CanWEA / CanSIA[1] Submission to the Alberta Climate Change Advisory Panel

September 30, 2015

Executive Summary

- CanWEA and CanSIA believe that Alberta's Climate Change Strategy must maximize the use of non-greenhouse gas emitting renewable energy sources like wind and solar energy in response to future electricity demand growth and new supply needs created by decisions to reduce output from greenhouse gas emitting coal-fired generation while also working to ensure that any required additional generation and ancillary services are secured to ensure system reliability.

- A significant increase in the production of wind and solar energy in Alberta can help reduce greenhouse gas emissions in the electricity sector in the short-term, while also ensuring that those reductions are long-term and sustainable. It will also create the foundation upon which much more significant reductions in greenhouse gas emissions can be achieved over time in other sectors of the economy through increased electrification.

- Despite the fact that many additional economic and environmental benefits would also result from a significant build-out of renewable energy in Alberta, CanWEA and CanSIA agree that Alberta's energy-only market cannot deliver on this objective as currently designed. As a result, Alberta's energy-only electricity market must evolve. Policy changes are required to provide renewable energy investors with enough revenue certainty to project finance their long-lived and capital intensive projects.

- A carbon price is a key component of any credible climate change strategy and CanWEA and CanSIA both support a strengthened and more effective carbon pricing framework for Alberta. We do not believe, however, that changes to Alberta's carbon pricing framework can be the key driver of significant new investment in renewable energy. As a result, the Alberta Government will need to implement policies targeted specifically at incenting renewable energy deployment if it wishes to see a significant build-out of renewable energy in the province.

- CanWEA and CanSIA believe that the Alberta Government should seek to put in place policies that would encourage wind and solar energy development at two scales:
    - Utility scale wind and solar energy projects that are connected to transmission lines
    - Smaller scale wind and solar energy projects (e.g., residential, community, commercial, industrial) that connect to distribution lines.

[1] See Appendix A for a brief description of CanWEA and CanSIA.

- CanWEA and CanSIA believe that a legislated Renewable Portfolio Standard (RPS) that establishes renewable energy targets for Alberta and mandates a central agency like the Balancing Pool to meet those targets through long-term contracts to purchase Renewable Energy Certificates (RECs) and energy from renewable energy producers selected through competitive tendering processes will be the most effective way to facilitate a significant build out of new utility scale wind and solar energy in Alberta. It is possible that such contracts could be for RECs alone, but such contracts will need to provide enough revenue certainty to enable project financing if new renewable energy projects are to proceed. Existing renewable generation should be able to contribute any RECs they own to the RPS. We also believe that a time-limited initial "set-aside" for utility scale solar under the RPS is appropriate.

- CanWEA and CanSIA believe that the most effective way to secure renewable energy from small renewable energy projects connected to distribution lines in the province is through the provision of long-term power purchase agreement contracts through a Standard Offer Program (SOP) for energy and RECs through a central agency like the Balancing Pool. A portion of the RPS should be "set-aside" for such small scale projects.

- CanWEA and CanSIA encourage the Alberta Government to move quickly to establish a process that would involve all relevant stakeholders and seek to finalize the design of a RPS that would follow the broad structure outlined in this submission and enable relevant legislation to be implemented within a year.

- CanWEA and CanSIA believe it is possible to build-out renewable energy penetration levels in the Alberta electricity grid from 9% of total electricity produced today to 15% - 20% by 2020, 22% to 30% by 2025 and 30%-40% in 203030%-40% in 2030.

- Given low load growth, however, we note that the pace and scale of actions to reduce output from coal-fired electricity generation in Alberta will be a key determinant of the pace and scale of a renewable energy build-out in the province. Renewable energy deployment as outlined above would require an accelerated reduction in coal-fired electricity production beyond that currently envisioned under federal coal phase-out regulations.

- CanWEA and CanSIA recommend that the Alberta Government establish targets for electricity produced from both coal-fired generation and renewable energy generation for the years 2020, 2025 and 2030. These targets are clearly interrelated and must inform each other.

- Once the Alberta Government has established its targets for future levels of electricity production from coal-fired generation and renewable energy, it should engage with all relevant stakeholders in a well-defined and time-limited process to determine if and how the energy-only market must further evolve to mitigate impacts on incumbent generators and potential new investors.

Wind and Solar Energy Must Be a Key Component of Alberta's Climate Change Strategy

- **CanWEA and CanSIA believe that Alberta's Climate Change Strategy must maximize the use of non-greenhouse gas emitting renewable energy sources like wind and solar energy in response to future electricity demand growth and new supply needs created by the phase-out of greenhouse gas emitting coal-fired generation while also working to ensure that any required additional generation and ancillary services are secured to ensure system reliability.**

- The Alberta government has made it clear that it wants to see renewable electricity like wind and solar energy making a larger contribution to the Alberta grid. This desire mirrors what is happening in electricity grids around the world. Bloomberg New Energy Finance forecasts that by 2040, the world's power-generating capacity mix will have transformed: from today's system composed of two-thirds fossil fuels to one with 60% from zero-emission energy sources. Renewables are projected to represent almost 60% of the 9,786GW of new generating capacity required and two-thirds of the $12.2 trillion of investment.[2]

- Governments have also agreed in international climate change negotiations that we must strive to limit increases in average global temperatures to 2 degrees Celsius. Doing so will require a minimum 80% reduction in global greenhouse gas emissions from today's levels by 2050. If Alberta is to succeed in achieving large and sustained greenhouse gas emission reductions both within the electricity sector and in other sectors of the Alberta economy, wind and solar energy will have a critical role to play.

- First, the electricity sector currently accounts for 17% of Alberta's GHG emissions and Alberta is responsible for more than 50% of Canada's total greenhouse gas emissions from the electricity sector. It is only by significantly increasing the use of renewable energy in the electricity sector that one can create long-term and sustainable greenhouse gas emission reductions in the sector as the demand for electricity increases in the future. While natural gas generation clearly will have an important and increasing role to play in Alberta's electricity generation mix going forward as both a provider of baseload power and as a tool to facilitate the integration of variable renewable generation, its potential role must be carefully considered because it remains a significant source of greenhouse gas emissions.

- Second, it is broadly understood that the significant greenhouse gas emission reductions that will be required in other sectors of the economy can only be achieved through a massive increase in electrification in energy uses like transportation, heating and cooling, and some

[2] Bloomberg New Energy Finance (2015) "New Energy Outlook (NEO)"

industrial processes through the use of non-greenhouse gas emitting electricity sources like wind and solar energy.[3]

- **A significant increase in the production of wind and solar energy in Alberta can help reduce greenhouse gas emissions in the electricity sector in the short-term, while also ensuring that those reductions are long-term and sustainable. It will also create the foundation upon which much more significant reductions in greenhouse gas emissions can be achieved in other sectors of the economy through increased electrification.**

- While Alberta's supply of clean and renewable non-greenhouse gas emitting electricity will need to dramatically increase over time to address climate change, Alberta should also make it a priority to facilitate actions that increase energy efficiency and energy conservation in all sectors of the economy.

The Multiple Benefits of Increasing Wind and Solar Energy Production in Alberta

- **While CanWEA and CanSIA believe that renewable energy like wind and solar energy must play a central role in any credible climate change strategy, there are many additional reasons why Alberta should strive to significantly increase the contribution of wind and solar energy to Alberta's electricity supply.**

- **Alberta has abundant wind and solar energy resources**. More than 35% of Alberta's land base has a wind resource considered viable for electricity production and this represents approximately 150 GW of potential wind power capacity.[4] Alberta also has one of Canada's best solar energy resources. In a day, Alberta's solar energy resource is equivalent to the province's remaining conventional established oil reserves. In a year, it is equal to almost one million TWh. These resources are distributed throughout the province as illustrated in the wind and solar resource maps found in Appendix B.

- **Wind and solar energy are increasingly cost-competitive forms of electricity generation with stable and predictable costs as the fuel is free.** Many studies, in Alberta and elsewhere, have demonstrated that wind energy has one of the lowest levelized costs of energy of any source of electricity generation.[5] As a general rule, these studies indicate that the only potential source of

[3] Deep Decarbonization Pathways Canada. : http://www.cmcghg.com/wp-content/uploads/2015/07/Final-Canada-DDPP-Country-Report-July-14.pdf Published by Sustainable Development Solutions Network (SDSN) and Institute for Sustainable Development and International Relations (IDDRI). Carbon Management Canada, Low Carbon Pathways group (September 2015)

[4] A WindVision for Alberta – Technical Overview Report, Version 2.0, Solas Energy Consulting Inc., May 2013, page 9.

[5] "2014 Long Term Outlook", Alberta Electric System Operator; Appendix C, Figure C-2, http://www.aeso.ca/downloads/AESO_2014_Long-term_Outlook.pdf ; Lazard's Levelized Cost of Energy Analysis – Version 8.0", Lazard; September 2014 https://www.lazard.com/media/1777/levelized_cost_of_energy_-_version_80.pdf ; "Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy

new electricity generation that can compete with wind energy today is natural gas generation, although wind energy does not face the carbon and commodity price risks associated with natural gas. Moreover, wind energy is only becoming more cost-competitive as the costs of wind energy generation have fallen by 58% in the last 5 years and are projected to continue to fall in the future.[6] Technology advances (e.g., taller towers and longer blades) are ongoing and have made wind energy economic in lower wind speed areas and also significantly increased wind turbine capacity factors.

- Since 2010, capital costs for solar electricity have declined by over 65% globally. As a result, solar has the lowest levelized costs of energy of any source of electricity generation in many regions of the world. Increasing numbers of countries are reaching "grid-parity" as pricing continues to decline.[7] In Alberta, the levelized cost of solar electricity is fast approaching that of other options. As solar generates during the day when electricity demand is highest and as it can be sited proximal to loads thus avoiding transmission and distribution costs, its value is greater than can be illustrated by a simple cost comparison.[8]

- **Wind and solar energy provide significantly more benefit to the environment than greenhouse gas emissions reductions.** Alberta today has current and emerging air quality challenges in some regional air sheds that represent significant health risks to Albertans. Wind and solar energy do not emit any of the air pollutants associated with air quality challenges in Alberta and will help to clean the air in the province when substituting for fossil-fuel fired generation. In addition, wind energy's lifecycle water consumption is approximately 1/6 that of a combined cycle natural gas generating facility - an important consideration as Alberta addresses growing challenges of water scarcity.[9]

- **Wind and solar energy provide significant economic development opportunities for Alberta.** Every 150 MW of installed wind energy capacity represents $316 million in investment, 140 direct full-time equivalent construction jobs and 10 permanent direct jobs in operations. It also will provide approximately $17 million in lease payments to rural landowners and $31 million in property tax payments to rural municipalities over a 20 year period.[10] Every 150 MW of installed solar energy capacity represents $310 million in investment, 1,875 direct full-time equivalent construction jobs and 45 permanent direct jobs in operations.[11] It also will provide approximately $54 million in lease payments to site-hosts and $30 million in property tax

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Outlook 2015" US Energy Information Administration, Table 1, June 2015
http://www.eia.gov/forecasts/aeo/pdf/electricity_generation.pdf

[6] Lazard (see above) and (IEA 2012 Task 26; LBNL 2014 Market Technologies Report)"

[7] Deutsche Bank (2015) "2015 Solar Outlook"

[8] NREL (2015) "Value of Solar: Program Design and Implementation Considerations"

[9] A WindVision for Alberta - Technical Overview Report, Version 2.0, Solas Energy Consulting Inc., May 2013, page 39.

[10] Facts and figures are drawn from the Alberta WindVision Technical Overview Report V2.0 Part IV, Solas Energy Consulting Inc.

[11] This assumes that 150 MW of solar is made up of 15MW residential, 45 MW commercial and 90 MW utility scale.

payments to municipalities over a 20 year period. Numerous studies have been undertaken in Canada and elsewhere that provide further evidence of the significant economic impacts of wind energy development.[12]

There may also be opportunities for the establishment of wind and solar energy manufacturing facilities in Alberta. Canada currently has wind energy supply chains in both Ontario and Quebec and solar manufacturing facilities in Ontario. While both of these jurisdictions utilized local content requirements as an incentive to stimulate local manufacturing (CanWEA and CanSIA do not believe Alberta should impose local content requirements), facilities would not have been constructed without a viable business case for them. That business case was provided by a commitment to build out thousands of MW of new wind and solar energy over a 10 year period with some potential to develop export markets. If Alberta makes such a commitment to wind and solar energy, it will attract the interest of manufacturers who will then assess potential opportunities in Alberta based on factors that will determine their ability to compete in the marketplace such as domestic market size, export market potential, labour costs, costs of production and existing competing facilities.

- **Wind and solar energy are scalable electricity generation technologies that can be deployed rapidly and will bring increased diversity to Alberta's electricity grid.** As future electricity demand is uncertain, scalability allows new supply to be more easily added in response to incremental changes to electricity demand. In Canada, we have 300 MW wind farms and the largest solar facilities are presently ~100 MW. Single turbines or solar on a single family home are also valuable applications of wind and solar energy. Wind and solar energy can also be rapidly deployed. Wind farms in Alberta can be developed, permitted and constructed in 3-4 years. Timelines of 1.5 – 3 years could be expected for large solar facilities. CanWEA and CanSIA believe there may be opportunities to shorten this timeframe through streamlining and improved efficiencies in permitting processes that will nonetheless continue to meet the environmental objectives of those processes.

- **Small-scale wind and solar energy generation can empower Albertans.** Everyone from individuals and households, to businesses and industry, to communities can take more control

[12] "Wind Dividends – An Economic Impact Analysis from Ontario's Wind Procurements: Methodology, Assumptions and Updated Results", Compass Renewable Energy Consulting Inc., September 28, 2015 "Estimated Economic Impacts of Utility Scale Wind Power in Iowa", National Renewable Energy Laboratory; November 2013; "Economic Development Impact of 1,000 MW of Wind Energy in Texas", National Renewable Energy Laboratory; August 2011; "Economic Impacts from Indiana's First 1,000 Megawatts of Wind Power", National Renewable Energy Laboratory; August 2014; "The Economic Impacts of the Wind Energy Sector in Ontario 2011-2018", ClearSky Advisors Inc., July 7, 2011; "RETOMBÉES ÉCONOMIQUES DE L'INDUSTRIE ÉOLIENNE QUÉBÉCOISE", KPMG, March 2013; "Understanding the Economic Impact of Renewable Energy Initiatives: Assessing Ontario's Experience in a Comparative Context", Mark Winfield, York University; September 2013; "The Economics of Wind Energy", European Wind Energy Association, March 2009; "The Local Economic Benefits of Wind Power Development and Operation A Case Study of Haldimand County and Neighbouring Aboriginal Groups, Ontario", Guy Holburn, Ph.D, on behalf of NextEra, February 2015.

of their energy consumption and carbon footprints. As energy storage becomes a more mainstream technology, the integration of storage with small-scale electricity generation will have major positive implications for system reliability and resilience.

- **Wind and solar energy are complementary electricity generating technologies**. Wind energy production peaks in the evening and in the winter. Solar energy production peaks in the daytime and in the summer. This complementarity may provide some assistance in mitigating concerns about the impact of increased variable generation on grid reliability.

The Need for Policy Change to Bring More Wind and Solar Energy On-Line

- **Despite the fact that multiple reasons exist for proceeding with a significant build-out of renewable energy in Alberta, and the Alberta Government is clearly committed to seeing this happen, CanWEA and CanSIA agree that Alberta's energy-only market cannot deliver on this objective as currently designed. As a result, Alberta's energy-only electricity market must evolve and policy changes are required if the Alberta Government wishes to accomplish this objective.**

- Alberta's energy-only electricity market was not designed with a view to achieving environmental outcomes like long-term and sustainable greenhouse gas emission reductions. It also was not designed to enable the introduction of significant penetrations of variable renewable electricity generation into the grid.

- In Alberta's energy only electricity market, potential generators make decisions on whether or not to invest based on market signals and their views on future power pool price trends in the market. This poses a number of significant challenges for utility scale wind and solar energy generators as their projects are predominantly project financed, require significant support from financial institutions, and see almost 100% of the financial risk of the project in the first year of its operating life because capital costs are such a high percentage of overall project costs (there are no fuel costs). Specifically:

    - The absence of any revenue certainty prohibitively increases the risk associated with an investment in renewable energy. Financial institutions are unwilling to bear this risk and most jurisdictions seeking renewable energy investment have taken steps to mitigate long-term revenue uncertainty as a result.

    - The absence of any revenue certainty, and the increased risk associated with it, also makes Alberta a less competitive destination for generator investment. Renewable energy generators are active in multiple markets in Canada and around the world. There are many markets that provide more revenue certainty and more attractive returns for renewable energy investors. As one would expect, capital flows to those markets instead of Alberta.

- For wind energy generators specifically, further risk and uncertainty is introduced by the current concentration of most wind energy production in one region of Alberta and the variable nature of wind energy production. The result in the market is that wind energy cannot count on receiving the average pool price for power produced over the course of a year. Indeed, the historical trend indicates that wind energy regularly receives a 30% discount on the average pool price on an annual basis.

- For smaller scale generators, additional obstacles can include a disproportionate level of administrative and regulatory burden and an inability to realize the true value of the role that they play in the electricity system as processes have not been designed to give rise to a meaningful penetration of small-scale power generation.

- **If Alberta hopes to see a significant increase in the penetration of renewable energy in the Alberta electricity grid, policy changes are required that can address these challenges by providing renewable energy investors with enough revenue certainty to enable project financing of their long-lived and capital intensive projects.**

- While it is true that almost 1,500 MW of wind energy have been built in Alberta, it is also true that what allowed much of this wind energy to be built was creative use of "out of market" revenue streams that provided at least a minimum of revenue certainty for these projects. Such support has come in the form of contracts for small power producers from the provincial government, federal production incentives (WPPI and ecoENERGY for Renewable Power), renewable energy credits from other jurisdictions and revenue from the sale of greenhouse gas offsets under Alberta's Specified Greenhouse Gas Emissions Regulation (SGER). Most of these "out of market" revenue sources are no longer available for new generation.

- There is presently less than 10 MW of solar facilities in Alberta. As solar facilities are more capital-intensive than that of wind energy, this issue is compounded for solar generators and it could be expected that Alberta would not reach an average level of deployment for more than a decade.[13]

- It is for these reasons that today's projections of future electricity supply in the Alberta market envision a future where virtually all new electricity supply in the province is provided by natural gas through either cogeneration or combined cycle natural gas facilities. Most of these facilities are likely to be built by incumbent generators in the Alberta Market, many of whom will finance these projects with their balance sheet.

[13] At the end of 2014, Alberta had approximately 1.5 watts per capita of cumulative installed solar capacity. This is compared to approximately 50 watts per capita for the United States and Canada and a global average of 25 watts per capita. Ontario had over 120 watts per capita in Ontario and Germany almost 500 watts per capita.

- The Alberta Government has signaled this is not the future it wants. While such a path forward has the potential to reduce greenhouse gas emissions in the short-term as natural gas replaces coal-fired generation, these benefits are short-lived as expanding electricity demand will cause greenhouse gas emission to rise and eventually surpass their original levels. While natural gas will have an important and growing role to play in Alberta's future electricity supply, the Alberta Government should be wary of relying solely on a single generation source that carries significant carbon and commodity price risks in a world where it is expected that greenhouse gas emissions obligations will become more stringent over time.

- **If the Alberta Government wants to create long-term and sustainable greenhouse gas emission reductions in the electricity sector through increased use of renewable energy, policy change and market evolution will be required as the existing energy-only market will not deliver this outcome.**

Why Changes to Carbon Pricing Alone are Inadequate to Drive New Investment in Wind and Solar Energy

- **A carbon price is a key component of any credible climate change strategy and CanWEA and CanSIA both support a strengthened and more effective carbon pricing framework for Alberta.** Economic theory clearly demonstrates that a carbon price will be most effective when it is designed to cover the largest possible percentage of greenhouse gas emission sources and is increased on a regular and steady basis that is communicated well in advance to allow for investors to consider carbon pricing trends in future investment planning decisions.

- **CanWEA and CanSIA do not believe, however, that changes to Alberta's carbon pricing framework can be the key driver for significant new investment in renewable energy.** This is consistent with global experience. We are not aware of any jurisdiction that has used carbon pricing as the primary tool to drive renewable energy investment. Other tools (e.g., feed-in-tariffs, renewable energy credits, production incentives) have been the real drivers of renewable energy development globally. The use of such tools has been justified by the fact that a carbon price only places a value on one of renewable energy's positive attributes – the reduction of greenhouse gas emissions. This leaves other attributes (e.g., air pollutant reductions, stable pricing) unrecognized and undervalued and the use of alternative tools has provided a mechanism to value the multiple benefits associated with renewable energy in and of itself.

- While Alberta's current carbon pricing framework established under the Specified Greenhouse Gas Emissions Regulation (SGER) does provide an opportunity for renewable energy projects to secure revenue through the creation of greenhouse gas emissions offsets, the current framework does not provide enough revenue (maximum value of $8.85 / MWh), or revenue certainty (8 year contract with the potential for a 5 year extension), for wind and solar energy greenhouse gas offsets to facilitate renewable energy project financing.

- If it is assumed that wind energy can capture 70% of the average power pool price in Alberta, a carbon price of $80 / tonne would be required for wind energy projects to secure enough revenue from both greenhouse gas offsets (given the grid intensity factor) and the energy only market to be economically viable assuming Alberta power pool prices based on current NGX forward settlement values (see Appendix C). The corresponding number for very large solar energy projects would be at least $110 / tonne and likely higher. As a result, CanWEA and CanSIA believe that economy-wide carbon prices are likely to be too low to stimulate investment in renewable energy. **This means that the Alberta Government will need to implement policies targeted specifically at incenting renewable energy deployment if it wishes to see a significant build-out of renewable energy in the province.**

- It is also important to note that the value of greenhouse gas emission offsets generated by wind and solar energy will decline over time as the greenhouse gas intensity of Alberta's electricity grid falls – requiring higher carbon prices to make future projects economically viable.

- Finally, reliance on a carbon price to drive renewable energy investment can provide no guarantees as to the quantity of renewable energy that will be built – and may engender boom and bust cycles in renewable energy development.

CanWEA and CanSIA's Policy Recommendations to the Alberta Government

- **CanWEA and CanSIA believe that the Alberta Government should seek to encourage wind and solar energy development at two scales:**
    - **Utility scale wind and solar energy projects that are connected to transmission lines**
    - **Smaller scale wind and solar energy projects that connect to distribution lines**

- Utility scale projects will provide the most power, and the most cost-effective power, but will also require new investment in transmission. They will be built largely in rural areas and will provide important opportunities for rural economic development and diversification.

- Smaller scale projects will produce less power, and will be more expensive, but can help to offset the need for new transmission investment and provide system benefits (e.g. reduction of network congestion, etc). Many of these projects can also be built in or near urban areas (e.g., rooftop solar) and can engage individual citizens directly in the Alberta Government's efforts to decarbonize the electricity grid.

- The policy frameworks to stimulate utility scale and distributed generation are distinct and we will address each of them in turn.

Policy Recommendations to Enable Utility Scale Renewable Energy Generation

- **CanWEA and CanSIA have reviewed the range of policies that have been utilized around the world to enable utility scale renewable energy generation, including feed-in-tariffs, production incentives and renewable portfolio standards (RPS). We believe that a legislated Renewable Portfolio Standard (RPS) is the most effective policy to drive significant new investment in utility-scale renewable energy in Alberta.**

- A RPS is a policy tool that has been widely used in North America. Appendix D lists the RPS that have been established in three Canadian provinces and 29 U.S. States.

- Under a RPS, legislation imposes an obligation on certain organizations (e.g., generators, retailers, government) to ensure that a certain percentage of electricity generation is produced by renewable energy. The production of renewable electricity produces renewable energy certificates (RECs) and organizations that face an obligation under a RPS must ensure that they have secured enough RECs to meet their legislated obligation. The organization can secure RECs by: (a) producing its own renewable energy, (b) purchasing RECs from another organization that produces renewable energy and / or has a surplus of RECs beyond what it needs to comply with the legislation. A RPS establishes a clear quantified renewable energy target and then uses market mechanisms (competitive processes to procure RECs and / or the production and trade of RECs) to enable achievement of the target at lowest cost.

- There are many potential ways to design a RPS. CanWEA and CanSIA Members considered designs where an obligation was placed on retailers and self-retailers to procure renewable energy and designs where an obligation was placed on government to procure renewable energy through a central agency like the Balancing Pool. There was also discussion of potential designs that combined elements of both approaches.

- **A very strong majority of CanWEA / CanSIA Members agreed that the most effective RPS design to stimulate significant new investment in renewable energy generation would impose an obligation on government to procure renewable energy through a central agency like the Balancing Pool.**

- Under this RPS design, the central agency would be obligated to secure enough RECs to allow it to meet the renewable energy targets outlined in legislation. CanWEA and CanSIA propose that the central agency would seek to procure those RECs from renewable energy producers at the lowest possible cost by holding competitive tenders for RECs and energy that would award minimum twenty year contracts to the low cost bidders. It would then retire the RECs and the cost of the RECs would then be passed on to all load (including self-suppliers) based on their share of provincial consumption. There is also the possibility of providing long-term contracts for RECs alone, but such contracts will need to provide enough revenue certainty to enable project financing if renewable energy projects are to proceed.

- This model of using competitive tendering to award long-term contracts for renewable energy development is the standard approach to renewable energy development in many other parts of Canada. The approach has resulted in intensely competitive processes that produce lowest cost outcomes because it is fairly common for a central agency to receive bids for several times more power than it is willing to contract for. An organization like the Balancing Pool would have a substantial amount of experience to draw on from across the country in designing a competitive tendering process that would produce efficient and effective outcomes.

- This approach would address the key barrier facing renewable energy projects in Alberta by providing long-term contracts to renewable energy producers that would provide them with enough revenue certainty to enable project financing and the construction of renewable energy projects. A minimum 20 year contract for RECs and energy provides a renewable energy producer with full revenue certainty for that period and a minimum 20 year contract for RECs alone provides a renewable energy producer with partial revenue certainty (the rest of the revenue would need to be recovered from the market). In the latter case, renewable energy producers would seek to sell their RECs to the central agency at a rate that would enable them to demonstrate a projected rate of return from the market that would allow them to secure project financing and build their project.

- CanWEA and CanSIA believe some additional strengths of this RPS design are the following:

    - A central agency like the Balancing Pool is a strong credit worthy counterparty for generators signing long-term contracts for RECs or RECs and energy. This will result in low risk premiums from bidding generators – reducing costs for consumers.

    - A central agency like the Balancing Pool can control the rate and pace of procurement to ensure that RPS targets are met – making it flexible enough to adapt to changing circumstances and minimizing the risk of oversupply

    - Competitive procurement conducted by a central agency like the Balancing Pool will minimize barriers to entry for credible and qualified renewable energy generators, maximize competition among those generators, and produce lowest cost outcomes.

    - This option is less administratively complex than many other RPS design options and can likely be implemented more quickly.

- There are many details to be addressed in the design of a Renewable Portfolio Standard and **CanWEA and CanSIA urge the Alberta Government to move quickly to establish a process involving all relevant stakeholders that would seek to finalize the design of a RPS that follows the broad structure outlined above and enables relevant legislation to be implemented within a year.**

- CanWEA and CanSIA believe the following design elements should be part of any formal RPS design:

    - Contracts for RECs and or RECs and energy must be structured to mitigate any risk of program cancellation.

    - Eligible generation sources should be renewable and non-greenhouse gas emitting. Technologies must be well defined and require facility qualification and verification / validation (technology and vintage as applicable).

    - The RPS targets should be clear and easily measurable and provide a predictable, stable and steady growth requirement in order to foster investor confidence. They should extend over a timeframe that provides incentive for the minimum 20 year supply contracts that are necessary to facilitate project financing of renewable energy projects.

    - The RPS targets should be defined on an energy basis where one REC is equal to 1 MWh of qualifying renewable energy.

    - The RPS will remove the ability of new renewable energy generation to create greenhouse gas offsets, as renewable energy would not meet the requirement of "regulatory additionality" under SGER. A transition mechanism can be established to move existing offsets into the RPS framework while respecting existing SGER offset contracts.

    - Existing renewable energy generators should be eligible to contribute to an RPS as long as their environmental attributes (RECs) are available for purchase.

    - If metered correctly (to show production volumes), "behind the fence" renewables generation should be eligible to contribute to an RPS provided it meets all other requirements.

- CanWEA and CanSIA note that of the 29 US States with a RPS, 22 have established a "set aside" under the RPS for utility scale solar and / or smaller generation connected through distribution lines. A "set-aside" specifies a specific portion of the overall RPS target that must be met by a specific generation type. CanWEA and CanSIA are also proposing that the final design of an RPS should include:

    - A "set aside" under the RPS for renewable generation connected via the distribution system. More details on the procurement of such power by a central agency like the Balancing Pool are outlined later in this submission.

- A time-limited initial "set-aside" for utility scale solar generation. This will facilitate the introduction of solar energy into the Alberta grid and position it to fully compete with all sources of renewable electricity generation later in the RPS mandate.

- Finally, CanWEA and CanSIA note that some of the additional design issues that will need to be considered include:

  - The treatment of renewable energy imports and exports

  - The treatment of geographic distribution of renewable electricity sources

  - The treatment of storage under the RPS

- **CanWEA and CanSIA believe that a legislated RPS that establishes renewable energy targets for Alberta and mandates a central agency like the Balancing Pool to procure renewable energy certificates to meet the targets by purchasing them from renewable energy producers through competitive tendering processes will be the most effective way to facilitate a significant build out of new utility scale wind and solar energy in Alberta.**

Policy Recommendations to Enable Distributed Renewable Energy Generation

- CanWEA and CanSIA have reviewed the range of policies that have been utilized around the world to enable small scale (e.g., residential, community, commercial, industrial) renewable energy generation, including feed-in-tariffs, production incentives and Renewable Portfolio Standards (RPS).

- **Successful policies for small-scale renewable energy reward the project's characteristics related to system benefit, ownership and the ability to deploy more rapidly which differentiates them from larger utility-scale assets. When project proponents can include everyone from individual citizens, households, farmers to businesses, industry and entire communities – a tailored approach is required to enable the unique challenges in an efficient way.**

- The unique challenges that small scale renewable generators face include i) process: many administrative, regulatory and technical costs are fixed irrespective of system size so it is critical to standardize them for small projects so the cost can be offset by consistency and volume; ii) timelines: streamlined processes are essential for cost efficient movement from project concept to construction – increasing the velocity of capital will help drive costs down as scale grows; iii) pricing: unless the true value of distributed assets is taken into account – proponents cannot achieve an appropriate economic return, and iv) counterparty risk: because of the number of projects associated with distributed generation, developers are unable to effectively manage counterparty risk on a project by project basis.

- **We believe that the most effective policy to drive significant new investment in, and address these unique challenges of, small-scale renewable energy in Alberta is a Standing Offer Program (SOP) that contributes to the legislated province-wide RPS.**

- A Standing Offer Program (SOP) is an on-going "call for power" that makes available long-term contracts (PPAs) on a continuous basis to eligible applicants until a program cap is reached. A common trait of SOPs is that they are exclusive to small-scale[14] zero-emissions generators. Application, technical and interconnection requirements are typically standardized to streamline and reduce the burden on proponents to a level that is proportionate to the size of the project.

- An SOP is similar to a FIT program in that it results in a fixed-price long-term PPA for generators. An SOP differs from a FIT program in that their design controls the scale and pace of deployment program with upper threshold limits in place prior to commencement to mitigate against unintended market, cost and technical consequences (as have been experienced in a limited number of jurisdictions globally). As a result, stable long-term program goals are communicated to industry providing the necessary market signals and predictability for planning horizons to inform investment decision-making.[15]

- An SOP program would be a consistent approach with the solar policies that have driven the majority of solar installed capacity to date (approximately 65% of which was procured through a policy that results in a Power Purchase Agreement (PPA) for the generator).[16] In addition, twenty-three jurisdictions in the United States (76% of those with an RPS) use "Carve-Outs" and/or "REC Multipliers" to ensure a role for solar and/or distributed generation in the resultant supply-mix of an RPS.

[14] For this purpose of this proposal, CanSIA recommends that "small-scale" is defined as that which can connect to the distribution system. In Alberta, the majority of the distribution network has a line voltage of 15 and 35 kVA. As a result (and due to additional technical considerations such as interconnection capacity at distribution substations and thermal and short circuit capacity) solar assets which connect to the distribution network are limited to typically 5 MW in capacity (some projects could be as large as 15 MW).

[15] For the purpose of this proposal, CanWEA and CanSIA recommend that two key program design elements be employed as mitigative measures in this regard: i) Program Size Limits: Examples include BC Hydro's SOP which has a 150 GWh/year target volume allocated under a first come, first served approach. ii) Capacity-Based Degression: Examples include California's Solar Initiative which degressed pricing based on capacity targets. The unit payments for solar electricity decreased over 10 steps as each successive 10% of the 1,750 MW capacity targets were met. Benefits of a measure such as this includes greater investor security by removing the uncertainty associated with annual program revisions and adjustments making it easier for them to be factored into investment decisions helping to foster greater planning security. A second advantage is the clear signal sent to the supply chain for them to reduce the marginal cost of their products and services to remain competitive.

[16] Calls for tenders are becoming more prevalent for utility-scale solar energy in mature solar markets. They are an effective way to procure electricity from large-scale solar projects, they are too administratively challenging for small-scale solar projects.

- CanWEA and CanSIA believe that these PPAs for bundled energy and environmental attributes should be offered and managed through a central agency like the Balancing Pool. In order to reflect the economies of scale that larger projects can achieve, projects should receive a different contract price determined by their installed capacity in size-tranches.

- Electricity generated through the SOP would generate a source of RECs in addition to those generated by utility-scale facilities. As transaction costs would render the monetization of small numbers of RECs uneconomic, the SOP offtake agreement would need to include the environmental attributes (i.e. a contract for "bundled RECs"). The off-taker would then retire the aggregated environmental attributes.

- Electricity generated from projects contracted under the SOP program would not be "bid-in" to the market. Instead these are considered as negative load.

Renewable Energy Targets for an Alberta RPS

- The Alberta Government has made it clear it would like to increase the penetration of renewable energy in Alberta's electricity grid. CanWEA and CanSIA believe the Alberta Government should, like many other jurisdictions, establish renewable energy targets within the framework of a RPS. It is possible to establish renewable energy targets in terms of capacity (MW) or electricity generated (TWh). **CanWEA and CanSIA believe that the Alberta Government should establish targets for the penetration of renewable energy into Alberta`s electricity grid that represent a percentage of total electricity generated in the province for, at a minimum, the years 2020, 2025 and 2030.**

The Potential Build-Out of Wind and Solar Energy in Alberta

- In 2014, Alberta secured approximately 9% of its electricity from renewable energy (wind – 4%, biomass and biogas – 3%, hydro – 2%). There is now approximately 1,500 MW of wind energy capacity in Alberta and about 10 MW of solar energy capacity.

- CanWEA and CanSIA surveyed their members to identify potential scenarios for the build-out of wind and solar energy in Alberta under a more supportive policy framework. The views of members can be grouped into "high" and "low" scenarios. While the scenarios are not the product of any analytical process, they are informed by the real world experience of members with respect to project development and construction timelines for wind and solar energy as well as their experience in other jurisdictions. The scenarios incorporate utility scale wind and solar energy generation, as well as smaller scale solar generation connected to distribution lines.

- In the tables below, the "high" and "low" scenarios are presented both in terms of MW of capacity and the percentage of electricity generated in the province relative to the future electricity demand forecasts found in the 2014 AESO Long-Term Outlook.

- The CanWEA / CanSIA "high" scenario is as follows as a percentage of electricity produced in Alberta:

Renewable Energy	2015	2020	2025	2030
Wind	1500 MW (5%)	3500 MW (11%)	6000 MW (17%)	9000 MW (24%)
Utility Scale Solar	N/A	1000 MW (1.2%)	2300 MW (2.6%)	4000 MW (4.2%)
Small Solar	N/A	500 MW (0.6%)	1200 MW (1.4%)	2000 MW (2.1%)
Total Wind / Solar	5%	13%	21%	30%

- The CanWEA / CanSIA "low" scenario is as follows as a percentage of electricity produced in Alberta:

Renewable Energy	2015	2020	2025	2030
Wind	1500 MW (5%)	3000 MW (9%)	5000 MW (14%)	7500 MW (20%)
Utility Scale Solar	N/A	500 MW (0.6%)	1000 MW (1.1%)	2000 MW (2%)
Small Solar	N/A	500 MW (0.6%)	1000 MW (1.1%)	1500 MW (1.6%)
Total Wind / Solar	5%	10%	16%	24%

- In both scenarios, the build-out of both wind and solar energy accelerate over time, but averages out to 500 MW / year of new wind energy and 400 MW / year of new solar energy in the "high" scenario and 400 MW / year of wind energy and 233 MW / year of new solar energy in the "low" scenario.

- We have seen jurisdictions pursue the build out of wind and solar energy at such rates. With respect to wind energy, Quebec established a target in to build 4,000 MW of wind energy in 10 years and Ontario's Long-Term Energy Plan called for the build-out of 6,000 MW of wind in 10 years. While both provinces will take slightly longer to meet their targets, the rate of build-out in recent years has been consistent with the scenarios outlined above. Ontario has seen approximately 270 MW, 445 MW and 635 MW of solar energy added in 2012, 2013 and 2014 respectively (with an imposed maximum project size of 10 MW_{AC} which inhibits annual market size). These rates of build-out in recent years are consistent with the scenarios outlined above.

- Given that it takes a number of years to develop and construct wind and solar energy projects, meeting 2020 targets will require that actions are taken quickly to put in place policies that can address the project financing barriers created by a lack of revenue certainty in the Alberta market. It is, however, important to note that there are already over 2,300 MW of wind energy projects and 60 MW of solar energy projects registered in the Alberta Electricity System Operator queue. While a number of these projects are very early in the development process, there are also a number of projects that are already fully permitted and simply waiting for an

enabling policy framework to allow them to proceed. As solar projects have even shorter development and construction timelines than that of wind energy, significant capacity could also be achievable by 2020.

- CanWEA and CanSIA recognize that the ability to integrate variable generation like wind and solar energy into an electricity grid can vary significantly from jurisdiction to jurisdiction as each jurisdiction is unique. Alberta, for example, is more challenged to integrate variable generation than some other jurisdictions because of its heavy reliance on coal-fired generation with low ramp rates and the limited interconnections it has with neighbouring jurisdictions.

- While the two scenarios mentioned above both envision rapid and significant growth in the addition of renewable energy to Alberta's electricity grid, the penetration levels envisioned here have already been replicated in other jurisdictions and penetration levels continue to increase rapidly around the world.

- For wind energy alone for example, 1 Canadian province and 9 US states already secure between 12% and 30% of their electricity from wind energy.[17] Globally, 7 countries already have wind energy penetration levels of 10% or more.[18] For solar energy, 2 – 3 % of total annual electricity demand and 10% or more of summer peak load is common in a diverse selection of global jurisdictions with several regions reliably achieving significantly higher than that.

- System operators across North America have consistently increased their estimates on how much variable renewable electricity can be integrated into the grid as they gain more familiarity with these technologies and learn from each other. The Alberta Electricity System Operator (AESO) once believed that the Alberta grid could not take on more than 900 MW of wind energy and maintain system reliability. Phase 2 of the AESO's wind integration study, however, makes it clear that the AESO now believes it could reliably integrate 4,000 MW of wind energy in Alberta without any change in current electricity system conditions or the tools it currently has available to facilitate wind integration. It also states that more variable generation could be reliably integrated if more tools were made available for its use (e.g., flexible natural gas generation, storage technologies, etc.) and the AESO is currently participating in a Pan-Canadian Wind Integration Study to understand the implications of wind penetrations of 20% or more in the Alberta electricity system. Similar learnings reflect the confidence in higher penetrations of solar energy in jurisdictions globally.[19] Please see Appendix E to view a graphic on the tools available to system operators to facilitate wind energy integration.

[17] PEI – 30%, Iowa -28%, South Dakota – 25%, Kansas – 22%, Idaho – 18%, North Dakota – 17%, Oklahoma – 16%, Minnesota – 15%, Colorado – 13%, Oregon – 12% (Lawrence Berkeley National Laboratory, 2015)
[18] Denmark – 39%, Ireland – 26%, Portugal – 24%, Spain – 21%, Romania – 14%, Germany – 13%, United Kingdom – 11% ("2014 Wind Technologies Market Report"; Wiser & Bolinger, Lawrence Berkeley National Laboratory, US DOE August 2015)
[19] For example, see International Energy Agency (2014) "Power System Operation and Augmentation Planning with PV Integration"

- Deployment of wind and solar energy in Alberta as envisioned in the scenarios outlined above would produce significant economic benefits to Alberta over the next 15 years. For wind energy alone, such scenarios represent:

    - $12.5 - $16 billion in investment
    - 5,600-7,000 full-time equivalent direct jobs in construction
    - 400 – 500 permanent direct jobs in operations
    - $680 - $850 million dollars in payments to be made to landowners
    - $1.24 - $1.55 billion dollars in property tax payments to be made to municipalities

- For utility scale and small scale solar energy combined, such scenarios represent:

    - $7.3 - 12.3 billion in investment
    - 44,000-73,000 full-time equivalent direct jobs in construction
    - 1,100 – 1,750 permanent direct jobs in operations
    - $1.3 - $2 billion dollars in payments to be made to landowners
    - $700 million - $1.2 billion dollars in property tax payments to be made to municipalities

- CanWEA and CanSIA are not able to speak to the future development potential of biomass / biogas, hydro, or geothermal sources of electricity. Given that these sources of generation already account for 5% of Alberta's electricity today, it is clear that the renewable energy targets associated with our scenarios would need to be higher than what we envision for wind and solar energy alone.

- CanWEA and CanSIA suggest that the Alberta Government should explore the adoption of renewable energy targets in the range of:

    - 15% - 20% of total electricity generation in 2020
    - 22% - 30% of total electricity generation in 2025
    - 30% - 40% of total electricity generation in 2030.

Considerations in Determining a Renewable Energy Target for Alberta

- In identifying what is possible in terms of wind and solar energy build-out in Alberta, **CanWEA and CanSIA recognize the introduction of new renewable electricity to the Alberta grid must nonetheless be justified by the needs of electricity supply and demand. As a result, any renewable energy targets ultimately adopted by the Alberta Government must reflect and respond to both projected growth in electricity demand and decisions taken to reduce output from coal-fired electricity generation.**

- With respect to future electricity demand, CanWEA and CanSIA recognize that the impact of the decline of global oil prices on the Alberta economy has likely significantly reduced the prospect

of future electricity demand growth. This means that the MW of new wind and solar energy capacity required to achieve the penetration levels outlined in our potential renewable energy target scenarios above will likely be lower. Ironically, this should make these targets easier to achieve from the perspective of a renewable energy build-out.

- Alberta's current economic conditions, however, also mean that the key driver for future renewable energy growth in Alberta will need to be the creation of "space" on the electricity supply side by reducing output from coal-fired generation. In other words, the Alberta Government will need to align its renewable energy penetration goals with coal-fired power reductions to replace coal energy losses with renewable energy while maintaining system reliability.

- **CanWEA and CanSIA are not offering recommendations on the pace and scale of an accelerated phase-out of coal-fired power generation.** It is clear, however, that the amount of electricity that would be produced by wind and solar energy in the scenarios outlined above is significantly greater than the amount of electricity that would be produced by the coal-fired power plants scheduled to shut down under the current federally mandated phase-out schedule – particularly in 2020 and 2025. **This means that the wind and solar energy deployment scenarios outlined above would require an accelerated reduction in power generation from coal-fired electricity generating stations in the province in order to proceed.**

- **Whatever actions the Alberta Government ultimately takes to define the pace and scale of reduced output from coal-fired electricity generation in Alberta will be the key determinant of the pace and scale of a renewable energy build-out in the province.**

- **CanWEA and CanSIA recommend that the Alberta Government establish targets, at a minimum, for future levels of electricity production from both coal-fired electricity generation and renewable energy in the years 2020, 2025 and 2030. These targets are clearly interrelated and should be informed by each other.**

Understanding the Implications of a Renewable Energy Target for Alberta

- An accelerated reduction in the output of coal-fired generation and the increased penetration of renewable energy in Alberta's electricity grid represents a fundamental transformation of Alberta's electricity system and it is important to understand the implications of such changes on a number of key variables including: generator bidding behaviours, power pool prices, transmission needs and costs, reliability needs and costs, baseload power needs, etc.

- Models exist to provide insights into some of these implications and CanWEA and CanSIA understand that the Climate Change Advisory Panel has looked to models run by the Brattle Group and others to consider the implications of significantly higher penetrations of renewable energy in Alberta's electricity grid. Naturally, a model is only as good as the assumptions that go

into it, but it is also true that every model has strengths and weaknesses and that no model will provide insights into all relevant aspects of this issue.

- **While CanWEA and CanSIA are unable to provide any additional modelling work to assist the Alberta Climate Change Advisory Panel at this time, we have commissioned General Electric to build upon their current work to deliver a Pan-Canadian Wind Integration Study by March 2016 (an exercise the AESO has been actively involved in) with the GE MAPS model[20] to provide some preliminary results of relevant modelling by mid-October.**

- Specifically, GE will model the impact of moving to 20% wind energy on the Alberta grid in 2025 under three scenarios:

    - Under the first scenario, there is no change in the current schedule for retirement of coal-fired generation by 2025.
    - Under the second scenario, all coal-fired generation is retired in 2025.
    - Under the third scenario, all coal is retired except what is required in order to meet the reserve margin established by the AESO

- While the GE model can't address all issues in the timeframe required, the outputs of the model are significant, and will provide an in depth, reliable view of some system conditions under the assumptions outlined in each scenario. Specifically, the outputs include:

    - Adjustment in energy production of various plant types, as a result of adding more wind
    - Production cost implications due to addition of new wind and displacement of thermal resources
    - Wind curtailment
    - Inter-provincial tie line and congestion costs
    - Emission reductions by thermal plant types – including system wide
    - Effect on export volumes to neighbouring jurisdictions, including the US
    - Implications for inter-provincial tie transmission congestion

- **CanWEA and CanSIA will provide Alberta's Climate Change Advisory Panel with the results of these modelling runs in a subsequent submission to the Panel in mid-October. Additional and more comprehensive analysis is going to be undertaken, but will require more time. It is also true that some potential questions of interest may fall outside the scope of the Pan-Canadian Wind Integration Study.**

[20] The GE team uses the proprietary GE Concorda Suite Multi-Area Production Simulation (GE MAPS) model. GE MAPS is a tool that has been used in previous renewable (wind and solar) integration studies performed by GE and its partners in the course of the last 10 years. GE MAPS is a nodal, security-constrained, unit commitment and economic dispatch model with detailed realistic representation of all generation types and the underlying transmission grid. Generation of all types, including existing and future thermal, hydro, wind, and solar plants are represented as connected to nodes or buses (substations) on the grid. The model provides detailed hourly outputs of operational and economic performance of all generation units. It also provides hourly information on fossil fuel consumptions, criteria pollutant (NOx and SO2) and CO2 emissions, transmission flows, binding transmission constraints, shadow prices, and congestion costs.

Implications of Introducing Significant Amounts of New Renewable Energy in the Alberta Energy-Only Electricity Market

- Alberta's energy-only electricity market was not designed with a view to achieving environmental outcomes like long-term and sustainable greenhouse gas emission reductions. It also was not designed to enable the introduction of significant penetrations of variable renewable electricity generation into the grid. Indeed, it will not do either of these things. As a result, Alberta's electricity market must evolve if the Alberta Government wishes to accomplish either of these outcomes.

- The implementation of CanWEA and CanSIA's policy recommendations would represent a significant evolution in the structure of the Alberta electricity market. This would have the potential to impact the market in two ways.

- First, in Alberta's energy-only electricity market, a significant increase in the penetration of variable renewable electricity generation into the grid changes market dynamics. Historical experience indicates power pool prices will have downward pressure during periods of high wind output. When wind output is low, power pool prices will be significantly higher. The result is an increase in price volatility.

- This is why it is important that the targets for future electricity generation from renewable energy and coal-fired power be interrelated. Avoidance of an over-supply of capacity can help minimize the impact on average pool prices.

- Second, the provision of long-term contracts to renewable energy producers through a central agency like the balancing pool means that new non-renewable generators will be treated differently than new renewable generators.

- The Alberta Government needs to be cognizant of the potential impacts of these changes on participants in the Alberta electricity market.

- Any time power pool prices fall it represents a potential benefit to consumers. It also means, however, that incumbent generators (renewable and non-renewable) with merchant price exposure will receive a lower price for their product and lower rates of return on their investment. Consumers may be impacted by the potential for increased volatility in the real-time power price as generators with a portfolio of supply options try to manage those options in an effort to try and recover their costs by driving market prices higher when variable generation is not producing. The market "ceiling price", however, sets a limit on the ability of generators to do this and many generators simply do not have this option.

- Reduced power pool prices also mean that potential new entrants into the market may receive a weaker market signal to encourage new investment and this may impact their future investment

decisions. An absence of long-term contracts when other generators are receiving them may also be a disincentive to investment. This is important to consider because it is recognized that new investment in renewable energy will need to be accompanied by some additional new investment in new generation or new ancillary services that can help the system operator meet necessary firming and capacity requirements to manage the variability of renewable energy generation at higher penetration levels and ensure a reliable system.

- While predicting the exact impact of increased penetrations of variable renewable energy on average power pool prices and market signals is challenging because many other variables will also have an impact, the Alberta Government will need to consider how incumbent generators and potential new investors will be impacted. If market signals are not strong enough to incent investment in such generation, alternative procurement mechanisms (e.g., a capacity market, a contract market) will need to be considered.

- **CanWEA and CanSIA believe that the Alberta Government must move to clarify and define the objectives it wants Alberta's electricity market to achieve with respect to both reduced output from coal-fired generation and increased penetration of renewable energy in the electricity grid. The best way to do this is to establish targets, at a minimum, for electricity produced from both coal-fired generation and renewable energy in 2020, 2025 and 2030 that are clearly interrelated and complementary to each other and to identify the specific tools (e.g., a Renewable Portfolio Standard) that will be used to meet these objectives.**

- **Once these parameters have been established, the Alberta Government should engage with all relevant stakeholders in a well-defined and time-limited process to determine if and how the energy-only market must further evolve to mitigate impacts on incumbent generators and potential new investors. This is a good time for such a process as no new investment in non-renewable electricity generation is required at this time or is likely to be required to enable the first steps taken by Alberta with respect to coal-fired generation and renewables.**

Conclusions

- Any credible climate change plan targeted at long-term and sustained greenhouse gas emission reductions in Alberta must include a significant expansion of wind and solar energy production in the province. Alberta's energy-only market cannot deliver on this objective as currently designed. Policy changes are required to provide renewable energy investors with enough revenue certainty to project finance their long-lived and capital intensive projects.

- CanWEA and CanSIA both support a strengthened and more effective carbon pricing framework for Alberta but changes to Alberta's carbon pricing framework will not be a major driver of significant new investment in renewable energy.

- CanWEA and CanSIA believe that a legislated Renewable Portfolio Standard (RPS) that establishes renewable energy targets for Alberta and mandates a central agency like the

Balancing Pool to meet those targets through long-term contracts to purchase Renewable Energy Certificates (RECs) and energy, or RECs alone, from renewable energy producers selected through competitive tendering processes will be the most effective way to facilitate a significant build out of new utility scale wind and solar energy in Alberta.

- CanWEA and CanSIA believe that the most effective way to secure renewable energy from small renewable energy projects connected to distribution lines in the province is through the provision of long-term power purchase agreement contracts through a Standard Offer Program (SOP) for energy and RECs through a central agency like the Balancing Pool.

- Alberta's renewable energy targets must ultimately be informed by the pace and scale of actions taken by the Alberta Government to reduce output from coal-fired electricity generation and must ensure that any required additional generation and ancillary services are secured to ensure system reliability.

- CanWEA and CanSIA believe the Alberta Government should explore the adoption of renewable energy targets that would increase renewable energy penetration levels in the Alberta electricity grid from 9% of total electricity produced today to 15% - 20% by 2020, 22% to 30% by 2025 and 30%-40% in 2030. Renewable energy deployment as outlined above would require an accelerated reduction in coal-fired electricity output beyond that currently envisioned under federal coal phase-out regulations.

- Once the Alberta Government has established targets for future levels of electricity production from coal-fired generation and renewable energy for 2020, 2025 and 2030, it should engage with all relevant stakeholders in a well-defined and time-limited process to determine if and how the energy-only market must further evolve to mitigate impacts on incumbent generators and potential new investors.

Appendix A – CanWEA and CanSIA

- CanWEA is the national association of companies participating in Canada's wind energy market. Our 250+ members are companies involved in the development, ownership and operation of wind energy projects, manufacturers of wind turbines and their components, and a broad range of service providers to the wind energy industry. Canada is currently the world's seventh largest wind energy producer, with wind turbines producing electricity for the grid in every province of the country.

- Wind energy has grown globally by an annual average of 25% for the last 10 years.[21] It has been the single largest source of new electricity generating capacity in Canada over the last five years and the second largest in the United States. In Europe, wind energy has been the largest single source of new electricity generating capacity over the last 15 years.[22]

- CanSIA is the national trade association that represents the solar energy industry throughout Canada. Since 1992, CanSIA has worked to develop a strong, efficient, ethical and professional Canadian solar energy industry with capacity to provide innovative solar energy solutions and to play a major role in the global transition to a sustainable, clean energy future. Since 2010, the annual market for solar has grown at an average annual rate of 178% in Canada, primarily in Ontario. CanSIA's vision for solar electricity in Canada is that in 2020: solar will be a mainstream energy source that is an integral part of Canada's diversified electricity-mix and that the solar industry will be sustainable without the need for direct subsidies.

- The sun could be the world's largest source of electricity by 2050, generating up to 16% of the world's electricity by 2050 according to the International Energy Agency.[23] This transition is beginning in Canada with 1 and 2 GW of national cumulative installed capacity surpassed in 2013 and 2015 respectively.

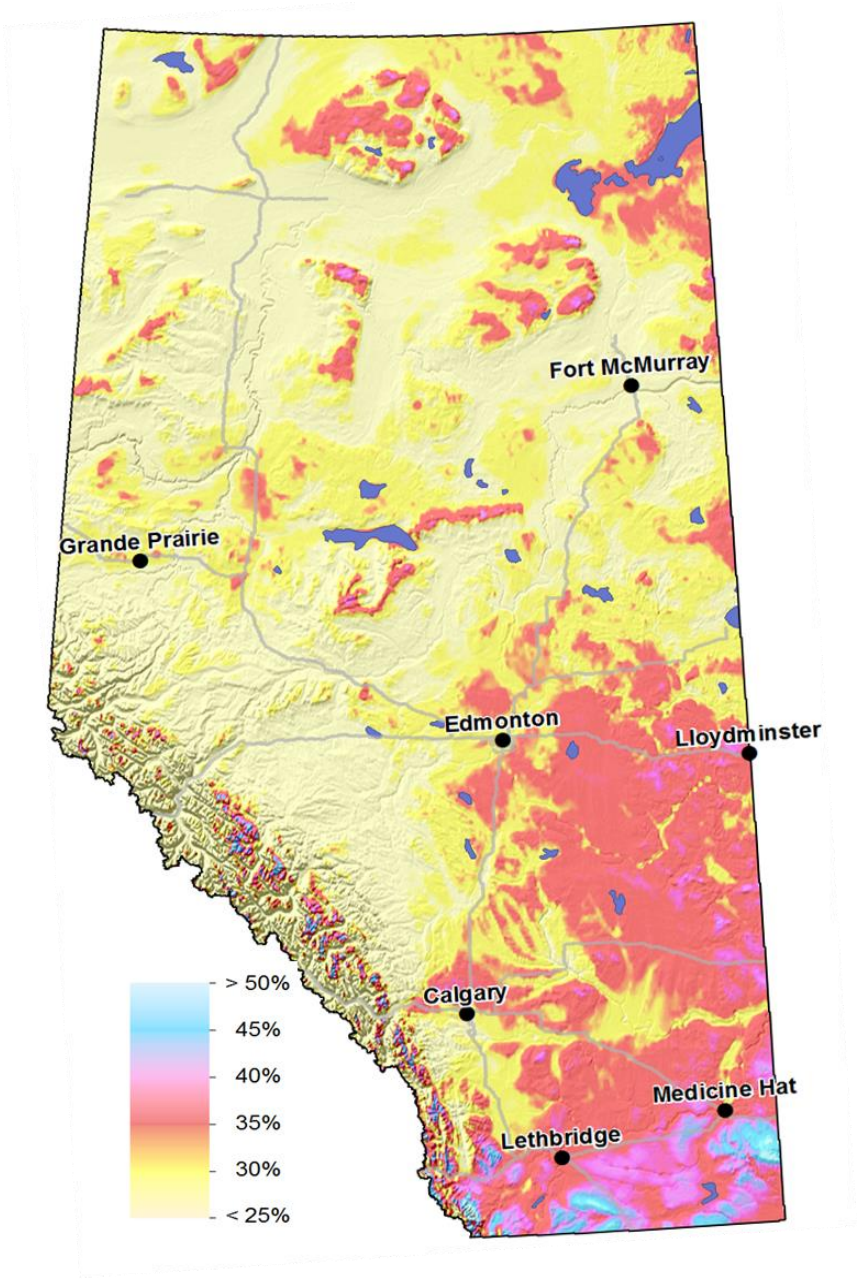
[21] Global Wind Report 2014, Global Wind Energy Council 2014.

[22] National Energy Board: Canada's Energy Future 2013 – Energy Supply and Demand Projections to 2035 – Table A5.4 (Appendices) - Reference Case - Capacity by Plant Type (MW) (2009 – 2014) + personal communication with CanSIA. https://www.neb-one.gc.ca/nrg/ntgrtd/ftr/2013/ppndcs/ppndcs-eng.html; http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=7294; http://www.ewea.org/fileadmin/files/library/publications/statistics/EWEA-Annual-Statistics-2014.pdf

[23] International Energy Agency (2014) "Technology Roadmap: Solar Photovoltaic Energy - 2014 edition"

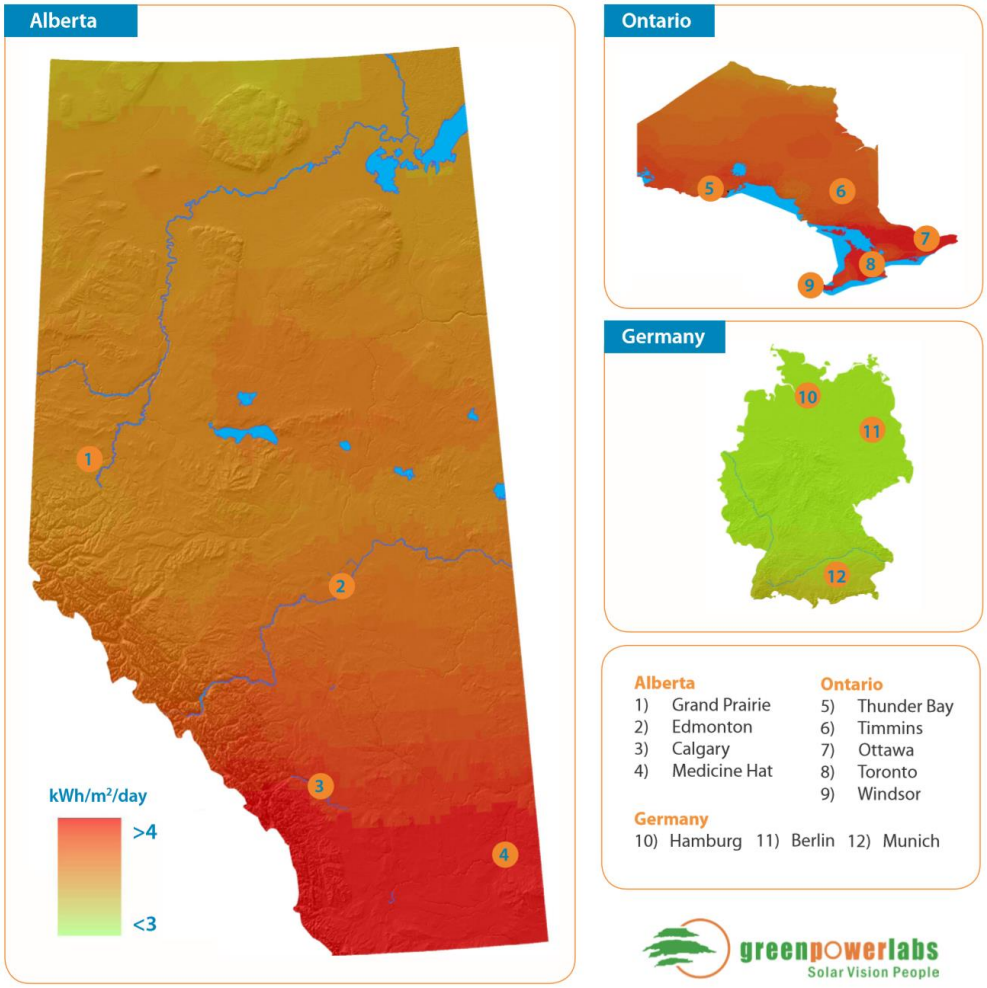
Appendix B: Wind Resource Map of Alberta

Wind Energy Capacity Factors



Source: Alberta WindVision Technical Overview, Solas Energy Consulting, Inc.

Maximum Daily Solar Energy Resource Achievable in Alberta



Appendix C – Carbon Price Required to Make Wind Energy Projects Viable Through the Use of Greenhouse Gas Offsets

The table below illustrates the required carbon price to achieve a 8% IRR unlevered

	Capital Cost ($/kW)	NCF (%)	Carbon Price ($/tonne CO2e)	Capture Rate (%)
Base Case	**$2,100**	**40.0%**	**$ 78.81**	**70.0%**
Capital Cost Improvement - $300/kW	$1,800	40.0%	$ 59.79	70.0%
NCF +5%	$2,100	45.0%	$ 64.01	70.0%
Capture Rate +5%	$2,100	40.0%	$ 72.35	75.0%

assuming:

1) Alberta power prices based on current NGX forward settlement to 2023 and escalating at 2% per year thereafter:

Year	Average Price
2016	$ 38.54
2017	$ 43.00
2018	$ 51.25
2019	$ 55.50
2020	$ 56.00
2021	$ 57.00
2022	$ 59.50
2023	$ 59.50

2) 25 year project life
3) 13 years of carbon offsets at 0.59 tonnes/MWh
4) Turbine O&M of $18/MWh, escalating at 2% per year.
5) 2016 construction with COD Jan 1 2017.

Sensitivities were conducted on capital cost, capacity factor and capture rate.

Appendix D – North American Renewable Portfolio Standards

State / Province	Renewable Portfolio Standard
Arizona	15% by 2025
California	50% by 2030 (recently extended from 30% by 2020)
Colorado	IOU: 30% by 2020; Large Coop: 20% by 2020; Small Coop & Muni: 10% by 2020
Connecticut	27% by 2020
District of Columbia	20% by 2020
Delaware	25% by 2025
Hawaii	40% by 2030: 100% by 2045
Illinois	25% by 2025
Iowa	105 MW (established in 1983 – Iowa now has almost 6,000 MW of wind alone)
Kansas	20% peak demand capacity by 2020
Maine	10% by 2017
Maryland	20% by 2022
Massachusetts	15% by 2020 + 1% annually thereafter
Michigan	10% by 2015
Minnesota	Xcel: 31.5% by 2020; IOU: 26.5% by 2025; Other: 25% by 2025
Missouri	15% by 2021
Montana	15% by 2015
Nevada	25% by 2025
New Hampshire	24.8% by 2025
New Jersey	20.38% by 2021 + 4.1% Solar by 2028
New Mexico	IOU: 20% by 2020; Coop: 10% by 2020
New York	8.3% by 2025
North Carolina	IOU: 12.5% by 2021; Coop, Muni: 10% by 2018
Ohio	12.5% by 2026
Oregon	Large Utility: 25% by 2025; Medium Utility: 10% by 2025; Small Utility: 5% by 2025
Pennsylvania	18% by 2021
Rhode Island	14.5% by 2019
Texas	5,880 MW by 2025 (Texas now has almost 15,000 MW of

	installed wind energy capacity)
Vermont	55% by 2017, 75% by 2032
Washington	15% by 2020
Wisconsin	10% by 2015
New Brunswick	40% by 2020
Nova Scotia	40% by 2020
Prince Edward Island	30% by 2013

Data Source: AWEA RPS Market Assessment 2015; New Brunswick Energy and Mines, 2014; Province of Nova Scotia, 2011; PEI Department of Environment, Energy and Forestry, 2008

Appendix E – Wind Integration Tools