ALBERTA RENEWABLE ENERGY ALLIANCE

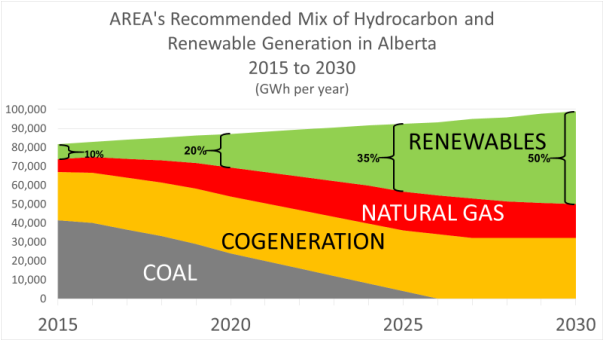
(October 31, 2016)

Open Letter to Climate Technology Task Force
Alberta's Transition to a Lower-Carbon Economy

AREA is recommending the progressive closure of all coal fired generating units in Alberta by 2025 coupled with the deployment of 50% renewable power generation by 2030. All coal units that have been operating for 40 years should be shuttered. These actions will improve air quality, reduce health costs and Greenhouse gases, and offer tens of thousands of jobs in a new diversified energy sector.

Alberta's Low Carbon Transition

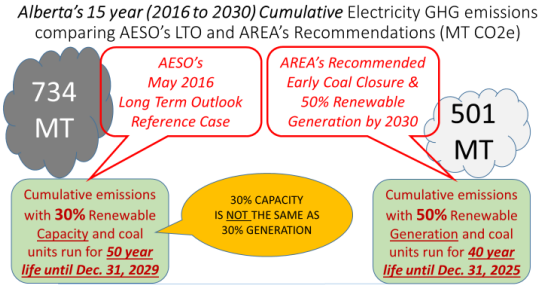
- Coal, gas, and renewables produced 52%, 38% and 10% (respectively) of 81,621 GWh total generation in Alberta in 2015 (1).
- By 2030, renewables should produce 50% of power generation as shown in the figure to the right; the AIL (Alberta Internal Load) is estimated to be 99,500 GWh in 2030.
- Cogeneration which involves the simultaneous production of heat and electricity should continue to be deployed in SAGD in the Oil Sands to lessen GHG emissions per barrel.



- Nine of 18 coal power units with generating capacities of 2,600 MW should be decommissioned by 2020 after 40 years of operation.
- The remaining nine coal units totalling 3,700 MW should be progressively decommissioned by 2025.
- Two coal units commissioned in 2005 and 2011 should be repowered with natural gas.

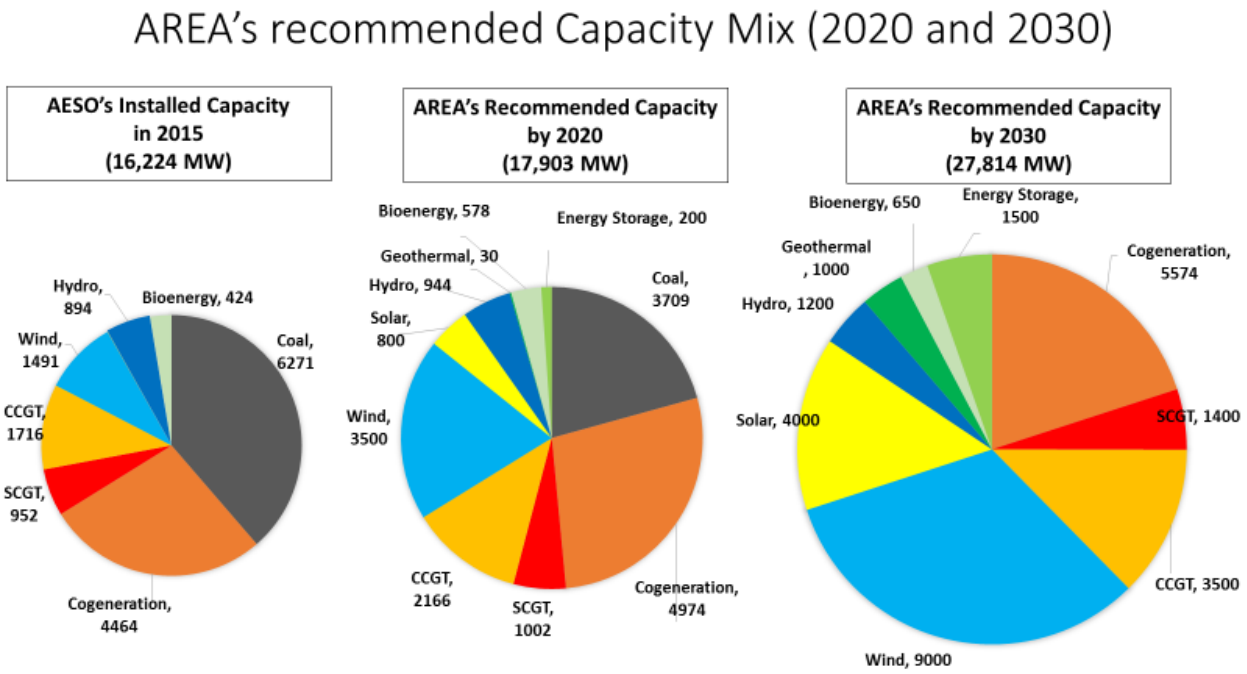
GHG Emissions from Alberta's Power Plants

- Alberta's coal and gas powered plants emitted 53 MT (million tonnes) CO2e equating to 19% of total GHG emissions in Alberta of 274 MT in 2014.



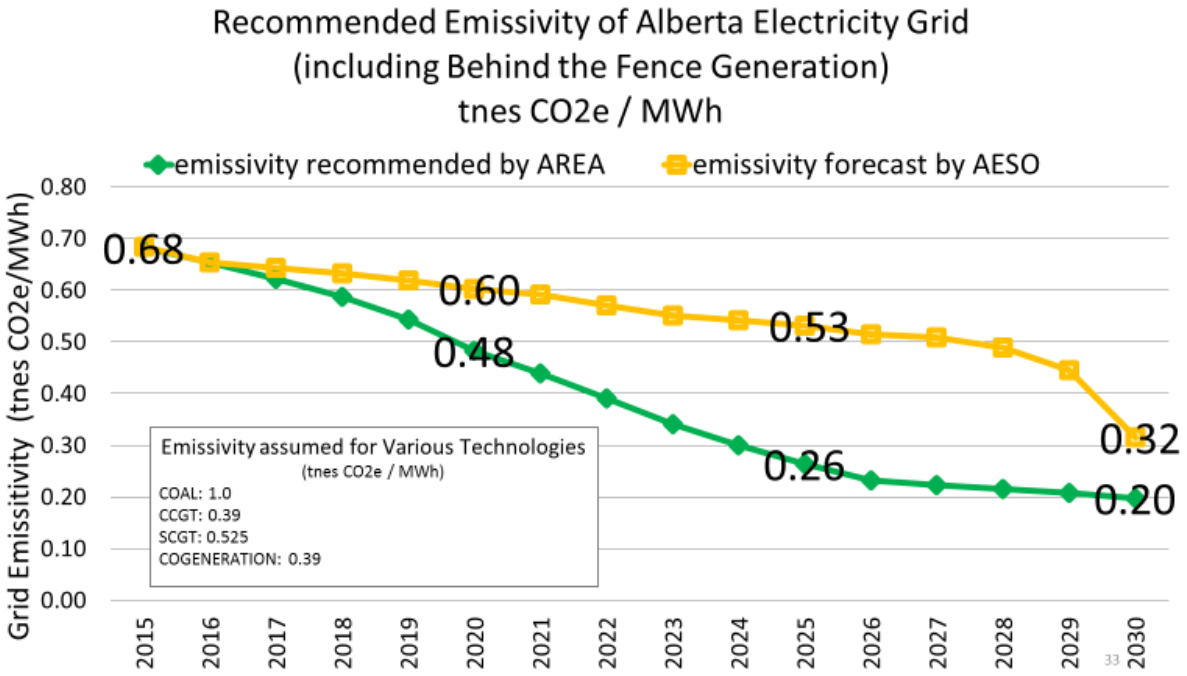
- Under AESO's May, 2016 Long Term Outlook (2), if coal plants are operated until Dec. 2029, and 30% renewable *capacity* is installed, cumulative GHG emissions from coal and gas power generation will amount to 734 MT between 2016 to 2030.
- If 40-year-old coal power units are progressively shuttered by 2025, and 50% renewable *generation* is deployed across Alberta by 2030, GHG emissions will total 501 MT; thereby reducing cumulative emissions by 233 MT CO2e = 32% less than AESO's Reference Case.

Alberta should double Renewable Capacity by 2020



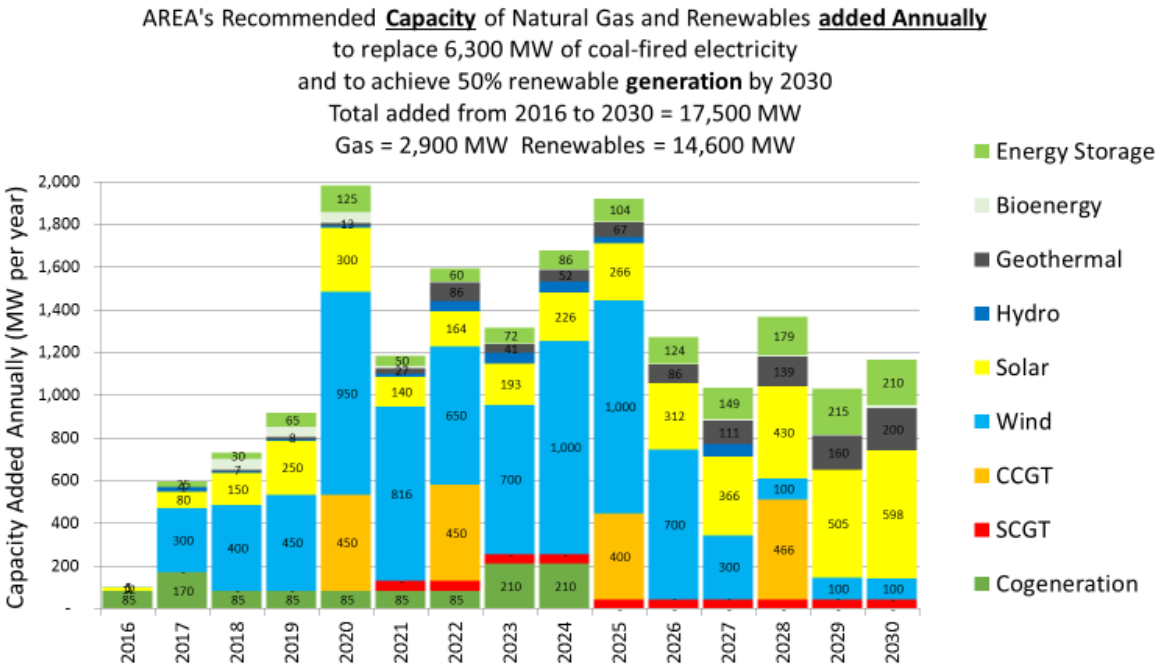
- As shown in the figure above, in 2015 Alberta had an installed renewable capacity of 2,900 MW of wind, hydro and bioenergy. This capacity represented 18% of total power capacity in Alberta.
- In 2015 those 2,900 MW of renewables produced 8,028 GWh of the total 81,621 GWh generated in Alberta, equating to 9.8% of total generation.
- By 2020, 20% of electricity generation should be produced from 3,500 MW of wind, 800 MW of solar, 944 MW of hydro, 30 MW of geothermal, 578 MW of bioenergy, and 200 MW of energy storage; this would essentially double the current renewable capacity to 6,052 MW, and immediately offer 17,000 new direct and indirect jobs.
- By 2030, 50% of electricity generation should be produced from roughly 17,400 MW of renewables.
- This action will significantly lower the emission intensity of the power grid to be more in line with the Canadian grid average.

Progressing to a Low Carbon Grid



- In 2015, the emissivity of the Alberta grid was 0.68 tne CO2e / MWh; this includes generation occurring BTH (behind the fence) such as cogeneration in the Oil Sands. This rate is significantly higher than the average emissivity of 0.15 tne CO2e / MWh of Canada's electricity grid. (3)
- AESO's May, 2016 Reference Case forecasts that coal power plants are to operate with 'useful' lives of 50 years, but close by December 2029; new gas power capacity is forecast to total 9,182 MW, and new renewable capacity is to total 4,241 MW in the year 2030.
- As shown in the above figure, AESO's forecast yields a much higher grid emissivity than the rate recommended by AREA.
- The faster reduction in emissivity forecast by AREA results from earlier coal unit closures, coupled with deeper penetration of renewable power by 2030.
- Earlier coal closure and higher deployment of renewable generation to 50% will save 233 MT of CO2e from being emitted to the atmosphere from 2016 to 2030.

Renewables and Natural Gas Power Plants can replace coal power

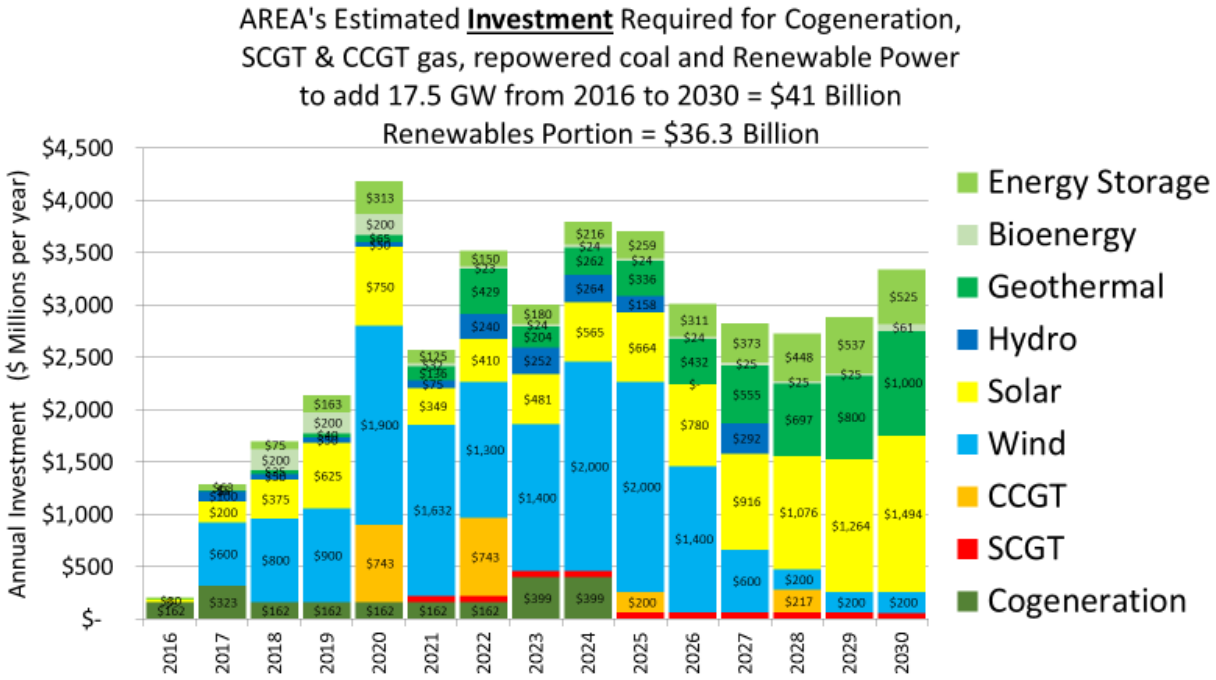


- As shown in the above figure, 6,300 MW of coal- fired electricity can be replaced by adding 2,900 MW of new natural gas fired cogeneration, SCGT (Simple Cycle Gas Turbines), CCGT (Combined Cycle Gas Turbines), repowered Genesee 3 and Keephills 3 coal units, and 14,600 MW of wind, solar, hydro, geothermal, bioenergy and energy storage.

- In years 2020 and 2025 major new construction should be completed to parallel the phasing out of nine coal units in 2020 and the remaining nine coal units in 2025.

- The two CCGT power plants shown as being deployed in 2025 and 2028 entail the repowering of Genesee 3 and Keephills 3 coal units with natural gas. Repowering may involve straight fuel switching from coal to natural gas or the possible integration of a gas turbine.

Alberta Offers a Significant Investment Opportunity



- As shown in the figure above, total investment from 2016 to 2030 in the order of $41 Billion will be required to build a combination of natural gas and renewable power plants.

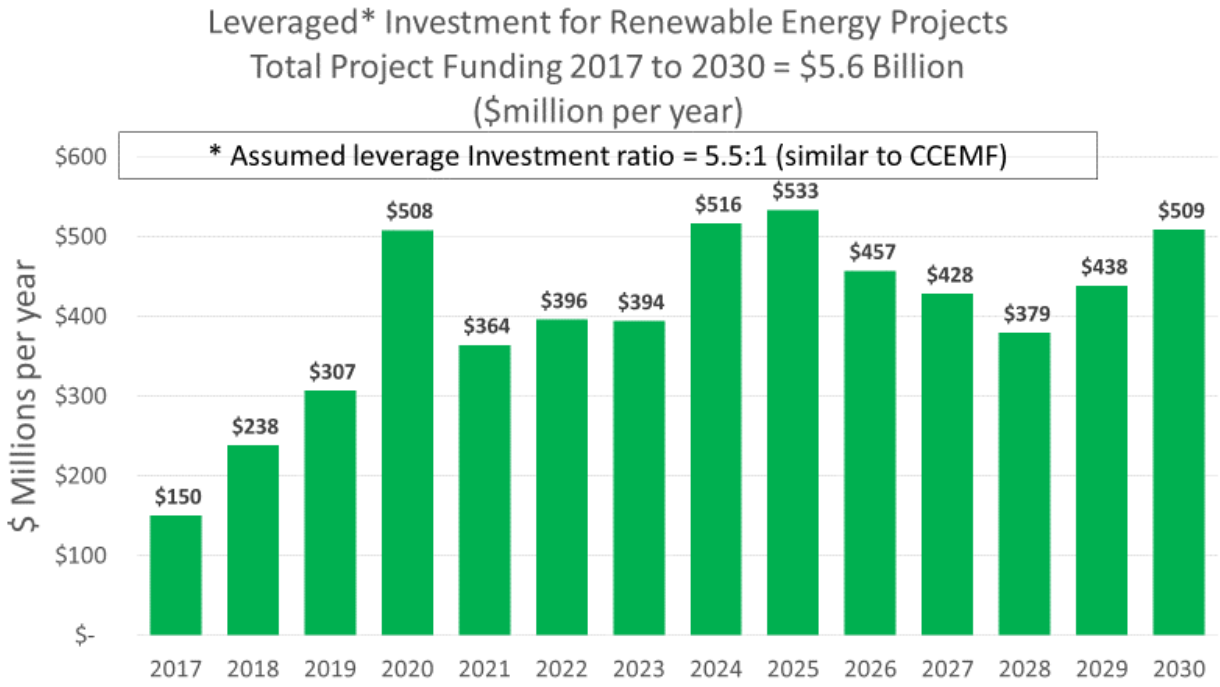
- Gas powered plants involving 2,900 MW of cogeneration, coal repowering, SCGTs and CCGTs are estimated to cost $4.7 Billion which equates to a unit cost of $1.6 Million per MW.

- The mix of 14,600 MW of various renewable energy systems are estimated to cost $36.3 Billion which equates to $2.5 Million per MW. While the unit CapEx cost of the renewable energy is higher than the unit CapEx of gas powered generation, two factors will significantly alter the LCOE (Levelized Cost of Energy) of gas power soon:

    - the price of natural gas will assuredly rise from its current low price; and

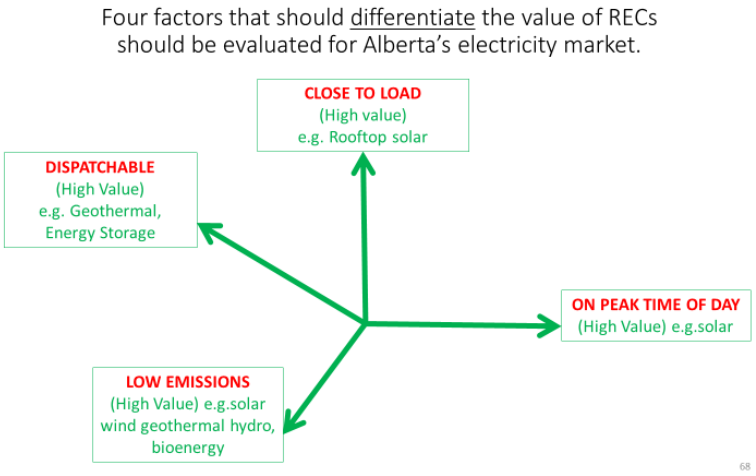
    - the November 2016 Federal announcement that carbon emissions will be taxed at $10.00 per tonne CO2e commencing in 2018, and rising by $10.00 annually until 2022 when the tax will be $50.00 per tne.

Leveraged Investment for Renewable Energy



- In the short term (over the next decade) investment in renewables will require leverage to foster the new energy sector in Alberta.
- As shown in the figure above, the historical leverage investment ratio of 5.5:1 that was established by the CCEMC (Climate Change and Emissions Management Corporation / now renamed as ERA Emissions Reduction Alberta) was applied to future renewable energy projects (4).
- Approximately $5.6 Billion could be appropriated from future carbon levies to leverage the $36.3 Billion CapEx that is estimated will be required to deploy 14.6 GW of renewable power over the next 14 years.

Incentives for Different Renewable Technologies



- As shown in the figure above, there should be differentiation between RECs (Renewable Energy Certificates) depending on four factors:
    - Proximity to Load – higher premiums for RECs should be given to technologies which are close to electrical load; e.g. rooftop solar photovoltaic is virtually at the point of load whereas hydro or wind may be distant from load and require a transmission line.
    - Ability to generate power during peak load hours – higher premiums should be given to technologies which generate electricity during peak demand; e.g. solar PV electricity produces power during the day when power demand is higher, and while air conditioning loads are working at maximum demand to provide cooling during the summer.
    - Zero-to-low emissions are emitted during generation – higher premiums should be given to technologies that emit few pollutants; biomass and geothermal technologies are not entirely emission free despite being categorized as renewable.
    - Ability to be dispatched upon demand – higher premiums should be given to technologies such as hydro, geothermal, or energy storage that can rapidly respond to load; wind and solar are variable and hence may not be available to generate power always.
- AREA recommends that premiums should not exceed a term of ten years to mitigate the risk to government of locking in to Purchase Agreements that may negatively affect consumer electricity prices as renewable generation reaches grid parity. Premiums should be set to encourage investment that achieves positive cash flow within ten years and an IRR (Internal Rate of Return) of 5% to 8%.

Job Opportunities in a Burgeoning Energy Sector in Alberta

Renewable Energy **Job Opportunities*** in Alberta
2016 to 2030
(*applying IRENA metrics for direct & indirect jobs per MW)

RENEWABLE TECHNOLOGIES ADDED BY 2030	ADDED CAPACITY BY 2030 (MW)	CAPACITY FACTOR	UNIT COST ($ / kW)	INVESTENT OPPORTUNITY ($ MILLIONS)	*DIRECT & INDIRECT JOBS PER MW	FORECAST NEW DIRECT & INDIRECT JOBS
Solar	4,000	16%	$2,500	$ 10,000	12.2	48,846
Wind	7,500	33%	$2,000	$ 15,000	2.5	18,724
Small Hydro	300	35%	$5,000	$ 1,500	5.5	1,650
Bioenergy	250	60%	$4,000	$ 1,000	3.6	898
Geothermal	1,000	85%	$5,000	$ 5,000	12.1	12,121
Energy Storage	1,500	20%	$2,500	$ 3,750	6.0	9,000
TOTAL	**14,550**			**$ 36,250**		**91,239**

- As shown in the figure above, some 91,000 direct and indirect job opportunities will be made available as Alberta transitions to a new sustainable energy future. These estimates were formulated by using historical metrics from IRENA (International Renewable Energy Agency) (4).
- In comparison, job losses from the closure of the coal fleet in Alberta are estimated to involve approximately 1000 direct jobs and 2000 indirect and induced jobs for a total of roughly 3,000 jobs. These estimates were calculated by using the rationale from the ACCCE (American Coalition of Clean Coal Electricity) (6).

References:

(1) Alberta Utilities Commission (AUC) "Alberta's Electricity Generation – 2015"

(2) AESO (Alberta Electricity System Operator) "AESO 2016 Long Term Outlook WEB" (Figure 7, Page 17).

(3) Environment Canada. "NIR 2016 National Inventory Report GHG Sources and Sinks in Canada" (Part 3, Page 88).

(4) Climate Change and Emissions Management Corporation "CCEMC Annual Report 2014/2015" (page 4).

(5) International Renewable Energy Agency "IRENA RE Jobs Annual Review 2016" (Figure 1, Page 5)

(6) American Coalition of Clean Coal Electricity "Job Losses Due to Coal Plant Shutdowns, October 1, 2012".

ALBERTA RENEWABLE ENERGY ALLIANCE

VISION

AREA envisions an Alberta where power is supplied entirely by renewable and ecologically sound sources.

MISSION

AREA advances the deployment of renewable power through educational events, political advocacy, and support for installations.

http://www.abrenewableenergy.ca

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