Appendix 3

Review of the Pembina Institute report "Power to Change: How Alberta can green its grid and embrace clean energy"

prepared for TransAlta Corporation by London Economics International LLC

September 29, 2015

London Economics International LLC ("LEI") was engaged by TransAlta Corporation ("TransAlta") to complete a high-level review of the Pembina Institute ("the Institute") and Clean Energy Canada report titled "Power to Change: How Alberta can green its grid and embrace clean energy." While the report provides detailed discussion on the opportunities available for Alberta to reduce its greenhouse gas emissions, LEI does not consider either the Transition or Transformation scenarios proposed for Alberta's power sector to be realistic at this point in time as presented by the Pembina Institute. LEI has identified a number of key weaknesses in the modeling approach and in the assumption used. LEI's main concerns focused on whether the contemplated Transition or Transformation would undermine Alberta's energy-only market design, and if the proposed changes would be technically and commercially feasible. Finally, LEI's analysis suggests that there are significant additional costs that need to be considered to ensure reliable service in light of such profound changes to Alberta's supply mix, such as the costs associated with the remuneration for coal fired power stations forced to retire early, the integration of renewables to the network, and the out of market payments to be paid to generation owners to develop new renewables and maintain existing generation required for reliability.

1 Executive Summary

London Economics International LLC ("LEI") was engaged by TransAlta Corporation ("TransAlta") to conduct a high-level review of the Pembina Institute ("the Institute") and Clean Energy Canada jointly released May 2014 report titled "*Power to Change: How* Alberta Can Green its Grid and Embrace Clean Energy" (referred to herein as the Pembina Report). LEI's mandate included a review of the analytical methods used by the authors, key assumptions and results.[1]

The Pembina Report details two conceptual scenarios to cut air pollution and greenhouse gas emissions ("GHG") from the power sector over the period 2015 - 2033, through the early retirement of coal-fired generation, the development of large quantities of renewable generation and by setting ambitious energy efficiency

LEI considered three key areas as part its review. First, are the assumptions, inputs, and methodology reasonable and reflective of the current market environment in Alberta? Second, does the forecast of future market conditions align with the current market design, such that the proposed Transition or Transformation is plausible and sustainable? Finally, are the findings and recommendations made by the Institute robust and reliable, from the perspective of industry and investors and in the context of consumer impacts?

LEI also reflected upon the Institute's decision not to outline specific policies or programs on how each scenario is to be achieved.

1.1 Outdated inputs and assumptions

Several of the key inputs and assumptions underpinning the Pembina Institute's assessment are now out of date and are not reflective of the current market or forecasts for the market.

The Pembina Report was issued in May 2014. The Pembina Report and associated analysis relied on several information sources in compiling its inputs and assumptions that are now out of date. Market conditions within Alberta and outside Alberta have evolved in the last two years. For example, due to changes in the global oil markets, and the impacts that oil production has on Provincial electricity demand, the Pembina Report is relying on outdated and overly optimistic (too high) load forecasts.[2]

The dated load forecast assumptions create an implicit bias in the Pembina Report analysis by suggesting that under its Base Case the Alberta market would have significantly increasing carbon footprint (because of demand growth) and that Alberta's market growth is sufficient to

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[1] LEI was not asked to simulate the analysis documented in the Pembina Report, nor to perform extensive alternative analysis. Nonetheless, LEI has provided indicative calculations to illustrate particular conclusions and findings.

[2] Since the release of the Pembina Institute report, there have been several updates to these data sources, for example the release of the Alberta Electricity System Operator ("AESO") 2014 Long Term Outlook ("LTO"), as well as other regulatory reforms (changes to the existing *Specified Gas Emitters Regulation* program), and other market developments.

absorb the new renewables without undercutting the continued operations of existing generation that is necessary to serve the system reliably.

1.2 Distortionary impacts to Alberta's energy-only market

While the stated objective of reducing greenhouse gas ("GHG") emissions from the electricity sector is commendable, the level of change in supply proposed under both the Transition and Transformation scenarios is likely to jeopardize the sustainable operations of an energy-only market in Alberta.

Renewables resources that are the cornerstone of the Pembina Report's Transition and Transformation scenarios have a short run marginal cost of virtually zero. Therefore, in a perfectly competitive environment, the addition of such resources will reduce market clearing prices of electricity. That is, in and of itself, not harmful, if the new entrants are competing on an equal footing to existing conventional generation. However, a level playing field is not possible in the scenarios modeled in the Pembina Report.

Under the current energy-only market design and consensus views on future investment costs for various renewable technologies versus gas-fired generation, such vast amounts of new renewables could not be brought online without additional financial supports (i.e., subsidies) and that will distort the market dynamics. The high costs associated with developing renewable energy in the province, relative to forecast wholesale electricity prices, will necessitate out of market payments to those resources. Thus, renewable generators will not be reliant on the wholesale market to earn their full compensation. These payments are likely to have a distortionary effect on the wholesale market, as a growing number of generators will not need for Power Pool prices to compensate their full costs or to serve as a signal for new investment. Moreover, intermittent renewables resources, depending on the structure of their out of market contracts, may be incentivized to offer at a negative bid price, further suppressing Pool Prices.

Artificially low Pool Prices - below otherwise economic levels – would likely trigger retirements and thereby jeopardize the market as we know it today in Alberta. In this way, we believe the scenarios and future conditions modeled in the Pembina Report are not compatible with the current market design. Changes to the market design will ultimately require that ratepayers bear additional costs, associated with costs of implementation of new market rules and institutions, and additional (and ongoing) costs to sustain existing generation to ensure reliable service – perhaps in the form of out-of-market contracts or capacity market payments.

1.3 Focus on conceptual quantities of renewables without fully considering technical, economic or commercial feasibility

The assumptions on the level of renewable energy penetration under both the Transition and Transformation scenarios may be conceptually feasible, but Pembina Institute has not shown with sufficient robustness that they are technically feasible. Supply changes as proposed under the Transition and Transformation scenarios will create operational issues for the system, and may not be economical or commercially feasible under the current market environment without significant additional infrastructure investment (such as new transmission) and government

supports. The Pembina Report does not discuss the specific policies and regulatory changes that would need to be implemented to get these supply changes realized.

The Pembina Report presents a conceptual design for the future Alberta market. Getting there will require significant regulatory changes, instructional capacity building, and government funding. These practical considerations are not discussed in the report. While Pembina was purposeful in its omission of these details, we believe such information is required to adequately assess the costs and viability of these projections.

There are operational constraints associated with introducing significant levels of intermittent generation onto any transmission network, and Alberta is no exception. The Southern Alberta Transmission Reinforcement ("SATR") project is designed to do just that, by re-enforcing the transmission network to accommodate up to 2,700 MW of new wind generation in southern Alberta, over a 10 year period, at a price tag of $3.4429 billion.[3,4] This project has not progressed as planned, as wind development interest has actually declined in recent years due to supply-demand conditions and market prices. Without that supporting infrastructure, the supply changes modeled in the Pembina Report may not be technically feasible.

In addition to the transmission infrastructure, developing such large quantities of intermittent resources will require investment in additional, flexible gas-fired resources. System operators need the right mix of baseload, intermittent, and peaking generation in order to dynamically balance the operation of the system in response to changes in real-time demand.

The Pembina Report provides little discussion on the system's operation in light of the significant volume of renewable generation to come online or importantly where and how the significant volume of renewable energy is to be connected to the network.

The Pembina Institute has made several assumptions regarding the commercial viability of large scale renewable technologies, and their level of development over the forecast period. For example, solar and geothermal energy are both forecast to increase dramatically over the forecast period, 3,000-4,000 MW and 300-400 MW respectively. This is despite the fact that there is less than 5 MW of solar and 0 MW of geothermal currently operating in the province as of end of 2014. As a point of comparison, California, a jurisdiction five times as large as Alberta, had a solar DG target of 3,000 MW over 10 years. LEI is skeptical of the commercial viability of this volume of new generation at the prices presented in the Pembina Report, given the significant investment costs associated with these technologies.

Finally the energy efficiency targets set are significant and a key consideration under both scenarios. By 2033, energy efficiency measures are projected to result in approximately 20 TWh of savings. By way of comparison and context, this is less than but comparable to California's target of 30 TWh in 10 years, which seems aggressive given California's lengthy history of energy efficiency programs dating back to the 1970s. This amounts to approximately 15% of the AESO 2014 Main Outlook of the Alberta Internal Load ("AIL") in 2033 (129.9 TWh), of which

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[3] AESO. Transmission System Projects – Quarterly Report (Q2 2015).

[4] AESO. South Area Transmission Requirements & Milestones. Stakeholder Sessions. September 24, 2009.

residential load makes up only 10% (13.2 TWh). This means that Alberta will need to achieve significant energy efficiency savings from industrial customers in order to achieve its 20 TWh target. More bottom up assessment is required to determine whether that is viable. Moreover, given that Alberta does not have any significant energy efficiency programs in place, time will be required for the province to develop and/or acquire the expertise needed to design, manage and oversee such programs. This then begs the question of whether the energy efficiency supply targets relied upon by Pembina Institute are realistic.

1.4 Refinement needed to modeling approach to consider costs of interconnecting and reliably operating more renewables

Analytical gaps include not factoring in transmission costs and other ancillary investments that would be needed to support such new supply. In addition, the ramifications for existing generation and overall sustainability of the electricity sector have not been examined. Adjusting the analysis in the Pembina Report to consider such issues should provide for a more comprehensive analysis. LEI expects that such modifications will also provide clarity on the cost implications for consumers, as the current estimates overlook important cost drivers that should be considered and be factored into policy deliberations for the future of Alberta's electricity sector.

The Pembina Institute appears not to have taken into account all costs associated with implementing the proposed scenarios, instead focusing on changes to the wholesale electricity price (Pool Price). The results presented by the Pembina Institute therefore reflect an incomplete costs benefit assessment of each future supply scenario. Additional costs to be covered in a revised assessment include, but are not limited to:

- remuneration of coal fired generation forced to retire early;
- articulation of, or further assessment of, the level of out-of-market payments incorporated in the wholesale energy price forecast for the province, as would be required to incentivize the development of new renewable generation;
- network expansion or transmission investment costs accommodating for the location (and quantity) of new renewable energy developments;
- reliability costs such as the carrying costs of new gas-fired generation that would be necessary to balance intermittency of renewables generation but would not otherwise be economic);
- implementation costs of new policies and regulations (as needed), including rules to support reliability and sustainability of electricity supply, if the energy-only market design is de-stabilized by the magnitude of new renewable supply; and
- the socio-economic implications associated with job losses and transitions due to early retirement of coal generation in the province, and overall higher electricity costs to consumers (after accounting for all these additional costs).

In addition, LEI notes the Pembina Institutes modeling approach would benefit from:

- broader consideration of system or operational impacts associated with the economic retirement of coal and introduction of large quantities of intermittent generation throughout the province;

- sensitivity analysis of changes to the established "baseline" outlook, given the lower demand forecast from AESO and Specified Gas Emitters Regulation ("SGER") reforms (beginning in 2016); and
- examination of whether new investment is economic and how the energy-only market design would remunerate such new entry (including consideration of how renewables affect sustainability of a workably competitive energy-only market design and bidding behavior of other generators[5]).

1.5 Lack of identification of proposed policy and programs

It remains unclear how the Pembina Institute proposes to achieve the targets set out for either the Transition or Transformation scenarios.

The scenarios presented in the Pembina Report appear to have been designed without sufficient consideration of:

a) the policy or program options available;
b) the costs of those options (for example, what aggregate subsidies or out–of-market/government supports will cost); or
c) how the options may interact with each other and with the operation of the energy-only market design we currently have in Alberta.

LEI recognizes the Pembina Institute has intentionally not tested any specific policy or programs, instead preferring to articulate their support of any and all policies that achieve a set of goals. However, this leaves the study open to criticism regarding technical feasibility. Is there a set of policies that can achieve these supply changes at the costs projected in the Pembina Report? LEI is doubtful of Alberta's ability to undertake policies that will transform the sector over the next 15 years in the way proposed by the Pembina Report and at the cost projected. LEI does not disagree with the desired targets put forth in the Pembina Report, but questions whether the realities presented under both the Transition and Transformation scenarios can be achieved without significantly higher costs burdens on consumers, and without undermining the existing competitive energy market.

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[5] Including, reconsideration about the efficacy of using actual 2012 merit orders in establishing price forecasts, versus more recent market dynamics (for example, after the start-up of Shepard Energy Centre in 2015) and future market dynamics when the current PPAs expire and economic rights to existing capacity changes ownership.

2 Background

2.1 Scope of Work

LEI was commissioned by TransAlta to complete a review of the Pembina Institute and Clean Energy Canada ("CEC") report titled *"Power to Change: How Alberta can green its grid and embrace clean energy."*[6] This report was jointly released in May 2014. Analysis for this report began in 2013, although the authors relied on data from as far back as 2012.

In completing the review, LEI was asked to comment on the assumptions, inputs, and modeling approach adopted by the Institute, as well as the Pembina Report's key conclusions and recommendations. This review is part of a broader suite of work being completed on behalf of TransAlta, analyzing the costs and benefits of alternative climate change policy options for Alberta, which includes detailed case studies of several emission reducing policies as well as LEI's own analyses of the economic impacts of such policies in Alberta.

Importantly, LEI's mandate for this review did not include modeling the Institute's scenarios. However, to provide context to LEI's discussion and findings, LEI has provided indicative calculations based on publicly available data sources, such as the Alberta Electricity System Operators ("AESO") 2014 Long Term Outlook, as well as our own internal proprietary modeling assumptions and inputs developed as part of LEI's bi-annual, multi-client market analysis for the Alberta electricity market.[7]

LEI recognizes the continued importance of the analysis presented by the Pembina Institute in contributing to the overall policy discussion in the province. Reports, such as the one reviewed, provide valuable thinking on alternative strategies and are useful in kick-starting the discussion on what may, or may not, be feasible within the province. Our analysis in this report is intended to provide additional insight and context for that discussion.

2.2 Summary of the Pembina Report

The Pembina Report was released at the same time as the then provincial government of Alberta's resumption of work on an Alternative and Renewable Energy Policy Framework. In releasing the report, the Pembina Institute *"sought to inform the development of this framework and inspire policy leadership so that the province might reduce pollution and capture a larger share of the growing global market for clean energy."*[8]

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[6] The report follows an earlier assessment completed by the Pembina Institute in 2009 titled: "Greening the Grid: Powering Alberta's Future with Renewable Energy."

[7] These market analyses form part of LEI's Continuous Modelling Initiative (or "CMI"). LEI releases such market outlooks for all North American electricity markets, and these include a 10-year "Base Case" price forecast (developed using LEI's proprietary simulation model POOLMod).

[8] Pembina Institute and Clean Energy Canada. Media Backgrounder – Power to Change: How Alberta can green its grid and embrace clean energy.

In drafting the Pembina Report, the Institute chose not recommend a specific policy (or policies) to be adopted in Alberta.[9] Instead, the Institute states that it generically supports any policy options that achieve the following goals[10]:

- *"leveling the playing field for renewable energy sources by accounting for the presently hidden pollution and greenhouse gas costs of fossil fuel generation;*
- *addressing the major hurdle to financing for renewable energy projects by providing some degree of long-term price certainty for the electricity generated;*
- *preparing the groundwork and dismantle regulatory barriers for the widespread market penetration of new, clean generation technologies – such as distributed generation and storage technologies that integrate renewable energy into the grid; and*
- *allowing renewable energy sources – including distributed generation sources – to fully realize the value of the energy they produce."*

In order to demonstrate the potential benefits associated with reducing the level of GHG emissions from the electricity sector, the Pembina Institute modeled three separate scenarios, two of which provide for a more aggressive reduction strategy in carbon emissions as compared to the status quo (Scenario 1). These three scenarios are as follows:

- ***Scenario 1: Continued Fossil Reliance*** – is reflective of the status quo in the province and is referred to throughout this report as the "Base Case". Under this scenario, demand is assumed to grow by approximately 53% by 2033, emissions are forecast to reduce in line with existing federal government carbon dioxide emissions regulations (and the restrictions on the lifespan of coal-fired generation to 50 years), and renewable energy is assumed to increase in line with AESO 2012 forecasts. By 2033, natural-gas is the dominant generation source in the province;

- ***Scenario 2: Clean Power Transition*** ("Transition") – under the Transition scenario, the Institute assessed the benefits associated with lowering the permissible operating lifespan (40 years) for coal fired generators in the province, increasing significantly the total renewable generation to come onto the market (approximately 10,600 MW to be online by 2033, relative to 4,000 MW under Scenario 1), and reducing total electricity demand resulting from a considerable increase in the energy efficiency targets for the province.[11]

- ***Scenario 3: Clean Power Transformation*** ("Transformation") – under the very ambitious Transformation scenario, there is coal fired generation left operating in the province by 2033 (two of the newest coal plants are converted to co-firing bio-mass and

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[9] The Pembina Institute reference the Clean Electricity Standard as a possible policy option for the province. Albeit noting this is one of many 'options or take-offs' which may be beneficial to the province.

[10] Pembina Institute and Clean Energy Canada. Power to Change: How Alberta can green its grid and embrace clean energy. May 2014.

[11] Energy efficiency targets were sourced from Energy Efficiency Alliance's analysis documented in the January 2014 report titled "*Energy Efficiency Potential in Alberta."*

the rest are retired on an accelerated schedule to their Federal requirements). Significant increases in renewable generation are assumed to come online (approximately 16,500 MW to be online by 2033), and finally energy efficiency targets are retained as per the Transition scenario, resulting in a lower overall demand forecast for the province relative to the status quo.

The scenario analysis was completed for a 20 year period spanning 2013 to 2033, with results presented for years 2023 and 2033. The results of the Pembina Institute's modeling efforts indicate that under Scenario 3, Alberta could reduce its reliance on fossil fuel, specifically coal fired generation, resulting in a 69% reduction in annual carbon pollution from the sector, relative to the Base Case. Under the Transition scenario, a 45% reduction below the status quo was achieved by 2033. Figure 1 highlights the modeled reduction in GHG emissions under each scenario.[12]

In addition to a reduction in GHG emissions, the Pembina Institute forecasts wholesale electricity prices will decline in the long run, as a result of the increased penetration of renewable generation, and greater insulation from fossil fuel prices (such as the costs of natural gas and coal).[13] This reduction in Pool Prices follows an initial increase in 2023, which the Pembina Institute attributes to the upfront costs of new capital investment, and accelerated retirement of coal fired generation.[14] Figure 2 highlights the forecast prices as presented in the Pembina Report.[15] As shown in the figure below, a decrease in wholesale electricity prices is achieved by 2033 relative to the Base Case under both Scenario 2 and Scenario 3.

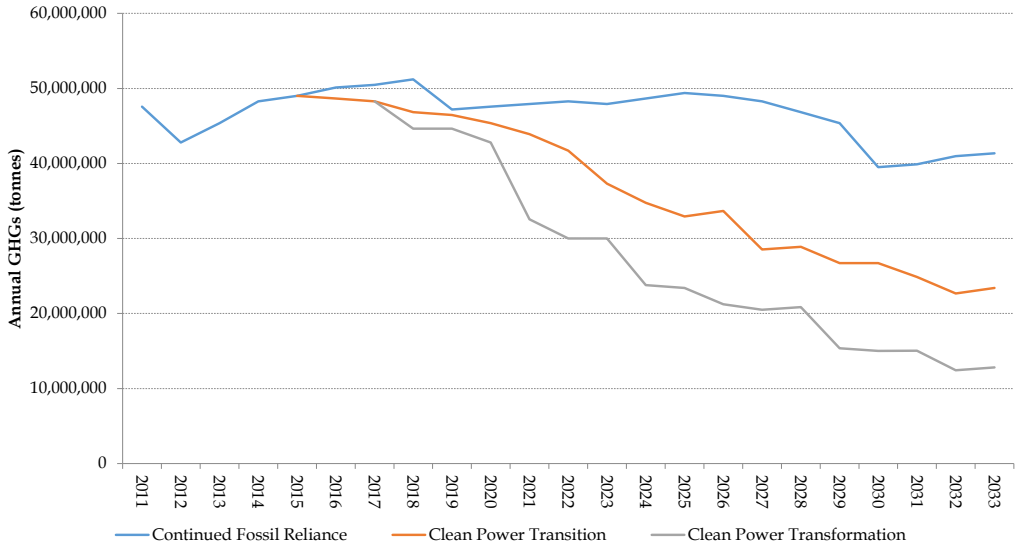
Figure 1. Modeled GHG emissions under different scenarios

[12] The Institute only modeled the Alberta Interconnected Electric System ("AIES"), and therefore "behind the fence" cogeneration were not included / counted in the analysis. The Institute's figures on GHG/carbon emissions therefore will understate the amount of total emissions from electric generation sources in the province.

[13] The Pembina Institute engaged Solas Energy Consulting Inc. to model the impacts of each of the three scenarios on the wholesale energy prices for years 2023 and 2033. LEI note no additional price information is presented within the report.

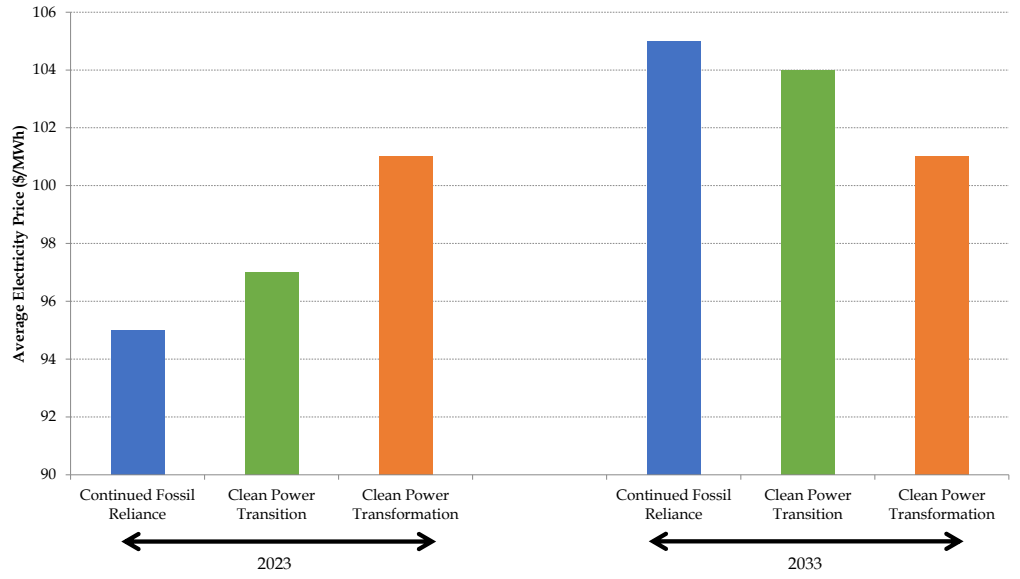
[14] Pembina Institute and Clean Energy Canada. Power to Change: How Alberta can green its grid and embrace clean energy. May 2014.Page 17.

[15] Pembina Institute and Clean Energy Canada. *Power to Change: How Alberta can green its grid and embrace clean energy*. May 2014.



Source: Pembina Institute and Clean Energy Canada. *Power to Change: How Alberta can green its grid and embrace clean energy*. May 2014. Figure 7: Annual greenhouse gas emissions under different scenarios.

Figure 2. Modeled wholesale electricity prices (2023 and 2033 only)



Source: Pembina Institute and Clean Energy Canada. *Power to Change: How Alberta can green its grid and embrace clean energy*. May 2014. Figure 8: Price of generation under different scenarios.

As a direct result of the proposed scenarios, the Pembina Institute notes "*an Alberta grid powered primarily by renewable energy could diversify the economy, buffer customers from future price shocks,*

provide rural economic development opportunities, and of course reduce pollution and GHG emissions."[16]

[16] Ibid. Page 4.

3 Review of the Institute's assessment methodology

The Institute states that it modeled the Alberta wholesale market using a simulation-based approach. However, the details of the model and various underlying inputs are not available for review. Based on LEIs experience with modeling of the Alberta market, and the magnitude of the supply change that the Institute is simulating in their scenarios, we believe that the results presented under the Transition and Transformation scenarios are not consistent with the current energy-only market design. At the prices presented, and given the changes made to the Power Pool market dynamics, existing generation (and new conventional gas-fired generation) is not likely to be sustainable. Furthermore, the reported wholesale electricity market prices are not adequately reflecting other costs that consumers and/or the industry will need to bear as a result of this metamorphosis. For example, the Pembina Report does not appear to fully consider the high costs associated with the technologies and subsequent need for significant out of market payments, as well as the commercial and operational adjustments needed to interconnect and operate such massive amounts of new intermittent generation.

LEI has identified significant gaps within the Pembina Institute's approach. Once these gaps are corrected for, the Pembina Report can provide a more comprehensive foundation for further policy analysis and review. The areas of improvement that LEI has identified include the following:

- ***assessment and discussion of the costs associated with plant retirements, integration of new generation on the network, and out of market payments;***
- ***revision of simulation modeling associated with portfolio bidding dynamic by market participants in an energy-only market design as supply conditions evolve;***
- ***updating for revised load forecast and recent changes to the established SGER program.***

3.1 Modeling approach and assumptions

In forecasting the benefits (and costs) associated with each of the proposed scenarios the Pembina Institute has relied on simulation modeling of the Alberta wholesale electricity market. Specifically, through their modeling efforts the Institute has attempted to estimate the total effective capacity requirements for the market, the wholesale electricity price (reported for years 2023 and 2033 only) and the total GHG emissions reductions achieved under each scenario relative to the base case. As noted previously, in addition to the wholesale electricity price, the Pembina Institute has also estimated the out of market (or subsidy) costs associated with each renewable technology for each scenario. These out of market costs are not documented by the Pembina Institute.

Due to the limited information contained in the report regarding the modeling approach, LEI's comments are restricted to key considerations which appear unaccounted for or otherwise appear inadequately addressed. LEI believes that incorporating the following factors would provide for a more comprehensive assessment of the proposed scenarios. The following sections discuss these factors in further detail.

3.1.1 Demand forecast

The 2015 downturn in the production and growth of the oil sands sector in Alberta, following a slump in global crude oil prices, will significantly lower overall demand in the province.

The Pembina Institute began its analysis with review of the forecast demand in the province as published by the AESO in the March 2014 report: "*2012 LTO Update Historical and Forecast Demand Tariff Service Energy*" and EDC Associates 2013 report "*Trends in GHG Emissions in the Alberta Electricity Market.*" LEI understands that at the time of completing the analysis, these reports presented the reasonably up-to-date information concerning demand forecasts for the province. However, the demand trajectory is now very much altered due to economic developments in last 12 months, most importantly, the recent downturn in the production and growth of the oil sands sector in the Province. This follows the recent slump in global crude oil prices, which affects demand for electricity from the oil sands industry.

The AESO's 2014 LTO was prepared in advance of the oil market shock. That said, even in the 2014 LTO, the AESO acknowledged the importance of this sector to the economy, stating that "*significant oil sands growth driving the Alberta economy is a major assumption of the 2014 LTO.*"[17] It can be argued that AESO's 2014 LTO Reference Case is now also outdated, and further reliance should be placed by market participants on the "Low Growth" scenario developed by the AESO in that same 2014 LTO. This scenario is a better representation of current conditions, and provides a more accurate starting point. Figure 3 highlights the difference between the 2012 LTO relied upon by the Institute, and 2014 LTO and 2014 low growth scenario assessed by the AESO. The contraction in demand, as indicated by comparison of AESO's more recent demand projections to the vintage forecast relied upon by the Institute, suggest a drop of as much as 438 MW in peak demand in the first three years of the forecast, and over 6,509 GWh less of electricity consumed by 2033, as show in the figure below. Relative to the low growth scenario, peak demand falls by as much as 2,176 MW in the first three year of the forecast relative to the 2012 estimates and a reduction of 421,526 GWh of electricity consumed by 2033.

Importantly the Institute appears not to have taken into account behind-the-fence ("BTF") generation.[18] In Alberta, BTF resources related to the oil and gas industry are significant. Historically, load as defined by the Alberta Internal Load ("AIL") measurement, which is load served by the market plus load served by BTF, is approximately 25% higher as compared to the Alberta Interconnected Electricity System ("AIES"). The Institute's exclusion of the BTF resources / load effectively underestimates the total demand across the province, potentially resulting in a misrepresentation of the overall benefits associated with the proposed scenarios.

Finally the dated load forecast assumptions create an implicit bias in the Pembina Report analysis, for example, by suggesting that the Alberta market without transformative changes

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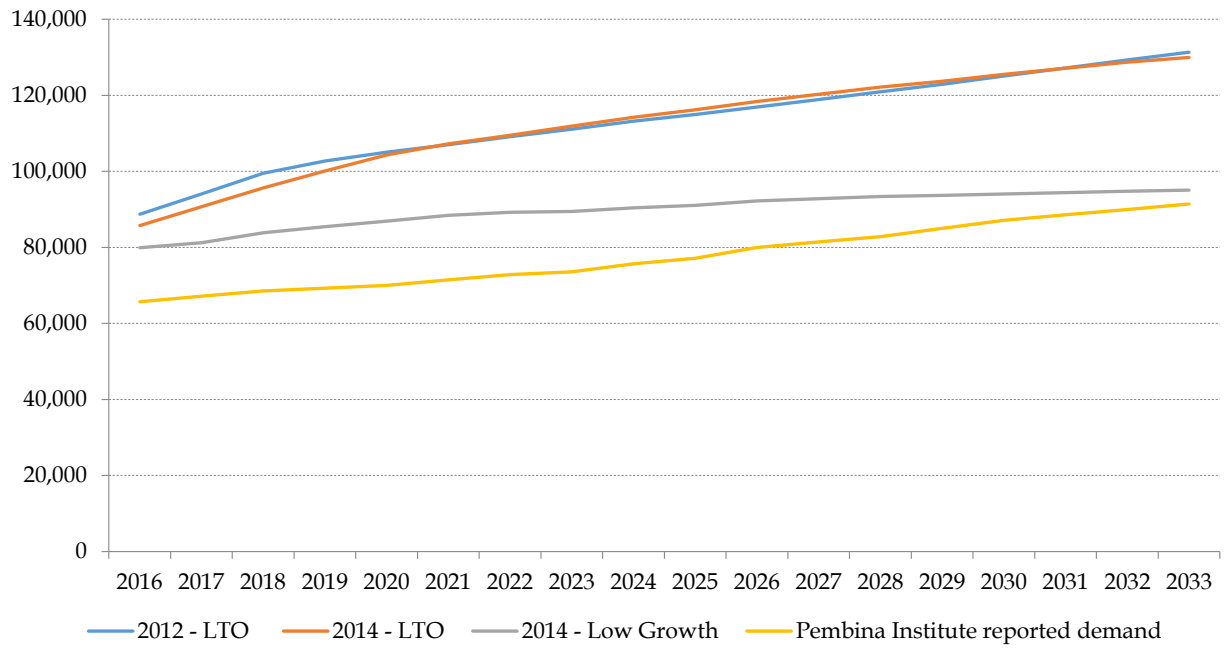
[17] Alberta Electricity System Operator. 2014 Long Term Outlook. Page 10.

[18] BTF resources are defined by the following characteristics: where a generating unit is located directly with load; where no utility-owned transmission or distribution facilities are used to deliver the energy from the generating unit to the load; and/or where the generation interconnection is located behind a retail customer meter.

would have significantly increasing carbon footprint (because of demand growth) and that Alberta's market growth is sufficient to absorb the new renewables without undercutting the continued operations of existing generation that is necessary to serve the system reliably.

Figure 3. Pembina Institute reported demand forecast, AESO 2012 and 2014 LTO demand forecast and 2014 low growth demand forecast (AIL MW)



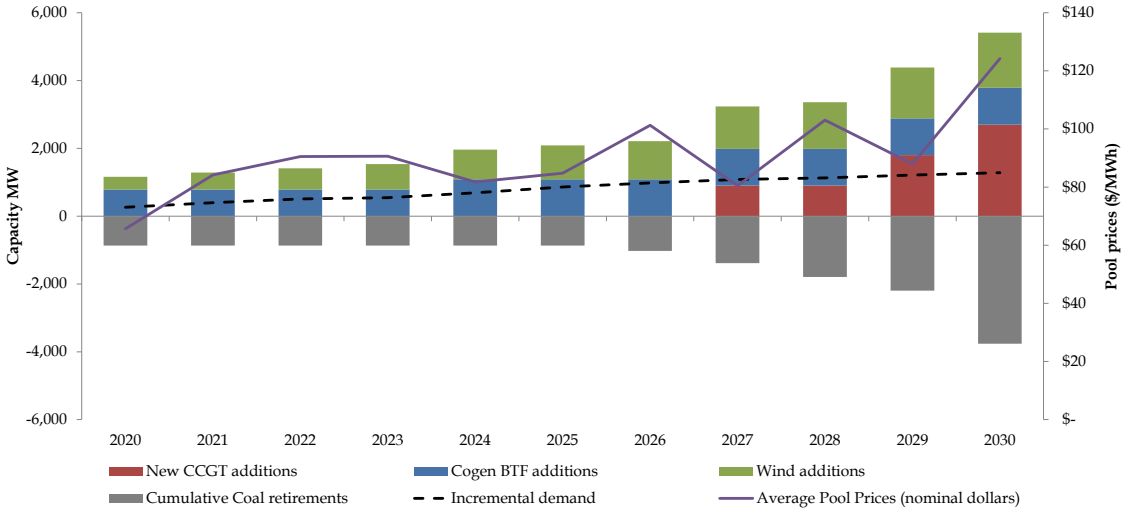
Source: AESO 2014 LTO and 2012 LTO

3.1.2 Coal-fired generation retirements and emission reductions

Existing federal regulation driving retirement of coal-fired generation in Alberta will be the single biggest driving factor of emissions reduction for the province.

In 2012, the Federal Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity regulation was passed. This regulation stipulates that the useful life for coal plants shall be 50 years. However, units commissioned before 1975 will reach their end-of-life after 50 years of operation or before 2019, whichever comes first. Similarly, coal-fired power plants commissioned between 1975 and 1986 will reach their end-of-life after 50 years of operations or before 2029. In addition, by July 2015 coal-fired power plants must reach the performance standard of 420 tonnes of CO_2 per GWh, which is equivalent to the emissions intensity level of a generic combined-cycle natural gas power plant.

Figure 4. LEI's Base Case forecast of new capacity additions alongside Federally-mandated coal generation retirements (as of Q2 2015)



Source: LEI analysis

As a direct result of this regulation, a substantial proportion of Alberta's coal-fired capacity will need to be replaced as older generation is shut down across the province by 2029. Moreover this will result in a significant reduction in GHG emissions from the sector, as this capacity is likely to be replaced by a combination of natural gas-fired and renewable generation technologies. Figure 4 highlights the coal generation retirement and new capacity additions incorporated into LEI's own base case modeling of the Alberta electricity sector. Almost 3,800 MW of coal generation is set retire by 2030, to be replaced by a combination of wind (approximately 1,600 MW) and natural gas generation (approximately 3,800 MW including cogeneration).

The significant reduction in coal-fired generation capacity from the market will be the single biggest driving factor of emissions reductions under not only the Base Case, but also in both scenarios assessed by the Pembina Institute. And if accelerated retirements are to be considered a policy option, which is implied in the scenarios in the Pembina Report, then such economic "taking" by the government through regulation should be compensated for. The Pembina Report does not appear to measure the lost profits to coal generators or consider compensation for such intrusions on a private parties' business economics.

3.1.3 Portfolio bidding

A unique feature of the Alberta electricity market is the portfolio bidding behavior of market participants. The Alberta Market Surveillance Administration's ("MSA") characterized portfolio bidding as *"a market participant optimizing the value of its portfolio of assets, which may include generation assets, load, and forward buy/sell obligations."*[19] This strategy was founded upon the

[19] Market Surveillance Administration. Offer Behavior Enforcement Guidelines for Alberta's Wholesale Electricity Market.

premise that "*the coordination and optimization of all assets within the portfolio will yield greater returns than the sum of individual portfolio asset optimizations.*"[20]

A static approach to estimating the bidding and rebidding of generation, based on actual 2012 merit orders, is likely to misrepresent the wholesale electricity costs presented by the Institute.

In a market like electricity, where a significant portion of total operating costs are fixed, it is imperative that generators earn a profit above their short run marginal costs to remunerate and cover those fixed costs. Therefore, in the short term, from time to time, prices may be higher than short run marginal costs ("SRMC") of specific generators. Indeed prices, need to rise above SRMC and approach long run marginal costs ("LRMC") of new generation, when supply-demand gap narrows, in order to motivate new investment. LRMC includes recovery of fixed costs in addition to SRMC. Alberta's energy market designers recognize the need for prices in the Power Pool to rise above the strict SRMCs of generators. And experience shows that dynamic occurring and evolving over time, subject to supply-demand conditions. Therefore, simulation models that forecast prices based on SRMC bidding strategies will likely understate actual market outcomes, especially in energy-only market, and cannot properly resolve the timing of new investment.

Although the authors of the Pembina Report appear to recognize the necessity of economic withholding, they have used a static approach where they simply take the markups observed from a single historical year and apply those going forward - Pembina Institute's external consultants have "*determined the power price using an average merit order for the years 2023 and 2033 creates from the actual 2012 merit orders.*"[21] Given the timeframe when the Pembina Report was being prepared, it's not surprising that 2012 market dynamics were reviewed. However, it is incorrect – especially given the dramatic supply changes modeled out to 2033 – to use the static observations from single historical year. Economic withholding and bidding behavior is the cornerstone of a sustainable energy-only market. In order to properly model it, the Institute should have considered how such behavior would change in light of the renewable additions and other supply changes. It does not appear that such dynamics were considered. This therefore raises important questions regarding the rationality of the modeled outcomes and whether they can sustain an energy-only market and provide for reliable service.

Based on the limited information presented by the Pembina Institute, further simulation analysis appears essential to confirm the Pembina Institute's results, and to better understand the behavioral aspects of generators bidding into the market, and what the resulting impact would be on wholesale market prices and sustainability of the energy-only market design.

3.1.4 Economic retirement

[20] Ibid.

[21] Pembina Institute and Clean Energy Canada. *Power to Change: How Alberta can green its grid and embrace clean energy*. May 2014.Page 17.

Given the significant changes in the market proposed by the Pembina Institute, it would be expected certain, older, natural gas-fired generators in the province may also be retired, or coal-fired generators are retired earlier than forecast.

Additional or early retirements beyond the forecasts provided by the Transition or Transformation scenarios may occur as a result of the prevailing market outcomes modeled.

There are many reasons why generators may be retired including but not limited to: an aging and inefficient fleet, the low cost of alternative fuel sources, the falling costs of renewables, slowing growth in electricity demand, rising construction costs for a particular technology (such as coal fired generators), or rising fuel prices.[22]

Both the Transition and Transformation scenarios provide for forced early retirement without a discussion of the merits behind the decision or reference to the underlying economic conditions of the market. Further it appears little consideration has been given to the retirement of other generation in the market, as a result of the significant increase in renewable generation and presumable impact on Pool Prices. For example, due to the treatment of renewable energy in the high volume of renewable generation penetration, it is possible wholesale electricity prices are supressed to a level which may no longer be sustainable for some generators.

Given these potential impacts, further analysis and discussion is warranted ensuring for a comprehensive understanding of the impacts to existing generators.

3.1.5 SGER Reforms

The provincial government established a price on carbon dioxide ("CO_2") emissions in 2007. The Pembina Institute is correct in noting this price has currently had little impact on improving the competitiveness of renewable energy technologies.[23] However, the explicit treatment of SGER within the modeling efforts of the Institute is not clearly written into the report.

Recent changes to the SGER necessitate further analysis of the wholesale energy market impacts, including the forecast wholesale electricity price and level of renewable energy penetration.

Under the SGER all facilities emitting over 100,000 tonne of CO_2 per year are required to reduce their emissions intensity by 12% below their 2003-2005 levels. Facilities that fail to meet this reduction target face a carbon tax of $15 per tonne of CO_2 over their reduction targets.[24] In June 2015, the Alberta government announced changes to the policy, increasing the carbon tax to $20 per tonne of CO_2 from January 1, 2016 and $30 per tonne of CO_2 starting in January 1, 2017. In

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[22] Lesley Fleischman, Rachel Cleetus, Jeff Deyette, Steve Clemmer, Steve Frenkel. Ripe for Retirement: An Economic Analysis of the U.S. Coal Fleet. The Electricity Journal, Volume 26, Issue 10, December 2013, Pages 51–63.

[23] Pembina Institute and Clean Energy Canada. *Power to Change: How Alberta can green its grid and embrace clean energy*. May 2014.

[24] AESO. 2014 Long Term Outlook.

addition to price increases the government increased the target reduction levels to 15%and 20% in 2016 and 2017, respectively. Increases in the price of CO_2 emissions are factored into the prevailing wholesale electricity price as fossil fuel generators account for the additional costs as part of their trading of generation in the market. This is likely to result in an increase in the wholesale price of electricity, all things being equal, and could increase the overall competitiveness of renewable generation technologies relative to more established fossil fuel technologies.

Given the recent changes in the level of SGER compliance costs, LEI considers further sensitivity analysis of the wholesale electricity price impacts would provide for a more comprehensive study.

3.1.6 Costs of integration onto the network

Proposed integration of a large volume of renewable energy may require expansion or extension of the network, investment in additional non-renewable (natural gas) capacity and result in changes to the operation of the market.

Significant penetration of renewable energy onto the transmission network, forecast under each of the scenarios, entails additional costs beyond the capital and operating expenditure of the generator itself. Specifically, the proposed level of renewable generation will require connection to the transmission network, and therefore transmission connection costs. Depending on the location of the generator, these costs may entail expansion or extension of the network to accommodate the additional renewable generation capacity. In 2009, the AESO first proposed the Southern Alberta Transmission Reinforcement ("SATR") program. Recognizing the wind development opportunities in the south of the province, the AESO proposed a $3.4 billion program providing for expansion and reinforcement of the network.[25] This proposal allowed for the interconnection of up to 2,700 MW of new wind generation onto the transmission network.[26]

The Pembina Institute does not appear to have taken into account these incremental costs. As these costs are passed through to consumers, and may be considerable given the volume of renewable generation coming online, this represents a further area of study to be considered.

Furthermore as more intermittent generation comes onto the network it is important to balance and firm the output of such generators, ensuring reliable supply even in periods when the wind is not blowing as hard or the sun is not shining. Based on experiences in other markets, as renewable penetration increases (to levels similar to what was modeled in the Pembina Report), additional gas-fired generation may be necessary to firm supply. However, in the face of low Pool prices (because of the abundance of zero SRMC resources), such new gas-fired resources will require out of market support. For example, if we look at the LCOE of a typical gas-fired peaker, the fixed operating costs alone amount to $22,200/MW-year. So for 2,000 MW of new

[25] AESO. Transmission System Projects – Quarterly Report (Q2 2015).

[26] AESO. South Area Transmission Requirements & Milestones. Stakeholder Sessions. September 24, 2009.

gas-fire peaking generation, consumers will need to pay $44.4 million to guarantee their availability. The Pembina Report does not provide a summary of the required additional investment necessary to ensure reliability of the system, in the face of the renewable penetration it has modeled.

3.1.7 Socio-economic implications

Further to the costs of integrating renewable energy resources onto the network, the Pembina Report fails to appropriately address the socio-economic implications associated with retirement of coal-fired generation in the province. LEI do not dispute the health benefits to the population, and the plant, associated with reducing the GHG emissions from the sector. However, given the substantial changes to the sector proposed in the Pembina Report, LEI note the risks of unintended consequences associated poor policy or program design. For example the level of plant retirements in the province will likely represent a net loss in the number of job opportunities for people working in the sector in the longer term. Operations of new wind and solar (and natural gas) generation are far less labor intensive than the coal-fired generators which they would be replacing.

Furthermore, as noted earlier, LEI considers the cost, and quantity of new renewable energy forecast to come online, will result in higher energy prices are likely under the proposed Transition and Transformation scenarios, due to the cost. This increase in energy prices will lead to a reduction in the real disposable income of families. Together job losses, and higher energy prices will therefore have flow on affects, potentially leading to a reduction in local economic activity. How much these socio-economic costs are offset by new renewable energy developments proposed by the Institute will be subject to the quantity and timing of new renewable generation to come online.

3.2 Forecasts of new renewables and efficiency target potential

Each of the proposed renewable energy technologies presented in the Pembina Report, while conceptually feasible, are not considered technically feasible, nor economically viable given the high quantities to come online and the current cost forecasts.

3.2.1 Wind

As of 2014, wind capacity made up approximately 9% of the total installed capacity available in the Province of Alberta, or approximately 1,453 MW. By 2033, under the Transformation scenario, the Pembina Institute forecasts this amount to increase to approximately 8,400 MW. This equates to an increase of almost 500% in the total installed wind capacity connected to the network. Relative to the 2014 LTO, where total installed wind capacity is forecast to be 2,679 MW by 2034, this significant increase under the Pembina Institute's modeling reflects the need for additional capacity, owing to the lower average capacity factors relative to more traditional sources. LEI is skeptical of the technical, economic and commercial viability of developing such high quantities of wind generation in the province.

3.2.2 Solar

Similar to the increases in wind capacity, forecast solar to be developed under the Transition and Transformation scenarios would represent a drastic change both in the operation of the network, and the fuel mix supplying the province. As of 2014, there is no utility scale solar generation connected to the Alberta network, and less than 5 MW of small scale solar generation installed. Under the proposed scenarios modeled by the Pembina Institute 3,000 MW and 4,000 MWs of new solar generation is forecast to come online in the province by 2033 under the Transition and Transformation scenarios respectively.[27] Unlike the Pembina Institute, the 2014 AESO LTO forecasts zero utility scale solar, connected an in operation on the network by 2034.

While noting the potential opportunities for solar development in the province, the AESO also comment *"[for] the development of large-scale solar, the main driver is around relative costs. Either a decrease in solar costs or an increase in costs of other technologies could increase the development of solar."*[28] The costs of solar are prohibitive, without significant government funding, and are therefore the obvious choice for new renewables in Alberta.

Solar generation across all of Canada amounts to approximately 1,200 MW. The Canadian Solar Industry Association expects this value to reach 2,000 MW by the end of 2015. This represents approximately half of the proposed solar installation under the Transformation scenario. While other markets, such as Germany and California, have seen significant increases in the volume of solar energy, this penetration is the result of significant funds invested over a period of more than 10 years, done in an environment which provides investors with regulatory certainty over the long term operation of policies or program.

While LEI continue to see solar energy playing a role in reducing the total peak load across the network, we do not agree with the proposed level of solar generation anticipated by the Pembina Institute in this report.

3.2.3 Geothermal

While the Pembina Report also envisions between 300 MW and 400 MW of assumed geothermal capacity to come online by 2033, under the Transition and Transformation scenarios, respectively, there has not been any commercial deployment of this technology in Alberta to date. Despite the existence of potential geothermal development opportunities within Alberta (and across Canada more broadly), risks associated with development of these facilities (specifically around the drilling aspects involved), together with high upfront capital costs, appears to have stalled any development. In developing the scenarios, LEI notes geothermal generation is forecast to come online starting in 2019 in the Pembina Report. Given the risks and high investment costs, and the recent decline in the Alberta economy, LEI does not consider this

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[27] Although not explicitly written, LEI assumes the majority of this generation will be of utility scale connected directly to the distribution or transmission network.

[28] Alberta Electricity System Operator. 2014 Long Term Outlook. Page 59.

technology as a feasible entrant into the market in accordance with the proposed timeframe presented by the Pembina Institute.

3.2.4 Energy efficiency

Energy efficiency forms a key component of the scenarios modeled by the Pembina Institute. By 2033, energy efficiency measures are projected to result in approximately 20 TWh of savings.[29] This is in contrast to Ontario's 2013 Long Term Energy Plan which set a conservation target of 30 TWh by 2032, but Ontario is a much larger market – a market with 22,774 MW peak demand and 139.8 TWh of annual electricity consumption in 2014. The difference between the provinces, besides the obvious 10 TWh difference in target, is Ontario has had energy efficiency / conservation initiatives or programs in place for many years and well before setting such a target.[30] In addition to the necessary testing of alternative programs, in order to identify which will work best in the context of the Alberta market, the development of a program capable of achieving the target set by the Pembina Institute will require significant investment and resources in order to be appropriately administered. Indeed, given the lack of existing efficiency programs in the province, there will have to be a major ramp up in terms of developing institutional capacity at the regulator, at the utilities (or whoever serves as the program administrator), not to mention a substantial investment in consumer outreach and education.

In context of Alberta's overall market, this is sizable demand reduction. As the bulk of the load in Alberta is a direct result of the commercial and industrial sector, of which the oil sands industry is the largest consumer, there may be fewer opportunities than in other jurisdictions to implement such efficiency measures. Indeed, industrial customers have had the incentive to invest in measures that will reduce energy consumption for many years, as such initiatives results in a direct benefit to their bottom line. While an effective industrial efficiency program may assist in finding additional savings, it is plausible that many of the most cost-effective opportunities have already been identified. Finally, as residential load in Alberta makes up a small portion of the total demand (on average around 10%) in the province any efficiency benefits from these consumers are unlikely to have the dramatic impact forecast by the Pembina Institute.

Moreover for these reasons, LEI views the proposed target of 20 TWh of energy efficiency supply as an unrealistic target for Alberta over the forecast period - without further corroboration of the sources for such demand reductions using a bottom up assessment of efficiency potential and, most importantly, factoring in implementation planning and costs.

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[29] Pembina Institute and Clean Energy Canada. Power to Change: How Alberta can green its grid and embrace clean energy. May 2014. Page 12.

[30] On June 4, 2015, the Government of Alberta announced *"a $2 million investment in energy efficiency and conservation initiatives led by local governments."* LEI understand these are the first significant energy efficiency initiative to be rolled out in the province. Alberta Canada. Website. Last accessed August 28, 2015. <http://www.albertacanada.com/business/industries/bp-gbpt-government-initiatives.aspx>

3.2.5 Energy storage

At present, energy storage remains extremely expensive. Even when considering large scale applications as would be the case within wholesale electricity markets, investment in this technology remains cost prohibitive. Little information is presented by the Pembina Institute regarding their assumptions on the cost and the utilization of energy storage technologies in Alberta. However, under the Institute's Transition and Transformation scenarios approximately 200 MW to 400 MW of energy storage is brought online respectively by 2033. Based on LEI's analysis, the LCOE of such technologies is a multiple of the costs for conventional gas-fired peaking technology. Therefore, from a reliability of supply perspective (and for firming renewables production), gas–fired peakers are likely more cost effective.

LEI does not consider this technology as a feasible source of effective capacity and supply in Alberta at this time, and in accordance with the proposed timeframe presented by the Pembina Institute. More analysis is required regarding the optional strategies about how energy storage may be utilized, and whether it could serve to support ancillary services requirements which may expand significantly with presence of intermittent supply.

3.3 Renewables investment will require additional out-of-market funding

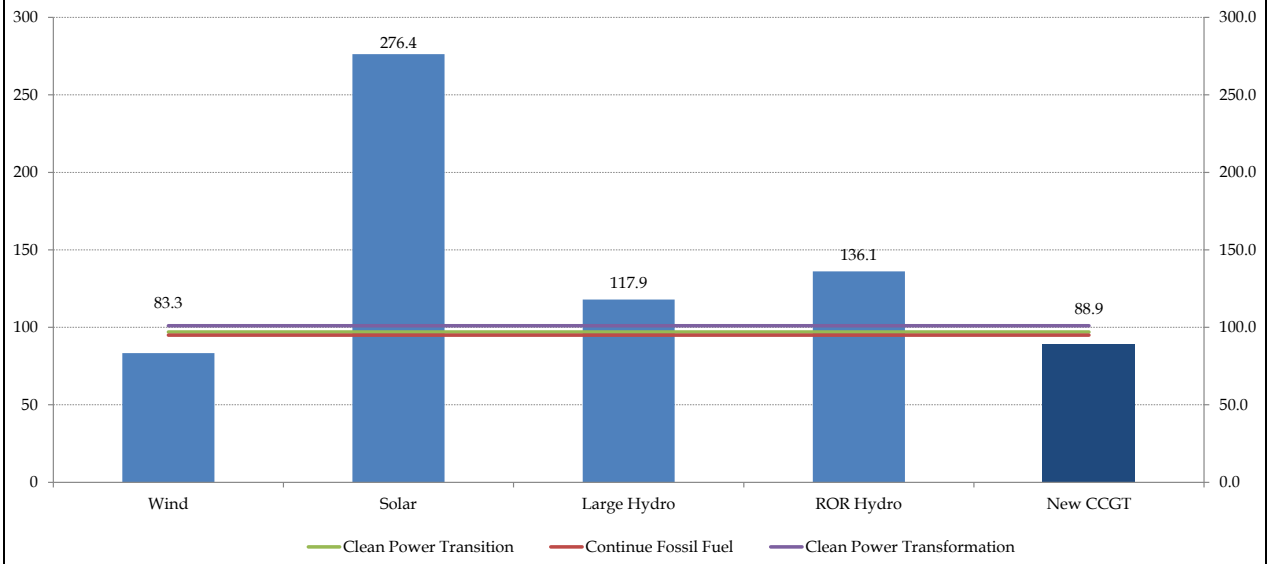
As the Pembina Institute has recognized *"it is extremely difficulty to finance a wind or solar farm – or, for that matter, a hydroelectricity or geothermal power plant – in Alberta"*. Three key factors may contribute to this difficulty specifically for renewables:

- due to the capital costs of investment in new renewables prevailing wholesale electricity prices in Alberta in recent years have been below the Levelized Cost of Energy ("LCOE") of renewable generation and therefore do not directly support such investment (without other forms of subsidies);
- a limited pool of customers seeking long term electricity contracts in Alberta, with few opportunities to enter into a power purchase agreements ("PPAs"); and
- significant uncertainty associated with the future market revenues reflecting the intermittent operating profile of renewable generation, and volatility in an energy-only market (Pool Prices), thereby impinging upon the ability to secure necessary financing.

If we compare the average wholesale electricity prices forecast by the Institute in the Pembina Report to LEI's forecast LCOEs as presented in Figure 5, we see that solar generators are short by $175 per MWh and new hydro is short between $17-$35 per MWh. Unfortunately the Pembina Report does not provide a breakdown of the wholesale energy costs and subsidies which make up the reported average wholesale electricity prices under each scenario. LEI's estimates of the LCOE for wind ($83.3 per MWh) and new combine cycle generation turbines ("CCGT") ($88.9 per MWh) are close to those prices modeled within the Pembina Report. Dependent on the estimated subsidies provided within these price forecasts, it suggests these technologies are also uneconomic under the proposed scenarios. Given these results, LEI is doubtful on the ability of new generation entering the market in the quantities outlined by the Institute.

LEI has developed its LCOEs based on announced project costs, and is generally consistent with AEO's LTO assumptions from 2014, with the exception of the solar costs (where LEI has a much lower figure).

Figure 5. LEI analysis of the levelized cost of energy vs. Pembina Institute modeled electricity and subsidy prices in 2023 ($/MWh)



Source: LEI and Pembina Institute analysis

In light of the above factors, it is apparent that investment in renewable energy, and possibly CCGT, will require some (continued) level of government support. The Institute, though avowing articulation of a specific policy or program, concedes this fact in its assessment of the wholesale energy price. Specifically, the Pembina Report notes *"in some scenarios, energy revenue alone was not sufficient to stimulate renewable development, and a policy based incentive would be required. The cost of the incentive is included in the resulting wholesale cost of power."*[31] However, details of the level of out of market payments or subsidies, and how it is to be funded, are not provided in the Pembina Report.

These costs are amplified, if significant renewable energy penetration suppresses the wholesale electricity price, as is currently being seen in Germany, leading investors, including fossil fuel generators, to earn lower revenues from the market. This reflects the current bidding and dispatch of these technologies into the market, or lack thereof, with renewable generation such as solar and wind categorized as negative load due to their intermittent operating profile, effectively reducing the total demand in the province. This arrangement is analogous to renewable generation being bid into the market at or below $0/MWh. In both instances, the

[31] Pembina Institute and Clean Energy Canada. Power to Change: How Alberta can green its grid and embrace clean energy. May 2014.Page 17.

displacement of 'more expensive' coal-fired and natural gas-fired generation from the dispatch merit order results in a reduction in the overall price level.

Finally, given the suppression of prices, and the need for the out of market payments for possibly all new generation to come online, LEI notes the continued operation of existing generation established in the market may no longer be sustainable, leading some plants to retire early.

3.4 Continuation of Alberta's energy-only market design

New generation investment in Alberta relies significantly on a well-functioning and competitive energy only market.

The foundation, or objective, underpinning the Pembina Report is to identify potential supply changes that would help the electricity sector in Alberta reduce its GHG footprint. While this objective is honorable and a move towards more renewables certainly has merit for carbon reductions in the fossil fuel dominated landscape of the Alberta electricity sector, LEI is concerned that the ramifications of the modeled shift to renewables generation have not been fully considered.

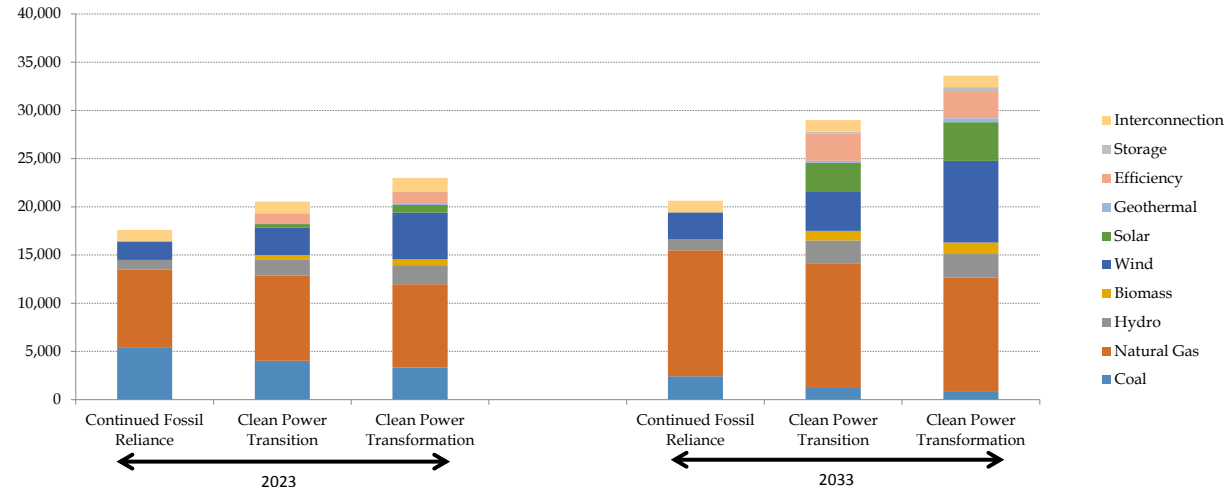
Specifically, we are concerned that the proposed level of renewable generation forecast to enter the market under the two scenarios (6,700 MW by 2030 in Transition scenario and 12,600 MW by 2030 in Transformation scenario) as presented in Figure 6, and the associated level of out of market payments that would be required, will likely have a distortionary effect on the overall operation of Alberta's energy market. It is unlikely the energy-only market design, and the commitment by Alberta to a deregulated competitive energy market, would be able to survive in its current form due to the shifts in Pool Prices and economic pressures on existing generation to exit the market, which would undermine reliability.

The Alberta wholesale electricity market is one of only two energy-only markets operating in North America.[32] This market design means that investors must rely on peak energy prices to provide revenue sufficiency for continued operation of existing generation and to catalyze new projects. If prices are not sufficiently high enough, out-of-market support[33] may be needed to grant investors comfort that there will be sufficient revenue from the project.

Figure 6. Forecast capacity (MW) – Transition and Transformation scenarios

[32] The Electric Reliability Council of Texas ("ERCOT") being the second.

[33] Either out-of-market contracts or capacity payments.



Source: Pembina Institute and Clean Energy Canada. Power to Change: How Alberta can green its grid and embrace clean energy.

While the introduction of renewable generation is an effective tool in reducing overall carbon emissions for the sector, it comes at a cost that is significantly more than traditional generation sources. Any additional capacity required in order to meet demand is therefore going to result in significant increases in overall investment required in the sector. This is particularly important in Alberta where labor and construction costs for new generation development compete with the other industrial sectors.

4 Pembina Institute – Findings and recommendations

LEI applauds the Pembina Institute on taking the initiative to study alternative pathways to resource development and electricity sector investment in the coming decades. The legacy of Alberta's natural endowments – abundance of minemouth coal and other fossil fuels – has served provincial consumers well over the years, and has fueled a vibrant economy and accommodated a reliable and vibrant competitive market for electricity. However, as the policy focus has shifted to reducing GHG in recent years, the legacy of a fossil fuel dominated landscape has wrongly been mischaracterized as a hindrance or detriment to future growth. We should not overlook the benefits that coal and natural gas has provided to Alberta electricity consumer in the past and the possibility for such benefits in the future. And as such, reducing the carbon footprint of electricity sector by minimizing the role of fossil fuels should be considered with care - it requires careful planning and patience, as it cannot happen overnight. Even with well-intentioned policies, there is a risk of negative, unintended consequences – and in the case of the electricity sector transformation, these could be in the form of higher costs of electricity, loss of jobs, and reduction in local economic activity.

Policies to achieve the stated goals need to be articulated and evaluated. While we recognize the benefits of conceptual studies like that in the Pembina Report, we are wary of the construct of the report, where a clear agenda has been set up front. The need to achieve an agenda should be balanced against what is technically and economically feasible within the current market environment. And in this regard, the specific policies to achieve the objectives should be identified and evaluated. Different polices may have varying cost implications that need to be considered, as well as unintended consequences.

As is common in this dynamic sector, conditions change and input assumptions are no longer valid, requiring revision and updates to the analysis. Market conditions have evolved since the Pembina Institute undertook this analysis. Some of critical assumptions in the Pembina Report require an update. We expect a revised Base Case would show that emissions are not as great, as electricity production will be lower due to lower demand. As such, to achieve reductions to a specific mass-based absolute limit of GHG, a smaller change in supply mix may be sufficient.

A comprehensive analysis requires transparent consideration of all measurable costs associated with the proposed changes in supply. Although the Pembina Report states that out of market support schemes were considered, it is unclear from the results how such additional costs were taken into account as they appear to be blended with the Pool Prices in the electricity prices presented in the Pembina Report., Furthermore, the costs of transmission interconnection, transmission to uncongest the system, operational system costs (for example, balancing costs and additional ancillary services) and payments resulting from forced early retirements were not measured.

Just as it is important for all costs to be evaluated, it is imperative to examine the sustainability of the market design in the face of the supply transformation and measure the impact on existing generation. Several of the assumptions made by the Pembina Institute regarding the penetration of renewable energy in the market in light of forecast coal retirements, and replacement of otherwise cheaper natural gas generation, do not appear economically viable under current market conditions and estimated costs, without significant

out of market payments. Moreover, incorporating large quantities of these technologies into the wholesale energy market, may also suppress wholesale market prices. Together these factors have the capacity to destabilized Alberta's energy-only wholesale market.

Studies such as the Pembina Report can provide valuable insight and generate ideas for policymakers and industry to evaluate, in particular for a jurisdiction like Alberta that is at a crossroads regarding future policy development and will be in need of new investment in the coming five to ten years. However, it is imperative that the studies provide a comprehensive evaluation of all costs to industry and consumers from following a particular investment pathway, based on the best available information. We are concerned that the conceptual portrayal of the Alberta market in the Transition and Transformation scenarios is simply intractable given the current market design – the investments portrayed will not occur without significant out of market subsidies, but the presence of such subsidies will create a vicious cycle that will lead to destruction of economic value for existing market participants and unraveling of the market design that has served Alberta well for nearly two decades. The Pembina Report deserves another revision before its usefulness to stakeholders and policymakers is established.