from renewable portfolio standards (RPS) to subsidized solar photovoltaic systems for households and tax credits. The implementation of RPS's is listed as a major milestone for the renewables industry. With an RPS, electricity suppliers are ordered to purchase a set percentage of renewable energy, with most of that energy being wind. While RPS's have proven to be the most effective renewable-stimulating policy in the U.S., the authors state that inter-state variability is substantial. Most states have made wind, solar and geothermal power eligible, but biomass and hydropower are not always accepted. Other differences exist on the operational side in terms of enforceability, duration of the policy, compliance flexibility and the development of renewable energy credit markets. After carrying out an analysis of individual state policies, the authors conclude that the lesson to be taken away from the U.S. experience is that details matter. They, and others[32,33], praise the Texas RPS for its design, which supports competition among renewable energy producers. RPS policies are too costly when markets operate on a short-term trade basis rather than relying on long-term contracts. In the presence of long-term contracts, RPS policies have been successful. The article points out three more design flaws that exist in several states. Where renewable supply exceeds the standard itself, the RPS will not promote the addition of new renewable energy capacity. States that apply the RPS to only part of the electricity market harm the

[30] Templeman, A., Ogra, R., Struk, M. & Crosby, B. 2013. "Financing Renewables: Renewable Energy Markets Challenged, but Strategies for Profit Still Exist." *Natural Gas & Electricity* 29 (11)

[31] Martinot, E., Wiser, R. & Hamrin, J. 2005. *Renewable Energy Policies and Markets in the United States*. San Francisco: Center for Resource Solutions

[32] Chen, C., Wiser, R. & Bolinger, M. 2007 "Weighing the Cost and Benefits of State Renewables Portfolio Standards: a comparative Analysis of State-level Policy Impact Projections", *Ernest Orlando Lawrence Berkeley National Laboratory*

[33] G**ü**len, G. & Makaryan, R. 2009 "REC Trading in Texas – Lessons learned & Way forward", *Center for Energy Economics*

competitiveness of companies operating in that segment while the RPS will not have a marked impact. Lastly, in the absence of enforcement, compliance rates among electricity suppliers are relatively low. On the flip side, the authors note several factors that form a recipe for success: long-term political support, clear eligibility rules, long-term renewable energy targets, attainable standards, an automated enforcement system and fair application of the RPS. While other policy measures are discussed, the authors conclude that an RPS is the most effective policy option at this time.[34]

Several analysts discuss the fact that deregulated electricity markets complicate the implementation of policies aimed at promoting renewables.[35,36,37] However, the Texas RPS is an excellent model for Alberta since the Texas electricity market is liberalized as well. Canadian experts have discussed the RPS as a policy measure for Canada.[38,39]

The Financial Post looked to Europe to assess the impact expired subsidy programs can have on renewables. With the continent still dealing with the aftermath of the economic crisis, national governments have been unable to renew subsidies. They have instead been focused on austerity measures that have impacted renewable energy incentives. As a result, analysts now believe Europe will no longer be able to meet its 2020 emissions target. In the middle of a financial crisis, oil and gas companies are emphasizing the job creation potential of oil and gas investments. This stands in stark contrast with struggling renewable energy companies.

[34] Ibid
[35] Borhani, M. 2011. "How can higher Cost Renewables be paid for in a liberalized Electricity Market?, University of Dundee
[36] Carbon Offset Solutions. "Alberta Legislation, Regulation and Policy Development", accessed July 2, 2013 http://carbonoffsetsolutions.climatechangecentral.com/policy-regulation/alberta-legislation-regulation-and-policy development
[37] Varone, F. & De Lovinfosse, I. 2001, "Renewable Electricity Policies in Europe: Patterns of Change in the liberalized Market", Universite Catholique de Louvain
[38] Jaccard, M. 2004. *Renewable Portfolio Standard.* Vancouver: Simon Fraser University
[39] Watt, D. 2008. "Renewable Portfolio Standards for Alberta", *Environmental Law Centre* 23 (5)

Analysis

In this section, the literature review is supplemented to further ascertain the extent to which low natural gas prices are a barrier to renewable energy investment by energy companies operating in Alberta. Information and data is presented from the following sources:

1. Data collected from the Alberta Utilities Commission and Alberta Energy. These institutions provide data with regards to historic natural gas prices and total installed electricity capacity by source respectively. Historic natural gas prices are graphed to establish a trend and renewable energy as a percentage of total installed capacity and total generation are computed and graphed over a time period of 27 years.
2. Historic average monthly Alberta pool prices for electricity collected from the Alberta Electric System Operator (AESO) and Alberta AECO C Hub natural gas spot prices gathered from the Natural Gas Exchange. Together, these data show the correlation between electricity and natural gas prices.
3. Interview with a Shell representative to discuss Shell's decision to scale back investments in renewable energy projects in 2009. The goal of the interview was to determine whether low natural gas prices were a factor in Shell's decision to withdraw from renewables.
4. Consultations with energy experts employed with the Pembina Institute to discuss the relationship between natural gas prices and renewable energy as well as policy options. Access was obtained to a study undertaken by the Pembina Institute, which included a roundtable with energy company representatives to discuss barriers to renewable energy investment in Alberta.

The analysis is clearly limited by the small sample size of companies willing to participate in Pembina's roundtable or this capstone project. However, the goal of this study is not to produce a representative sample of the entire energy industry in Alberta. The data and information obtained allow for an in-depth analysis to determine the effect low natural gas prices have on renewable investments. Policy recommendations are based on that analysis.

Findings

Alberta Natural Gas Prices and Installed Capacity

After a decade of stable, slowly increasing natural gas prices, the AECO natural gas price spiked to $10.60/GJ in June 2008. In the following months, prices declined but remained strong and hovered around the $6 mark until February 2009. Starting from that month, prices began to decline and they have remained low since, reaching a low point of $1.59/GJ in April 2012[40]. This data set confirms that the trend discussed in the literature exists in Alberta as well.

An examination of the installed capacity and total generation of the Alberta electricity market, indicates that renewable sources of electricity as a percentage of total generation have grown. Renewables as a percentage of total generation have steadily increased from 1.2% in 1985 to 6.5% in 2012. Expressed in terms of installed capacity, the percentage of renewable capacity grew from 0.8% in 1985 to 11% in 2012.[41] The difference between total generation and installed capacity is the energy that is lost as waste heat or is not dispatched to the power pool. Renewables produce energy much more efficiently than conventional power plants, resulting in the higher proportion of renewable energy in installed capacity.[42]

At first blush, it would appear from this data that Alberta renewable energy projects are not experiencing any negative consequences from the low natural gas prices. However, as discussed at various points previously, since renewable energy projects operate under long-term contracts and the natural gas price only plummeted in 2009, this conclusion cannot be drawn. Wind energy makes up the majority of renewable capacity, accounting for 55.8% of total generation. It is also a very efficient power source, which is reflected by its even higher proportion of installed capacity: 72.9%. Wind energy contracts are typically valid for 20-30 years.

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[40] Alberta Electric System Operator, 2012. "2012 Annual Market Statistics", accessed June 7, 2013 http://www.aeso.ca/downloads/AESO_2012_Market_Stats.pdf

[41] See Appendix 1A and 1B

[42] Casey, Z. 2012. *Wind Turbines Waste Much Less Energy than Fossil Fuels*. RenewableEnergyWorld.Com

The Correlation between Alberta Electricity and Natural Gas Prices

The AESO records the monthly pool prices for the Alberta electricity market. Historic pool prices in Dollars per MWh are available from January 2003 to December 2012. A graph displaying both electricity pool prices and natural gas prices,[43] shows that electricity prices follow natural gas prices closely with the exception of several spikes in electricity prices which were not preceded by a spike in natural gas prices. However, each of those electricity price spikes is explained by events occurring during the corresponding months. The price spike in May 2010 was due to transmission outages[44], [45] while the surges in 2011 were caused by the supply shortage resulting from the shutdown of Transalta's Sundance 1 and Sundance 2 plants.[46] While new power plants and wind farms added capacity, this supply increase did not offset the Sundance plants' capacity that was taken offline.[47] Lastly, the Summer of 2012 saw a price hike after a series of generation outages.[48] Thus, all electricity price spikes that do not follow the natural gas trend can be traced to specific events. The resulting graph showcases the relationship between natural gas and electricity.

As discussed in the literature, low electricity prices severely impact the operating margins for plants. Generators with high fixed costs are most affected because the prospect of low margins deters entry into the market.[49] Since wind power is more competitive than other renewables, it makes up the largest share of renewable energy in the Alberta electricity market. Wind power is very capital

[43] See Appendix 2
[44] Pfeifenberger, J. & K. Spees, K. 2011. *Evaluation of Market Fundamentals and Challenges to Long-Term System Adequacy in Alberta's Electricity Market*. Cambridge: The Brattle Group, Inc.
[45] O'Meara, D. 2011. "Alberta Power Prices to Continue Rising." *Calgary Herald*, October 6, 2011
[46]Wood, D. 2011. "Power Bill Spike "Shocking"." *Daily Herald Tribune*, April 7, 2011
[47] Mittelstaedt, M. 2012. "Surging Electricity Prices to Juice Alberta Power Producers." *The Globe and Mail*, August 23, 2012
[48] Alberta Energy, "Questions and Answers about Rolling Outages.", last modified July 9, 2012, accessed July 2, 2013, http://www.energy.alberta.ca/Electricity/3289.asp
[49] Pfeifenberger, J. & K. Spees, K. 2011. *Evaluation of Market Fundamentals and Challenges to Long-Term System Adequacy in Alberta's Electricity Market*

intensive and requires a long operating window to earn a return on its investment.[50] As such, wind power generators are discouraged from entering the Alberta electricity market in the current business environment of low natural gas prices. This means that in order for wind power to continue to enter the Alberta grid in the long run, policies must be in place to incentivize this investment. The disincentive of narrow margins must be offset by a green policy that compensates the investor for the economic risk he is taking by entering the electricity market with a renewable energy source.

Interview with Shell

In 2009, after the price of natural gas had plummeted, Shell withdrew from the majority of its renewable energy investments. The company stated that it did not plan to make any substantial investments to wind, solar and hydrogen energy projects, leaving biofuels as its only renewable energy venture.[51] An email interview with a Shell representative[52], who prefers to remain anonymous, shed some light on the reasons behind this business decision. When asked what the main motivation was behind the move, it was indicated that renewable energy projects typically cannot be run profitably by a company of Shell's scale. While Shell specialists have the expertise needed to work on these files, the Shell business model is too capital intensive to yield a significant return on an investment with a small margin. Because Shell "blows these projects out of the water", the company made the decision to focus its attention on projects that are more in line with its principal operations. A Carbon Capture and Storage (CCS) project, for example, can be linked directly to an existing project. Shell's Quest CCS project for instance will capture CO2 emissions from the company's oil sands operations.

[50] Hughes, G. 2011. "Why is Wind Power so Expensive? an Economic Analysis." *Regulatory Policy Institute*: 1-36
[51] Bergin, T. 2009. "Shell Goes Cold on Wind, Solar, Hydrogen Energy." *Reuters*, March 17, 2009
[52] Anonymous Shell Representative. Interview by Romy Yourex. Email Interview. Calgary, June 17, 2013

While for a period of time Shell believed it to be profitable to diversify and market itself as an energy company rather than an oil and gas company, the economics of renewable energy projects have made it clear that this is no longer the path the company wants to follow at this time. Other companies such as Total are still representing themselves as energy companies.[53] The reason Shell will continue to invest in biofuels is driven by government policy. Biofuel investment is promoted through government programs. In Canada such programs include the ecoENERGY for Biofuels program and the Clean Energy Generation Accelerated CCA. The ecoENERGY program supports the production of biofuels by paying out incentives to recipients for up to seven consecutive years while the Clean Energy Generation Accelerated CCA allows investments in green energy to be tax depreciated by 50% per year.[54] However, when the proposed Shell-Iogen cellulosic ethanol plant experienced financial setbacks, Shell withdrew from that biofuels project too.[55]

The Shell representative confirmed that Shell's primary driver for energy investment is the economic outlook of the project at hand, regardless of the nature of the project. He indicated that stronger and more consistent government policies would provide companies like Shell with a clear signal that such investment will grow in importance in the future. This would increase the long-term earnings potential of renewable energy projects, stimulating energy companies to invest in renewables. Some analysts have stated that the current regulatory framework does not promote investment in any form of renewable energy.[56] The Shell representative confirmed that assertion. Therefore it can be deduced that the low natural gas price, while not the sole reason for the discontinuation of Shell's renewable energy investments, certainly is a contributing factor. The low

[53] Total. "Our Energies". Accessed June 9, 2013 http://www.total.com/en/energies-940837.html
[54]Department of Foreign Affairs and International Trade Canada. "Canada as an Investment Destination for Biofuels", accessed July 1, 2013
http://www.agrireseau.qc.ca/energie/documents/0915Biofuels%20Investment%20Case_August%202009.pdf
[55] McCarthy, S. 2012. "Shell-Iogen Plant Cancellation Raises Doubts about New Biofuel Technology." *The Globe and Mail*, April 30, 201
[56] Ibid

natural gas price has reduced the margin for energy companies that do not rely on natural gas such as coal plants and renewables. Since Shell cites lack of profitability as the main driver behind the cancellation of its green energy projects and the natural gas boom has reduced the margin for renewable energy plants even further, natural gas prices form a contributing factor in Shell's decision.

Consultations with the Pembina Institute

The Pembina Institute, a leading environmental think tank based in Alberta, engaged oil and gas companies in a roundtable discussion aimed at documenting the extent of and barriers to renewable energy investment in the oil and gas sector. The project was funded by Shell, Cenovus, Statoil, Suncor and Alberta Innovates Energy and Environmental Solutions. While the resulting findings were not made public, Pembina graciously made them available for the purpose of this paper.[57, 58] Pembina found that there is no systematic integration of renewable projects into the operations of oil and gas companies. Companies that have invested in projects made that decision based on the economics of a specific project. This is in line with the observations of the Shell representative. Other advantages such as image, future positioning and environmental benefits, are taken into consideration but pure economics dictate the ultimate decision. In the absence of strong government policies with regards to renewable investments, companies are driven by their corporate profits. The oil and gas companies that participated in Pembina's workshop cited low natural gas prices as a significant barrier to investment in renewables.

In the current low natural gas price environment, businesses will only invest in renewable energy activity if the economics of the project make undertaking it worthwhile. Therefore, oil and gas companies are beginning to explore offshore wind projects. Stronger and more consistent wind

[57] Severson-Baker, Chris, Managing Director Pembina Institute. Interview by Romy Yourex. Personal Interview. Calgary, June 19, 2013

[58] Weis, Tim, Director Renewable Energy & Efficiency Policy Pembina Institute. Interview by Romy Yourex. Personal Interview. Calgary, June 19, 2013

combined with larger turbines ensures improved economics. Echoing the Shell interview findings, oil and gas companies asserted that biofuels are more attractive than other renewables. Investment in this area is driven by government incentives. While wind is the most economically competitive renewable energy source, return on investment remains significantly lower than on traditional oil and gas projects. Partly due to the lack of profitability and partly due to the absence of government policies, companies do not treat renewable energy projects as a standard and real part of their business. As a result, projects may not be undertaken for years or several may be clustered together depending on political will within the company. Companies do not take a systematic approach to implementing renewable energy production targets.

Adding to the difficulty in finding profitable renewable energy projects is the corporate structure of oil and gas companies. Most of these businesses have a debt target of around 30% with 70% equity. This high equity structure makes it more difficult to justify the undertaking of renewable energy projects with lower returns due to the need to invest available equity into the project. Utility companies tend to invest in green energy more than oil and gas companies and in analyzing the business structure of utilities, Pembina found that they carry a higher percentage of debt. Therefore utilities are less affected by the low natural gas prices than traditional businesses. Suncor addressed the issue to some extent by establishing a separate division for its renewable operations. This renewable side carries lower returns on investments. However, Pembina reports that most oil and gas companies are not interested in a move into the renewable energy business. Their focus remains on the liquid fuels business and they choose to invest in biofuels only.

Lastly, many oil and gas companies view the lack of direction from government as a barrier to further investment in renewables. Since the current provincial and federal government promote the exploration of hydrocarbons, oil and gas companies do not feel the need to explore these alternative forms of energy. The oil and gas companies Pembina interviewed also list the lack of urgency in addressing renewables' shortcomings as a barrier. They report a need for energy storage development

to account for the variability of wind power. Ultimately, the effort oil and gas companies take to start up green energy projects is correlated to the political effort taken provincially and federally.

Policy Implications, Consultation, Communication and Implementation

All sources that were accessed over the course of this project confirm that low natural gas prices are posing a significant challenge to renewable energy projects in Alberta. The long-term contracts that renewables operate under make it difficult to quantify the impact. However, the combination of market data, an interview with a prominent oil and gas company with large-scale operations in Alberta and consultations with a leading Alberta environmental think tank provide a comprehensive view of the problem.

In the future, two potential scenarios might unfold. Many energy experts believe the natural gas boom will continue for decades. If it does, renewable energy producers will have a reduced incentive to enter the electricity market. In the absence of government policies promoting renewables, these energy sources will be unable to compete with natural gas. In order to stay on track with the provincial climate change targets, Alberta must continue to develop its renewable energy capacity. Natural gas, while cleaner than coal, is not clean enough to achieve the province's climate change policy targets. In the process of extracting natural gas, Methane leaks out of the shale deposits the gas is extracted from.[59] Methane is an even more powerful greenhouse gas than carbon dioxide. Natural gas emits only half the carbon dioxide of coal but the methane leakage counteracts those savings. The National Center for Atmospheric Research conducted a study, which concluded that if leaks are not kept below 2 percent, natural gas is not a cleaner energy source than coal. Thus far it has proven difficult for producers to maintain this low level of leakage.[60] Consequently, in the long run, natural gas alone is unable to achieve the reduction in emissions needed to achieve climate change targets.

[59] Ingraffea, A. 2013. "Gangplank to a Warm Future." *The New York Times*, July 28, 2013
[60] Wigley, T. 2011, "Coal to Gas: the Influence of Methane Leakage", *Climate Change* 108:601-608

Therefore, if natural gas prices remain low, government policy should still promote continued entry of renewable energy sources into the electric grid.

Some analysts believe the natural gas boom will end within months to years. Even in this scenario policies are needed. If natural gas prices rally over time, renewable energy sources will become more competitive. However, the natural gas boom has demonstrated the vulnerability of alternative energy. Therefore, policies aimed at stabilizing the electric grid and power sources in Alberta would still be desirable. Moreover, Alberta currently derives around 7 percent of its energy from renewables. Experts state that the disadvantages of these energy sources, most notably grid instability resulting from the intermittent nature of wind power, do not become a factor until renewables reach 10-15 percent of total generated capacity. Since Alberta is well below this threshold, promoting renewable energy sources will not result in increased grid instability. In conclusion, in the face of uncertainty around the future of natural gas prices, it is prudent to invest in measures stimulating the entrance of renewables onto the Alberta electricity grid, regardless of the duration of the natural gas boom.

The fact that government policy is successful at achieving an increased production of a renewable energy source becomes apparent after analyzing the current markets. The Canadian and Alberta governments are currently focusing their policies on biofuels. As a result, biofuel production and research and development were boosted. Both Shell and Pembina's roundtable with other oil and gas companies demonstrate that companies are focusing their renewable energy investments on biofuels. Since the government policies signal the importance of biofuels to companies, they perceive this to be the area with the most potential for future growth.

Policy Options

Since Alberta's electricity market is deregulated[61], not all policy measures are suitable for the promotion of renewables in the province. Renewable energy producers that operate in liberalized markets require more government support than renewables in centralized markets because the connection to the electricity grid is more expensive for them.[62] There are two categories of methods used to promote renewables in a liberalized market: financial measures and regulatory measures.[63] The most efficient price-based system is a feed-in tariff (FIT) while a renewable portfolio standard (RPS) is a widely applied regulatory policy option. Under a FIT policy, the government sets a minimum price per kWh for electricity generated from renewable sources. This price is based on the cost of production associated with each renewable energy source. Renewable energy producers receive the contract price and the government imposes the obligation on electric utilities to purchase electricity generated from renewables at a predetermined tariff. Because a FIT policy provides a high level of certainty to producers of renewable energy, it promotes rapid deployment. However, the cost of the tariff is borne by the government and the consumer. Moreover, a FIT policy does not promote competition between renewables. All renewable energy producers that are able to produce energy above the government prescribed cost-level qualify for the FIT program. As such, further competition amongst renewable energy operators is not incentivized. Another downside to a FIT policy is the difficulty in controlling the amount of renewable energy that will enter the market upon implementing the policy. If the tariff is set too high, renewables will flood the market, driving up the cost of the program to the government.[64]

[61] Henton, D. 2012. "Alberta Power Rates among Highest in Country; Deregulated Market Blamed for Price Spikes." *Canada.Com*, October 15, 2012

[62] Varone, F. & De Lovinfosse, I. 2001, "Renewable Electricity Policies in Europe: Patterns of Change in the liberalized Market", Universite Catholique de Louvain

[63] Borhani, M. 2011. "How can higher Cost Renewables be paid for in a liberalized Electricity Market?, University of Dundee

[64] U.S. Energy Information Administration. 2013. "Feed-in Tariff: a Policy Tool encouraging Deployment of renewable Electricity Technology", *Today in Energy, May 30, 2013*

Ontario adopted a FIT policy in 2009, and a two-year review report concluded that the program has been a success. Not only has Ontario's renewable energy production increased, the program has also resulted in increased investment and job creation.[65] However, critics, most notably the Ontario Conservatives, have taken issue with the high public cost of the FIT program.[66] Renewable Portfolio Standard policies are applied widely in the U.S. Under an RPS, electricity suppliers are mandated to provide a specified portion of electricity from renewable sources. Renewable energy producers provide the electricity supply companies with credit certificates along with the renewable energy. The electricity companies in turn submit the credits to a regulator as proof of compliance.[67] Since there are no fixed prices or contracts, renewables compete with one another. As such, RPS policies promote renewable energy production while preserving competition among renewable energy producers. This makes it a better policy option for liberalized markets than its alternatives.

The principles of a free market economy are deeply entrenched in the Alberta political and business landscape. The Canadian Wind Energy Association recognizes this and calls for a market-based incentive to promote wind energy production.[68] An RPS would fit in well with the Alberta economic environment. Since the Ontario FIT program is already under fire for its public cost and Alberta's political climate has a longer Conservative tradition than Ontario, it is key that an Alberta renewable energy policy is not perceived as an unnecessary interference in the market. Moreover, Alberta's market is the only fully deregulated electricity market in Canada.[69]

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[65] Government of Ontario, 2011 "Ontario's Feed-in Tariff, Two-Year Review Report" accessed June 2, 2013 http://www.energy.gov.on.ca/docs/en/FIT-Review-Report.pdf

[66] Morden, P. 2013. "Tory MPP Says High Electricity Costs Kill Job Creation." *The Observer*, March 4, 2013

[67] Governors' Wind Energy Coalition. "Renewable Electricity Standards: State Success Stories", accessed June 8, 2013, http://www.governorswindenergycoalition.org/wp-content/uploads/2013/03/RES-White-Paper-March-2013.pdf

[68] Cooper, D. 2013. "Wind Energy Industry calls for green Power Incentives in Alberta", *Calgary Herald*, May 23, 2013

[69] Henton, D. 2012. "Alberta Power Rates among Highest in Country; Deregulated Market Blamed for Price Spikes." *Canada.Com*, October 15, 2012

After analyzing the different policy options, an RPS would be the best mechanism to ensure renewables will continue to enter the Alberta electricity grid despite low natural gas prices. If natural gas prices will increase in the near future, as some analysts believe will happen, an RPS would allow the market to adjust accordingly. When renewables become more price competitive with traditional energy sources, they will be selected based on their price relative to other energy sources rather than based on the RPS percentage. An RPS policy can be customized to set standards for various energy sources to ensure all renewables are developed.[70] Since wind energy is currently the most competitive renewable energy source, it is highly likely that wind would outcompete all other renewables under an RPS that does not specify percentages for each energy source. Indeed, this has been the outcome of U.S. RPS policies.[71] However, since Alberta has historically been opposed to green policies, putting in place a skeleton framework for an enforceable RPS policy is the best course of action. This will ensure minimal political opposition and it allows for future expansions should the province decide to protect all sources of renewable energy in the future. Alberta's deregulated electricity grid makes the implementation of an RPS more complicated than would be the case in any of the other Canadian provinces, all with government owned electricity infrastructure. Since investors and municipalities own Alberta's electricity grid together, an RPS policy would require the establishment of regulations addressing the different ownership structures. For instance, retail customers may demand a grandfather clause for their existing contracts.[72]

As of January 2012, 30 of the U.S. States had implemented enforceable RPS policies while another 7 set voluntary RPS goals.[73] The majority of these States had mixed governments at the time of implementation, indicating bipartisan support.[74] This is an important factor in Alberta where

[70] Jaccard, M. 2004. *Renewable Portfolio Standard.* Vancouver: Simon Fraser University
[71] Governors' Wind Energy Coalition. "Renewable Electricity Standards: State Success Stories
[72] Watt, D. 2008. "Renewable Portfolio Standards for Alberta", *Environmental Law Centre* 23 (5)
[73] U.S. Energy Information Administration. 2013. "Feed-in Tariff: a Policy Tool encouraging Deployment of renewable Electricity Technology"
[74] Governors' Wind Energy Coalition. "Renewable Electricity Standards: State Success Stories

political association tends to divide the population on important issues. Cost benefit analyses carried out in the U.S. indicate that RPS policies do not significantly increase electricity rates. The studies that found that rates did increase note that this increase would constitute no more than 1 percent of current electricity bills. 6 studies report cost savings for the electricity consumers.[75]

Not all RPS policies are created equal; the Texas policy has been lauded domestically and internationally for its design.[76] Texas, like Alberta, has a deregulated electricity market. In 1999, it implemented a renewable portfolio standard, one of the first U.S. states to do so. The original Bill mandated the production of an additional 2,000 MW of renewable electricity by 2009. At the same time, the Bill created a renewable energy certificate (REC) market. Utility companies are now obligated to buy RECs representing the share of renewable electricity they purchased. This design boosted demand for renewable electricity and Texas achieved its target in 2005. It has since increased its target to 5,880 MW of renewable electricity by 2015 and 10,000 MW by 2025. The RPS policy has been so successful that the State had already met its 2015 target by the end of 2008. Under the Texas system, the Public Utility Commission of Texas (PUCT) is authorized to enforce compliance with the RPS scheme while the Independent System Operator (ISO) manages the REC market's operations. RECs are issued quarterly and vary in price based on their availability.[77]

In Alberta, all electricity must be sold to the power pool. The AESO administers the power pool and its varying associated submarkets. An RPS policy in Alberta modeled after the Texas design would require an amendment to the *Alberta Utilities Commission Act* of 2007. This Act outlines the powers granted to the Alberta Utilities Commission (AUC), which is the Alberta equivalent of the PUCT. The Act would have to be amended to grant the AUC the authority to enforce the RPS. The renewable generators would be issued RECs representing a set number of MW based on their

[75] Ibid
[76] Martinot, E., Wiser, R. & Hamrin, J. 2005. *Renewable Energy Policies and Markets in the United States*
[77] Gülen, G. & Makaryan, R. 2009 "REC Trading in Texas – Lessons learned & Way forward", *Center for Energy Economics*

electricity output. Utilities would have to purchase enough RECs to meet the percentage of renewable electricity mandated by the RPS. Since the RECs would trade in their own market, administered by the AESO, utilities would purchase the credits in that market. Competition would be preserved since renewable generators would value their RECs based on the premium between market price at which their electricity was sold to the Power Pool and the actual cost of production. Thus, renewable electricity plants with cheaper technologies and more efficient operations would sell their RECs at a lower price than less efficient renewables. Utilities would purchase the cheapest RECs first, potentially leaving the most expensive credits on the market. Eventually, electricity producers that are unable to recover their cost of production through the combination of sales to the AESO Power Pool and the premium of their RECs would be driven out of business. The consequence of this design is that wind power would outcompete other renewables at this time, unless the Alberta government was to set standards for each renewable energy source it wants to promote. However, since Alberta is typically risk and market interference adverse, an RPS without further specifications and with an initial target not much higher than current renewable production is an optimal starting point for this province. The idea of a renewable standard is not an entirely new concept to Alberta. In 2001, the City of Calgary contracted Enmax and Vision Quest Windelectric Inc. to power the city's light rail transit system with wind energy. The City engaged in a contract on the basis that when power pool prices fall below wind prices, it pays a premium to Vision Quest. When power pool prices exceed wind power prices, Vision Quest reimburses the city for the difference.[78] An RPS would operate on the same principle but it would eliminate the high administrative costs associated with unique bilateral contracts. Furthermore, an RPS would result in less market interference as renewables compete amongst one another. In the Calgary LRT case, the city handpicked wind energy to power its

[78] Calgary Transit, 2002. "Ride the Wind! – A Success Story", accessed July 1, 2013 http://library.tac-atc.ca/proceedings/2002/calgary.pdf

train system.

Implementation

Alberta developed a comprehensive climate change strategy in 2008 through the establishment of the *Climate Change and Emissions Management Act*. The Act consists of three regulations: the *Specified Gas Reporting Regulation,* the *Specified Gas Emitters Regulation* and the *Administrative Penalty Regulation.*[79] The *Specified Gas Emitters Regulation* (SGER) establishes guidelines for greenhouse gas emissions and it is due to be renewed in 2014. The Government of Alberta is therefore reviewing the SGER. There have been indications in the media that the Government is contemplating more stringent regulation.[80] The Auditor General has been reviewing the regulation and has already concluded that it is currently difficult to assess provincial progress on greenhouse gas reduction.[81] Environmental think tanks are reviewing the existing framework as well and have begun proposing amendments.[82] The timing is right for an RPS policy for the electricity sector to be incorporated into the updated SGER. If the government were to adopt the concept of an RPS, it would make a policy announcement informing the involved parties of the decision.

The *Alberta Utilities Act* would have to be amended to extend the AUC's authority. The AUC would be granted the power to enforce compliance with the new RPS regulation. AESO's responsibilities are outlined in the *Electric Utilities Act*.[83] This Act would also have to be amended to include the authority to manage the REC market. Once the legislative amendments are in place, the

[79] Carbon Offset Solutions. "Alberta Legislation, Regulation and Policy Development", accessed July 2, 2013 http://carbonoffsetsolutions.climatechangecentral.com/policy-regulation/alberta-legislation-regulation-and-policy-development

[80] Dyer, S. 2013 *Strengthening Alberta's Greenhouse Gas Regulations.* Calgary: The Pembina Institute

[81] Cryderman, K. 2012. "Greenhouse Gas Reduction Policies difficult to assess, Auditor finds", *Calgary Herald,* November 2, 2012

[82] Dyer, S. 2013 *Strengthening Alberta's Greenhouse Gas Regulations.* Calgary: The Pembina Institute

[83] Alberta Electric System Operator, 2003. "Electric Utilities Act", accessed May 27, 2013 http://www.aeso.ca/downloads/Electric_Utilities_Act.pdf

Minister could then issue a directive for the AUC and AESO to respond to the new legislation by creating the RPS regulation.

Conclusion

While Alberta may benefit economically from the development of shale gas in the province and elsewhere in Canada, the exploitation of this resource will negatively impact the advancement of renewable energy sources. As this paper has shown, absent government policy, renewables will be unable to compete with the cheap natural gas fired electricity. Aside from the impact on renewable energy, the future supply of shale gas is not sufficiently secure to base the province's energy forecast on it. In the absence of an export route to Asia for liquefied natural gas, natural gas prices may remain low for the foreseeable future.

If methane leaks are kept under control, natural gas can be a bridge to a more sustainable energy future. It is however not a clean enough energy source to be regarded as an end solution to the climate change problem. Policy is needed to ensure renewables will continue to enter the grid and natural gas will indeed be a bridge rather than a dead end. Renewable Portfolio Standards are being used successfully in the United States. The Texas RPS in particular is an excellent model for Alberta since electricity markets in both jurisdictions are deregulated. The AUC and AESO are well equipped to handle the operational side of an RPS. Alberta, like Texas, is well suited for the development of wind energy. Since wind energy is currently the most competitive renewable energy resource, there is plenty potential for additional renewable energy to be developed. The shale gas boom has brought North America an economic windfall. Alberta should use its natural gas profits to build a bridge to a sustainable future.

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Appendix 1A
Alberta Electricity Energy Generation (GWh) by Resource and Interchange
Data: AESO and AUC

	Resource Type								
Year	Coal	Natural Gas	Hydro	Wind	Biogas & Biomass	sub total Renewables	*Others	Total	% Renewables
1985	27,798.4	3,806.3	1,385.4	0.1	396.8	396.9	0.4	33,387.4	1.2%
1986	29,094.5	3,524.4	1,791.4	0.2	408.9	409.1	0.5	34,819.9	1.2%
1987	30,886.2	4,164.9	1,443.6	0.3	373.7	374.0	0.4	36,869.1	1.0%
1988	33,103.5	5,300.7	1,422.7	0.2	381.8	382.0	0.4	40,209.3	1.0%
1989	34,002.6	7,341.1	1,589.5	0.2	377.5	377.7	0.6	43,311.5	0.9%
1990	34,963.6	5,551.5	2,050.9	0.6	629.0	629.6	0.6	43,196.2	1.5%
1991	36,689.5	5,129.6	2,031.8	0.7	705.2	705.9	0.5	44,557.3	1.6%
1992	38,546.7	6,814.2	1,575.0	0.5	913.9	914.4	0.4	47,850.7	1.9%
1993	39,187.2	6,762.4	1,792.3	1.8	920.3	922.1	0.5	48,664.5	1.9%
1994	42,269.8	7,468.9	1,763.2	35.6	1,370.9	1,406.5	1.5	52,909.9	2.7%
1995	42,460.8	6,236.8	1,999.8	54.3	1,452.6	1,506.9	1.3	52,205.6	2.9%
1996	41,220.3	7,135.0	1,966.7	59.1	1,583.1	1,642.2	0.4	51,964.6	3.2%
1997	43,054.2	7,654.1	1,824.3	62.0	1,628.8	1,690.8	0.4	54,223.8	3.1%
1998	41,267.7	10,607.9	2,043.3	49.4	1,659.9	1,709.3	0.4	55,628.6	3.1%
1999	40,276.7	10,645.3	2,181.0	64.6	1,718.0	1,782.6	0.3	54,885.9	3.2%
2000	40,462.2	13,937.3	1,748.2	71.8	1,625.7	1,697.4	0.4	57,845.6	2.9%
2001	41,713.3	15,493.6	1,446.3	151.0	1,619.4	1,770.4	207.0	60,630.6	2.9%
2002	42,541.7	14,623.3	1,668.0	296.1	1,686.4	1,982.5	266.7	61,082.3	3.2%
2003	42,345.7	17,272.7	1,733.0	374.2	1,676.5	2,050.7	248.1	63,650.3	3.2%
2004	42,538.6	18,936.3	1,977.2	669.6	1,692.5	2,362.1	254.3	66,068.6	3.6%
2005	43,986.2	17,161.6	2,371.8	813.1	1,725.2	2,538.3	255.9	66,313.8	3.8%
2006	44,531.4	19,449.2	1,966.4	921.4	1,855.2	2,776.5	246.9	68,970.4	4.0%
2007	44,278.4	19,804.6	2,113.0	1,430.3	1,870.4	3,300.6	237.9	69,734.6	4.7%
2008	42,418.7	21,047.6	2,149.9	1,472.9	1,917.4	3,390.3	111.5	69,118.0	4.9%
2009	41,230.7	22,689.8	1,695.3	1,557.9	1,861.5	3,419.4	227.0	69,262.2	4.9%
2010	41,120.2	24,058.4	1,620.0	1,628.6	1,908.8	3,537.4	250.3	70,586.3	5.0%
2011	38,859.4	25,077.6	2,035.6	2,419.1	1,972.2	4,391.3	321.3	70,685.2	6.2%
2012	38,272.0	27,238.5	2,318.7	2,640.5	2,089.1	4,729.6	359.5	72,918.3	6.5%

* Others include fuel oil, waste heat

Appendix 1B
Alberta Electric Energy Net Installed Capacity (MCR MW) by Resource
Data: AUC

Year	Resource Type								
	Coal	Natural Gas	Hydro	Wind	Biogas & Biomass	Sub total renewables	*Others	Total	% Renewables
1985	4158.0	1896.2	808.1	0.1	55.2	55.3	7.4	6925.0	0.8%
1986	4158.0	1864.6	808.1	0.3	55.2	55.5	7.4	6893.6	0.8%
1987	4158.0	1868.3	808.1	0.4	55.2	55.6	7.4	6897.4	0.8%
1988	4167.0	1870.5	795.4	0.4	53.0	53.4	7.4	6893.7	0.8%
1989	4553.0	1795.9	795.4	0.4	52.0	52.4	7.3	7204.0	0.7%
1990	5299.0	1796.0	795.4	0.6	122.0	122.6	7.3	8020.3	1.5%
1991	5299.0	1770.1	797.9	0.6	122.0	122.6	7.3	7996.9	1.5%
1992	5299.0	1772.1	818.3	0.6	122.0	122.6	7.3	8019.3	1.5%
1993	5318.0	1773.8	818.3	12.4	204.5	216.9	7.3	8134.3	2.7%
1994	5704.0	1785.7	847.3	21.4	263.7	285.1	7.9	8630.0	3.3%
1995	5704.0	1797.0	847.3	21.4	225.2	246.6	7.4	8602.3	2.9%
1996	5704.0	1818.9	847.3	21.4	235.9	257.3	12.4	8639.9	3.0%
1997	5704.0	1819.4	847.3	23.1	235.9	259.0	11.2	8640.9	3.0%
1998	5636.0	1878.1	847.3	24.3	239.9	264.2	6.2	8631.8	3.1%
1999	5638.0	2247.5	850.4	24.3	256.0	280.3	12.7	9028.9	3.1%
2000	5638.0	2883.1	863.2	36.8	271.6	308.4	41.2	9733.9	3.2%
2001	5615.0	3618.9	863.2	94.1	271.6	365.7	50.2	10513.0	3.5%
2002	5658.9	4017.0	860.0	96.6	276.8	373.4	50.2	10959.5	3.4%
2003	5519.6	4788.2	893.0	171.8	277.3	449.1	50.2	11700.1	3.8%
2004	5508.6	4797.5	900.0	273.2	277.3	550.5	50.2	11806.8	4.7%
2005	5839.6	4770.2	899.7	276.7	308.1	584.8	55.2	12149.5	4.8%
2006	5863.6	4324.5	899.7	386.2	313.1	699.3	54.1	11841.2	5.9%
2007	5917.9	4425.2	899.7	525.2	313.1	838.3	54.1	12135.2	6.9%
2008	5918.3	4823.4	899.7	525.2	313.1	838.3	74.1	12553.8	6.7%
2009	5971.3	5138.6	900.0	591.2	323.2	914.4	72.5	12996.8	7.0%
2010	5735.3	5217.5	900.0	804.8	340.2	1145.0	73.3	13071.1	8.8%
2011	5631.8	5251.5	899.9	895.4	358.7	1254.1	73.8	13111.0	9.6%
2012	5690.3	5682.8	899.9	1113.3	413.8	1527.1	97.8	13897.8	11.0%

* Others include oil, diesel, waste heat

Appendix 2
Electricity Prices and Natural Gas Prices - Historical
Data: AESO and AUC