

## 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 from the retirement 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 2016, which resulted in several weeks of flooding and threatened our coal deliveries. We focused on improving drainage infrastructure and using stockpiles to mitigate future risks.

## Climate Change

We believe in open and transparent reporting on climate change. Our climate change reporting is structured as per guidance from the Financial Stability Board's Task Force on Climate-Related Financial Disclosures ("TCFD") recommendations. The following highlights our management, performance and leadership of climate change related impacts. For more detailed information, please visit our Climate Change Management webpage: <https://www.transalta.com/sustainability/climate-change-management/>

### Governance

The highest level of oversight on climate change related business impacts is at our Board level, specifically by our Governance Safety and Sustainability Committee ("GSSC") of the Board and the Audit and Risk Committee ("ARC") of the Board. Business impacts related to climate change are assessed by our executive team quarterly and reported to the Board GSSC and ARC, as applicable.

### Strategy

Our corporate vision is to be a leading clean power company by 2025. To support this vision our strategic goals include growth in renewable energy and gas, while reducing a significant amount of emissions from our coal fleet by way of coal-to-gas conversions and coal retirements.

Our corporate goal is to reduce our GHG emissions by 19.7 million tonnes by 2030 compared to 2015 levels, while we grow renewable energy and gas. Our modeling shows that our target aligns us, under many scenarios, with science-based target setting, which highlights the resilience of our business to 2 degrees of global warming. We have not officially validated a science-based target, but continue to monitor and model our future performance with the Sectoral Decarbonization Approach from the Science Based Target Initiative.

Aligned with our corporate strategy, our business units or operations consistently seek energy-efficiency improvements, development of emissions offset portfolios to achieve emissions reductions at competitive costs, and development of clean combustion technologies.

We seek investment in climate change related mitigation solutions, such as renewable energy development, 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 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 one of the largest producers of wind power in Canada and the largest producer of hydro power in Alberta. Production from renewable energy in 2018 resulted in avoidance of approximately 2.9 million tonnes of CO<sub>2</sub>e, which is equivalent to removing over 620,000 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.

### Risk Management

Risks and opportunities are identified at the business unit level and through corporate functions (government relations, regulatory, emissions trading and sustainability). Furthermore, risks and opportunities are monitored through our Corporation-wide risk management processes and actively managed on a priority basis. As noted above risks and opportunities are reviewed by our executive team quarterly and reported to the Board GSSC and ARC, as applicable.

The following highlights identified climate change risk or opportunities, which have been assessed and integrated into business operations.

Risk or opportunity	Management approach
<b>Policy requirements</b>	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 MOU 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
<b>Carbon pricing</b>	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.
<b>New technology</b>	We have demonstrated upside in growing renewables and gas-powered generation. From 2000 to 2018 we have grown renewables capacity from approximately 900 MW to over 2,200 MW. We have recently announced development of three wind projects, totaling over 330 MW of future capacity.
<b>Adaptation and mitigation</b>	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 towers 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.
<b>Water stress</b>	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.

### Greenhouse Gas Emissions

In 2018, we estimate that 20.8 million tonnes of GHGs with an intensity of 0.77 tonnes per MWh (2017-29.9 million tonnes of GHGs with an intensity of 0.86 tonnes per MWh) were emitted as a result of normal operating activities. Our significant reduction in GHG emissions is the result of coal closures and reduced coal power generation from our Sundance facility in Alberta and increased co-firing with gas at our merchant coal facilities. Notably, our 2018 emissions reductions, supported achieving our 2021 target to reduce GHG emissions by 30 per cent over 2015 levels of 32.2 million tonnes CO<sub>2</sub>e. This target was achieved well ahead of schedule and supports our clean power transition.

Our 2018 data are estimates based on best available data at the time of report production. GHGs include water vapour, CO<sub>2</sub>, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons. The majority of our estimated GHG emissions are comprised of CO<sub>2</sub> 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* developed by the World Resources Institute and the World Business Council for Sustainable Development. 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.

The following are our GHG emissions in million tonnes CO<sub>2</sub>:

Year ended Dec. 31	2018	2017	2016
Coal	18.3	27.4	27.7
Gas and renewables	2.4	2.5	3.0
<b>Total GHG emissions</b>	<b>20.8</b>	<b>29.9</b>	<b>30.7</b>

Our total GHG emissions include both scope 1 and scope 2 emissions. 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. Scope 1 emissions in 2018 were estimated to be 20.6 million tonnes CO<sub>2</sub>e. Scope 2 emissions were estimated to be 0.2 million tonnes CO<sub>2</sub>e. We estimate our scope 3 emissions to be in the range of six million tonnes.

Future performance on GHG emissions will reduce as we retire or convert coal plants to gas and grow our renewable energy and gas fleet, while optimizing our existing fleet. Our target is to reduce 60 per cent or 19.7 million tonnes of GHG emissions by 2030 over 2015 levels, which is line with UN Sustainable Development Goal ("SDG") Goal 13, Climate Action. Since 2015 we have reduced 9.1 million tonnes, which represents a reduction of 35 per cent.

The following highlights our longer-term track record on GHG emission reductions since 2005 and our projected emissions in 2030.

Year ended Dec. 31	2030	2018	2005
<b>Total GHG emissions</b>	<b>12.5</b>	<b>20.8</b>	<b>41.9</b>

In 2018, 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. In 2017 we were 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.

#### *Regional Regulation and Compliance*

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

Future changes to carbon regulations could 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 and other environmental 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*

On June 21, 2018, the *Greenhouse Gas Pollution Pricing Act* (GGPPA) was passed. Under this Act, the Canadian federal government implemented a national price on GHG emissions. The price will begin at \$20 per tonne of CO<sub>2</sub>e for emissions in 2019, rising by \$10 per year, until reaching \$50 per tonne in 2022.

On Jan. 1, 2019, the GGPPA's "backstop" mechanisms came into effect for large emitters in jurisdictions that did not have an independent carbon pricing program or where the existing program was not deemed equivalent to the federal system - Ontario, Manitoba, New Brunswick, Saskatchewan, Prince Edward Island, Yukon and Nunavut. The backstop mechanism has two components: a carbon levy for small emitters and regulation for large emitters called the Output-Based Pricing System (OBPS). The carbon levy sets a carbon price per tonne of GHG emissions related to transportation fuels, heating fuels and other small emission sources.

The OBPS is an intensity-based standard where large emitters must meet an industry specific emission intensity performance standard per unit of production. A large emitter's emission intensity per unit of product must meet their

industry's OBPS intensity performance standard. If the facility's emission intensity is below or above the performance standard, the facility will generate carbon credits or carbon obligations equal to the difference between the industry's emission intensity performance standard and the regulated facility's emission intensity.

#### Federal Gas Regulation

On Dec. 18, 2018, the federal government published the *Regulations Limiting Carbon Dioxide Emissions from Natural Gas-fired Generation of Electricity*. Under the regulation, new and significantly modified natural-gas-fired electricity facilities with a capacity greater than 150 MWs must meet a standard of 420 tCO<sub>2</sub>e per gigawatt hour (tCO<sub>2</sub>e/GWh) to operate. Units with a capacity of between 25 MW and 150 MW must meet a standard of 550 tCO<sub>2</sub>e/GWh.

The rules for converted units will allow the plants to operate for a set number of years following the end-of-life for the unit under the coal regulations based on a one-time performance test at the time of conversion. For our units, these rules are expected to provide 8 or 10 additional years of operating life to each of our units.

#### Federal Coal Regulation

On Dec. 18, 2018, amendments to the *Reduction of Carbon Dioxide Emissions from Coal-Fired Generation of Electricity Regulations* came into force under the *Canadian Environmental Protection Act, 1999*. The amended regulations will require coal units to meet an emission level of 420 tCO<sub>2</sub>e/GWh by the earlier of end-of-life under the 2012 regulations or Dec. 31, 2029.

#### Alberta

On November 22, 2015, the Government of Alberta announced the Alberta Climate Leadership Plan. The government has now largely delivered on its commitments through legislation to require:

- the elimination of coal generation by 2030;
- the creation of the Renewable Energy Program (REP) to meet the commitment that renewables account for 30 per cent of Alberta's electricity system by 2030. Under the REP, the system operator, the AESO, is tasked with running procurement processes for government approved volumes of renewable power. To date, the AESO has run three separate Requests for Proposals (RFP). The RFPs have resulted in 20-year contracts for approximately 1,360 MWs of wind power projects. These projects are scheduled to be grid integrated between 2019 and 2021;
- the *Carbon Competitiveness Incentive Regulation* (CCIR) replaces the previous large emitters regulation, *Specified Gas Emitters Regulation* (SGER), moving from a facility-specific compliance standard to a product or sector performance compliance standard; and
- a carbon levy was introduced on most carbon emissions not covered by the CCIR.

On Jan. 1, 2018, the Alberta government transitioned from the SGER to the CCIR. Under the CCIR, the regulatory compliance moved from a facility-specific compliance standard to a product or sector performance compliance standard. Currently, the provincial government has announced that the carbon price will remain at \$30/tCO<sub>2</sub>e going forward and will not increase to the federally mandated price increase of \$40/tCO<sub>2</sub>e in 2021 and \$50/tCO<sub>2</sub>e in 2022; however, increases may be implemented by the federal government under their program equivalency review. The electricity sector performance standard was set at 370 tCO<sub>2</sub>e/GWh 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 renewables that did not receive credits under the previous standards will now be able to opt in to the CCIR and get carbon crediting up to the electricity sector performance standard in perpetuity. Once wind projects' crediting under SGER protocol ends, these projects will also be able to opt in to the CCIR system and be credited up to the performance standard for the rest of their operational life.

#### British Columbia

Beginning April 1, 2018, BC increased its carbon tax rate to \$35/tCO<sub>2</sub>e and committed to raise the price \$5 per year until it reaches \$50 per tonne in 2021.

BC Hydro has indicated there will be no additional contracts for independent power producer renewable projects with capacity above 15 MW. It has also suspended the purchase of energy from its Standing Offer Program for small projects up to 15 MW pending a review of the program.

#### Ontario

On Oct. 31, 2018, the Ontario government passed the *Cap and Trade Cancellation Act*. This Act removed all existing provincial carbon emission regulations and costs on large emitters.

The Canadian federal *Greenhouse Gas Pollution Pricing Act* requires provinces to have GHG gas regulations and prices in place that align with the federal GGPPA. On Oct. 23, the federal government announced that the federal program would be implemented in Ontario as of Jan. 1, 2019. Small emitters will face a carbon levy and large emitters, under covered industries, with annual GHG emission greater than 50,000 tCO<sub>2</sub>e will be subject to the OBPS. Ontario is now subject to the federal government's backstop carbon levy price for small emitters and the OBPS for large emitters.

On Nov. 29th, 2018, the Ontario government unveiled a new climate change policy called *Preserving and Protecting our Environment for Future Generations: A Made-In-Ontario Environment Plan*. The plan aims to keep the province working toward meeting the emissions-reduction goal of achieving 30 per cent reduction of 2005 levels by 2030. The plan commits to developing emission performance standards to achieve reductions from large emitters and references Saskatchewan's OBPS as an example. The government has indicated that it will be consulting and developing the program in 2019. The plan's specifics related to the electricity sector have not yet been defined and are expected to be determined through the program development process.

#### *Australia*

On Dec. 13, 2014, the Australian government enacted legislation to implement the Emissions Reduction Fund (the "ERF"). The AUD 2.55 billion ERF is the centrepiece of the Australian government's policy and provides a policy framework to cut emissions by five per cent below 2000 levels by 2020 and 26 to 28 per cent below 2005 emissions by 2030.

The ERF's safeguard mechanism, commencing from July 1, 2016, is designed to ensure emissions reductions purchased by the Australian government through the ERF are not displaced by significant increases in emissions elsewhere in the economy. The ERF and its safeguard mechanism provide incentives to reduce emissions across the Australian economy.

The Australian government has also committed to develop a National Energy Productivity Plan with a target to improve Australia's energy productivity by 40 per cent between 2015 and 2030. The ERF is not expected to have a material impact on our Australian assets as a result of the Australian assets being primarily composed of gas-fired generation.

In addition, on June 23, 2015, the federal Australian government also reformed the Renewable Energy Target ("RET") scheme. The RET should add at least 33,000 gigawatt-hours (GWh) of renewable sources by 2020. This would double the amount of large-scale renewable energy being delivered compared to current levels and result in approximately 23.5 per cent of Australia's electricity generation being sourced from renewable projects.

#### *Pacific Northwest*

In 2010, the Washington Governor's office and Ecology negotiated agreements with TransAlta related to the operation of Centralia's two coal power electricity generating units. TransAlta agreed to retire its two Centralia coal units - one in 2020 and the other in 2025. 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 of Washington.