

Greenhouse Gas Emissions

In 2017, we estimate that 29.9 million tonnes of GHGs with an intensity of 0.86 tonnes per MWh (2016-30.7 million tonnes of GHGs with an intensity of 0.83 tonnes per MWh) were emitted as a result of normal operating activities.⁽¹⁾ Our GHG emissions decreased in 2017, primarily as a result of lower emissions from our gas facilities. In 2017 our Mississauga plant was no longer operational and our Windsor plant transitioned to a peaking facility. In Australia, our diesel burn at Parkeston and Solomon Power Station significantly declined. Our coal GHG emissions were relatively flat overall. At our Centralia plant in Washington State production increased due to market demand, which increased our emissions from the facility by 1.4 million tonnes of CO₂e. This was offset by lower production and associated emissions (-1.6 million tonnes of CO₂e) from our Alberta coal fleet.

The following are our GHG emissions in million tonnes CO₂:

Year ended Dec. 31 (in million tonnes CO ₂)	2017	2016	2015
Coal	27.4	27.7	29.2
Gas and renewables	2.5	3.0	3.0
Total GHG emissions	29.9	30.7	32.2

Our total GHG emissions include both scope 1 and scope 2 emissions⁽²⁾. Scope 1 emissions in 2017 were estimated to be 29.7 million tonnes CO₂e. Scope 2 emissions were estimated to be 0.2 million tonnes CO₂e. We estimate our scope 3 emissions to be in the range of six million tonnes.

In 2017, TransAlta maintained its scoring on the Carbon Disclosure Project Climate Change investor request. Our overall score was a B, which places us as ahead of our peers when it comes to carbon disclosure, management, performance and leadership. We were also highlighted by the Chartered Professional Accountants of Canada ("CPA Canada") as the only company in Canada, out of 75 companies, that reports on climate change across all levels of disclosure: the Annual Information Form, this MD&A, and our information circular. Our 2016 Integrated Report was selected as a finalist for CPA Canada's Award of Excellence in Corporate Reporting – of note, our Climate Change disclosure was highlighted as "outstanding" by CPA Canada Judges.

Climate Change

We believe in open and transparent reporting on climate change. Our climate change reporting is guided by the Financial Stability Board Task Force on Climate Related Financial Disclosures recommendations. The following highlights our management of climate change related impacts. For more detailed information, please visit our Climate Disclosure webpage: <https://www.transalta.com/sustainability/climate-change-action-and-strategy/>

(1) 2017 data are estimates based on best available data at the time of report production. GHGs include water vapour, CO₂, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons, and perfluorocarbons. The majority of our estimated GHG emissions are comprised of CO₂ emissions from stationary combustion. Emissions intensity data has been aligned with the "Setting Organizational Boundaries: Operational Control" methodology set out in The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard. As per the methodology, TransAlta reports emissions on an operation control basis, which means that we report 100 per cent of emissions at facilities in which we are the operator. Emissions intensity is calculated by dividing total operational emissions by 100 per cent of production (MWh) from operated facilities, regardless of financial ownership.

(2) The GHG Protocol Corporate Standard classifies a company's GHG emissions into three 'scopes'. Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.

Climate change related risks are monitored through our Corporation-wide risk management processes and actively managed. Identified climate change risks and opportunities are also reviewed by our management team. We apply regionally specific carbon pricing, both current and anticipated, as a mechanism to manage future risks pertaining to uncertainty in the carbon market and as a safeguard to anticipate future impacts of regulatory changes on our facilities. It is also a method of modelling for future electricity prices and analyzing the viability of acquisitions. Identified climate change risks or opportunities and carbon pricing are recognized in the annual TransAlta long-and-medium range forecasting processes. Regulatory risk/compliance (coal electricity generation), physical risks (hydro and drought/floods) and monetary opportunities (gas and renewable electricity generation) are the main drivers of integration into business strategy.

Aligned with our business strategy is our climate change strategy, which is implemented and managed on a corporate-wide business unit level, consisting of four main areas of focus:

- energy-efficiency improvements;
- development of emissions offset portfolios to achieve emissions reductions at competitive costs;
- development of clean combustion technologies; and
- growth of our renewables portfolio as an increasing component of our total generation portfolio.

We seek investment in climate change related mitigation solutions where we can maximize value creation for our shareholders, local communities, and the environment. Conversion of our large coal fleet to gas-fired generation highlights this approach, which will allow us to run our assets longer than the federally mandated coal retirement schedule. Our goals for undertaking such anticipated actions are to enhance value for our shareholders, ensure low-cost and reliable power for Albertans, and reduce the environmental impact from coal-fired generation.

Our investment and growth in renewable energy is highlighted by our diverse portfolio of renewable energy generating assets. We currently operate over 2,200 MW of hydro, wind and solar power. We are the largest producer of wind power in Canada and the largest producer of hydro power in Alberta. Production from renewable energy in 2017 resulted in avoidance of over 3.1 million tonnes of CO_{2e}, which is equivalent to removing over 660,000 vehicles from North American roads over the same year. For further details on governance and risk, see the Governance and Risk Management section of this MD&A.

Climate change related risks are monitored through our Corporation-wide risk management processes and actively managed. Identified climate change risks and opportunities are identified at the business unit level and through corporate functions (government relations, regulatory, emissions trading, and sustainability). Risks and opportunities are reviewed by our management team quarterly and reported to the Governance Environment and Safety Committee ("GESC") of the Board and the Audit and Risk Committee of the Board, as applicable.

Risk or opportunity	Management approach
Policy requirements	TransAlta supports smart regulation and carbon pricing that ensures economic growth and certainty for investment. We have also demonstrated co-operation and collaboration on climate-related policy, while ensuring we protect value for employees and shareholders. This is evidenced by our Off-Coal Agreement with the Alberta Government, totalling \$524 million and Memorandum of Understanding to convert coal plants to gas. Further climate-related policy updates can be found in the Regional Regulation and Compliance subsection of this MD&A
Carbon pricing	Our corporate function attributes regionally specific carbon pricing, both current and anticipated, as a mechanism to manage future risks pertaining to uncertainty in the carbon market and as a safeguard to anticipate future impacts of regulatory changes on facilities. This information is directed to the business unit level for further integration. Identified climate change risks or opportunities and carbon pricing are recognized in the annual TransAlta long-and-medium range forecasting processes. We capture economic profit from carbon markets through generation of renewable energy credits or offsets and via our emission trading function, which seeks to commoditize and profit from carbon trading.
New technology	We have demonstrated upside in growing renewable and gas power generation. From 2000 to 2017 we have grown renewable capacity from approximately 900 MW to over 2,200 MW. Our proposed Brazeau hydro expansion is an innovative energy storage project, which would involve a 900 MW expansion of the facility to operate as a pumped hydro facility.
Adaptation and mitigation	Our clean power strategy means that all new investment must meet clean standards in order to mitigate potential future risk related to carbon policy and pricing. Our target is for 100 per cent of net generation capacity to be from gas and renewables capacity by 2025. Our coal-to-gas conversion plan in Alberta is an adaptive measure to climate change related policy. Using existing infrastructure significantly reduces capital costs compared with new gas builds and also results in the avoidance of approximately \$15/MW in carbon related pricing (assuming a \$30 per tonne carbon price). Our new gas facility at South Hedland Power Station is built with adaptation in mind. The facility will operate with a best-in-class emission intensity, and the facility uses less water than traditional gas plants as we use dry cooling towers as opposed to the normal wet cooling towers (wet cooling tower have heavy water consumption). The plant is designed to withstand a category 5 cyclone, which can frequent the northwest region of Western Australia. Category 5 is the highest cyclone rating. Floods, which can occur in the area, have been mitigated by constructing the facility above the normal flood levels.
Water stress	Our thermal plants require water for operation. The majority of our thermal facilities are operated in low water stress environments. Our most water-stressed area of operation is at Sarnia; however, due to the nature of the operation, 98 per cent of water is recycled. The plant is a cogeneration facility. At all of our coal facilities we hold licences to pull water from low stressed areas. In Australia we purchase water for operations, and despite operating in remote locations, these areas are not currently water-stressed. Water purchasing will allow us to minimize local water stress if this becomes an issue. Our operating cost increase exposure due to water in Australia is low as our thermal operations are small.

Weather

Abnormal weather events can impact our operations and give rise to risks. In addition, normal year-over-year variations in wind, solar, water and temperatures give rise to various levels of volume risk depending on the input fuel of each facility; events outside the design parameters of our facilities give rise to equipment risk; and fluctuations in temperatures can cause commodity price risk through impact on customer demand for heating or cooling. Refer to the Governance and Risk Management section of this MD&A for further discussion of each risk and our related management strategy.

During the past five years, some deviations from expected weather patterns have negatively impacted our annual financial results:

- the southern Alberta flood of 2013 disrupted our hydro operations and caused us to invest in substantial repair work. Our losses have been largely covered through insurance;

- warm weather in Alberta in 2015 increased derates at our coal facilities due to its impact on the Sundance cooling ponds. These cooling ponds are susceptible to warm weather; however, we anticipate that decreased coal production and the retirement and mothballing of Sundance Units 1 and 2, respectively, in the medium term will reduce the stress from such occurrence; and
- our Alberta mine was susceptible to significant rain starting in August of 2016, which resulted in several weeks of flooding and impacted our coal deliveries. We focused on improving drainage infrastructure and using stockpiles to mitigate future risks.

Over the same period, other deviations have positively impacted our financial results, such as the cold temperatures in eastern North America in the winter of 2014 that caused market volatility and benefitted our Energy Marketing Group.

Adaptation

Our new South Hedland gas facility in Western Australia started commercial operation in 2017. The facility is built with adaptation in mind. The facility will operate with a best-in-class emission intensity for gas power generation and the facility uses less water than traditional gas plants as we use dry cooling towers as opposed to the normal wet cooling towers (wet cooling towers have heavy water consumption). The plant is designed to withstand a category 5 cyclone, which can frequent this region. Category 5 is the highest cyclone rating. The plant was also constructed above normal flood levels, as floods can occur in the area.

In 2017, our wind operations team developed and implemented a Blade Icing Mitigation program designed to reduce downtime of wind turbines during icing events. The program entails weather forecasting data, revised standard procedures and alarms for both active and forecasted icing conditions. Created for our wind farms in Ontario, Quebec and New Brunswick, this program allows our technicians to analyze the data before an icing event occurs and reduce the time during which the wind turbines are shut down, in turn increasing the generating time, revenue opportunity and safety of the wind turbines. Typically, we lose 40,000 MWh annually due to icing events. In 2017, we set a goal to reduce this by 5 per cent or \$0.25 million. In its first season, the program has saved over \$0.6 million. This program will be extremely valuable to ongoing operations of the wind turbines during the winter months.

Regional Regulation and Compliance

Carbon pricing and related legislation will continue to have an impact on our business. We are committed to complying with legislative and regulatory requirements and to minimizing the environmental impact of our operations. We work with governments and the public to develop appropriate frameworks to protect the environment and to promote sustainable development.

Recent changes to carbon regulations may materially adversely affect us. As indicated under "Risk Factors" in our Annual Information Form and within the Governance and Risk Management section of this MD&A, many of our activities and properties are subject to carbon requirements, as well as changes in our liabilities under these requirements, which may have a material adverse effect upon our consolidated financial results.

Canadian Federal Government

In November 2016, the Canadian federal government announced that coal-fired generation would be phased out by 2030, following a similar commitment by the Alberta provincial government in November 2015. These decisions changed the coal plant closure requirements, which had previously been guided by federal regulations that became effective on July 1, 2015, and that provided for up to 50 years of life for coal units. According to the new shutdown requirements, the Corporation's older coal units (which retire prior to 2030) will be guided by the 50-year life rule, while newer units (which were previously scheduled to retire post-2030) will face the new 2030 shutdown date. In November 2016, the Corporation signed an OCA with the Alberta government that confirmed the 2030 shutdown commitment for the impacted units.

On Nov. 21, 2016, the Canadian federal government announced that the Department of Environment and Climate Change will develop regulations for gas-fired generation. The announcement confirmed plans to include specific rules for coal-to-gas converted units, including a proposed 15-year life and a separate emissions intensity standard. The Canadian federal government conducted consultations on the proposed regulation in the first two quarters of 2017. Finalized regulations are currently expected by the end of 2018.

On Oct. 3, 2016, the Canadian federal government announced its intention to implement a national price on GHG emissions. Under this proposal, beginning in 2018, there would be a price of \$10 per tonne of carbon dioxide equivalent emitted, rising to \$50 per tonne by 2022, or a comparable reduction in GHGs under a cap-and-trade program. The application of the price would be co-ordinated with provincial jurisdictions. We are currently assessing how this price mechanism will affect our operations.

Alberta

On Nov. 22, 2015, the Government of Alberta announced, through the CLP, its intent to phase out emissions from coal-fired generation by 2030, replace two-thirds of the retiring coal-fired generation with renewable generation and impose a new carbon price of \$30 per tonne of CO₂ emissions based on an industry-wide performance standard. On March 16, 2016, the Government of Alberta announced the appointment of a Coal Phase-out Facilitator to work with coal-fired electricity generators, the AESO, and the Government of Alberta to develop options to phase out emissions from coal-fired generation by 2030. The Coal Phase-out Facilitator was tasked with presenting options to the Government of Alberta that would strive to maintain the reliability of Alberta's electricity grid, maintain stability of prices for consumers and avoid unnecessarily stranding capital.

In March 2016, Alberta began developing its renewable energy procurement process design for the AESO to procure a first block of renewable generation projects to be in-service by mid-2019. On Sept. 14, 2016, the Government of Alberta reconfirmed its commitment to achieve 30 per cent renewables in Alberta's electricity energy mix by 2030. On May 24, 2016, the Government of Alberta passed the *Climate Leadership Implementation Act* which establishes the carbon framework for its application to fuels. It was effective for the electricity sector on Jan. 1, 2018.

On Nov. 24, 2016, we announced that we had entered into the OCA, which provides for transition payments for the cessation of coal-fired emissions from the Keephills 3, Genesee 3 and Sheerness coal-fired plants on or before Dec. 31, 2030. The affected plants are not, however, precluded from generating electricity at any time by any method other than the combustion of coal. Under the terms of the OCA, the Corporation will receive annual cash payments of approximately \$37.4 million, net to the Corporation, commencing in 2017 and terminating in 2030. For further details, refer to the Highlights section of this MD&A.

Additionally, we announced that we had reached an understanding set out in the MOU to collaborate and co-operate with the Government of Alberta in the development of a policy framework to facilitate the conversion of coal-fired generation to gas-fired generation, to facilitate existing and new renewable electricity development through supportive and enabling policy, and to ensure existing generation and new electricity generation are able to effectively participate in the capacity market being developed for the Province of Alberta.

On Jan. 1, 2018, the Alberta government transitioned from Specified Gas Emitters Regulation ("SGER") to the Carbon Competitiveness Incentive Regulation ("CCIR"). Under the CCIR, the regulatory compliance moved from a facility-specific compliance standard to a product/sectoral performance compliance standard. The carbon price remains set at \$30/tCO₂e from 2018 to 2022 and will then follow the federal price increase to \$40/tCO₂e in 2021 and \$50/tCO₂e in 2022. The electricity sector performance standard was set at 0.37tCO₂e/MWh but will decline over time. All renewable assets that received crediting under the SGER will continue to receive credits under CCIR on a one-to-one basis. All other renewable assets that did not receive credits under SGER will now be able to opt into the CCIR and get carbon crediting up to the electricity sector performance standard in perpetuity. Once the wind projects crediting standard under SGER ends, these renewable projects will also be able to opt into the CCIR and receive crediting.

In Alberta there are additional requirements for coal-fired generation units to implement additional air emission controls for oxides of NO_x and SO₂ once the units reach the end of their respective PPAs, which in most cases is in 2020. These regulatory requirements were developed by the province in 2004 as a result of multi-stakeholder discussions under Alberta's Clean Air Strategic Alliance ("CASA"). The release of the federal regulations in 2012 adopted by the Government of Canada and the Government of Alberta, and the accelerated coal-fired generation retirement schedule, creates a potential misalignment between the CASA air pollutant requirements and schedules and the retirement schedules for the coal plants, which in themselves will result in significant reductions of NO_x, SO₂ and particulate emissions. This is something which has been identified as a matter yet to be addressed in the MOU.

The Government of Alberta's Renewable Electricity Program is intended to encourage the development of 5,000 MW of new renewable electricity capacity by 2030. The AESO solicited interest in the first competitive procurement for 400 MW in 2017. Eligible projects must be 5 MW or larger and can be hydro, wind, solar and certain biomass. The first competition utilized an indexed renewable energy credit or contract for difference mechanism that will fix the price to the proponent for over 20 years. Four successful projects were announced in December of 2017, for nearly 600 MW of wind generation at a weighted average bid price of \$37/MWh.

The Government of Alberta has tasked the AESO with transitioning Alberta's energy-only market to a capacity market structure. The capacity market will help to ensure that there is sufficient supply adequacy, as over 6,000 MW of coal generation retires by 2030. The new market structure is expected to reduce reliance on scarcity pricing, which drives energy price volatility and the price signal for new investment, and to compensate resource owners with monthly capacity payments for making their capacity available in the energy and ancillary services market. The AESO is currently engaging with stakeholders in determining the design and implementation of the capacity market. The AESO will begin formalizing the capacity market design and implementing it in the second half of 2018, with the first procurement expected in the second half of 2019, to be effective in 2021, with first capacity contracts awarded at that time.

Pacific Northwest

Our Centralia coal facility is located in Washington State. On Dec. 17, 2014, Washington State Governor Jay Inslee released a carbon-emissions reduction program for the state. Included in that program were a cap-and-trade plan and a low-carbon fuels standard, with the proposed emissions cap becoming more stringent over time, providing emitters time to transition their operations. A late-2017 Court of Appeals case found that the Governor's Clean Air Rule was beyond his authority to implement.

On Aug. 3, 2015, the US federal government announced the Clean Power Plan ("CPP"). The plan set out GHG emission standards for new fossil-fuel-based power plants and emission limits for individual states. States had the option of interpreting their limits in mass-based (tons) or rate-based (pounds per MWh) terms. The plan was intended to achieve an overall reduction in GHG emissions of 32 per cent from 2005 levels by 2030. On Feb. 9, 2016, the US Supreme Court stayed the implementation of the Clean Power Plan, pending consideration of whether the regulations are lawful. Currently, the Environmental Protection Agency ("EPA") is not expected to implement the CPP, although the EPA will still have an obligation to address climate change emissions. The EPA's new approach to addressing climate change has yet to be defined or consulted on. The US also provided notice of its intention to withdraw from the 2015 Paris Agreement.

TransAlta has agreed with Washington State to retire its two Centralia coal units in 2020 and 2025 respectively. This agreement is formally part of the State's climate change program. We currently believe that there will be no additional GHG regulatory burden on US Coal given these commitments. The related TransAlta Energy Transition Bill was signed into law in 2011 and provides a framework to transition from coal to other forms of generation in the State. We are currently evaluating a number of transition solutions.

Ontario

On Feb. 25, 2016, Ontario released draft regulations for its GHG cap-and-trade program that were finalized on May 19, 2016. The regulations became effective Jan. 1, 2017, and will apply to all fossil fuels used for electricity generation. The majority of our gas-fired generation in Ontario will not be significantly impacted by virtue of change-in-law provisions within existing PPAs.

Australia

In March 2017, state elections were held in Western Australia and a change of government took place. The new Labor government announced a road map for electricity initiatives. The reform program focuses on three pillars of work: improving access to Western Power's network, improving reserve capacity and pricing signals, and improving access to, and operation of, the Pilbara electricity network.

Coal Transition

Our coal transition, whether it is executing on our coal-to-gas conversion plans or completing a full phase-out by 2030, is expected to vastly improve our environmental performance. Energy use, GHG, air emissions, waste generation and water usage is expected to significantly decline. A conversion of coal-fired power generation to gas-fired generation is expected to eliminate all mercury emissions and the majority of nitrogen oxide emissions.