

Progressive Environmental Stewardship: Natural Capital Management

We continue to increase financial value from natural or environmental capital-related business activities, while minimizing our environmental footprint and potential risk factors related to environmental impacts. Comparable EBITDA from renewable energy generation in 2020 was \$353 million (2019 - \$341 million). Our revenue in 2020 from environmental attribute sales was \$25 million (2019 - \$28 million). In addition, in 2020 the sale of coal byproducts and waste-related recycling generated financial value in the range of \$15 million to \$20 million. This is lower than our range reported in 2019 of \$25 million to \$35 million due to our ongoing transition away from coal-fired generation.

The following are key trends in our natural capital:

Year ended Dec. 31	2020	2019	2018
Renewable energy comparable EBITDA	353	341	342
Environmental attribute sales revenue	25	28	22
GHG emissions (million tonnes CO ₂ e)	16.4	20.6	20.8

Environmental Strategy

All energy sources used to generate electricity have some impact on the environment. While we are pursuing a business strategy that includes investing in renewable energy resources such as wind, hydro and solar, we also believe that natural gas will continue to play an important role in meeting energy needs as part of a clean electricity transition. Natural gas provides low-emission baseload and peaking generation to support system demands and intermittent renewable generation. TransAlta operates simple and combined-cycle natural gas units and cogeneration facilities. Since 2002, we have retired over 2,000 MW of coal and converted approximately 420 MW of coal to gas. Our conversion to gas transition is ongoing, and we plan to convert or repower Alberta coal units to natural gas in the 2020 to 2023 timeframe while retiring our Washington State coal facility by the end of 2025. In 2026, our generation mix will be made up of natural gas and renewable energy only.

Regardless of the fuel type, we place significant importance on environmental compliance and continued environmental impact mitigation, while seeking to deliver low-cost and reliable electricity. The Corporation strives to be environmentally responsible and recognizes that the competitive pressures for economic growth and cost efficiency must be integrated with sound sustainability management, including environmental stewardship.

We are subject to environmental laws and regulations that affect aspects of our operations, including air emissions, water quality, wastewater discharges and the generation, transport and disposal of waste and hazardous substances. The Corporation's activities have the potential to damage natural habitat, impact vegetation and wildlife, or cause contamination to land or water that may require remediation under applicable laws and regulations. These laws and regulations require us to obtain and comply with a variety of environmental registrations, licenses, permits and other approvals. The environmental regulations in the jurisdictions in which we operate are robust. Both public officials and private individuals may seek to enforce environmental laws and regulations against the Corporation. We interact with a number of regulators on an ongoing basis, including but not limited to: Alberta Environment and Parks; Ministry of the Environment, Conservation and Parks in Ontario; Ministry of Natural Resources and Forestry in Ontario; Ministry of Forest Lands, Natural Resource Operations and Rural Development in British Columbia; Environment and Climate Change Canada; Fisheries and Oceans Canada; Michigan Department of Environment, Great Lakes, and Energy; Southwest Clean Air Agency in Washington; Washington State Department of Ecology; Washington State Department of Health; US Environmental Protection Agency (EPA); and the Department of Agriculture, Water and the Environment in Australia; and the Clean Energy Regulator in Australia.

Currently, the most material natural or environmental capital impacts to our business are GHG emissions, air emissions (pollutants, metals) and energy use. Other material impacts that we manage and track performance on via our environmental management systems include land use, water use and waste management.

Environmental Governance

The GSSC assists the Board in fulfilling its oversight responsibilities with respect to the Corporation's monitoring of environmental, health and safety regulations, public policy changes, the establishment and adherence to environmental, health and safety practices, procedures and policies in response to legal/regulatory and industry compliance or best practices. The importance of environmental protection is outlined under our Total Safety Management Policy as a corporate responsibility for TransAlta, and the personal responsibility of each employee and contractor working on TransAlta's behalf. This policy is approved by our President and Chief Executive Officer ("CEO").

For more details on governance, please refer to the Governance and Risk Management section of this MD&A.

Environmental Management Systems

All of our 75 facilities have Environmental Management Systems ("EMS") in place, the majority of which closely align with the internationally recognized ISO 14001 EMS standard. We have operated our facilities in line with ISO 14001 for over 20 years, and our systems and knowledge of management systems are therefore mature. Only two facilities do not have ISO 14001 aligned EMS in place, although these facilities do have a comparable EMS in place. This is due to commercial arrangements (TransAlta is not the operator of those two sites). Aligning with ISO 14001 provides assurance that our systems are designed to continuously improve performance.

Environmental Performance

Reducing the environmental impact of our activities benefits not only our operations and financial results, but also the communities in which we operate. We have a proactive approach to minimizing environmental risks and we anticipate this strategy will benefit our competitive position as stakeholders and society place an increasing emphasis on successful environmental management.

Renewable Energy and Battery Storage

Since 2005, we have added over 1,500 MW in renewable electricity capacity. We operate over 900 MW of hydro energy and our experience with hydro operations spans over 109 years. We were an early adopter of wind energy and today operate 1,500 MW of wind power. In 2015, we made our first solar investment in a 21 MW solar facility in Massachusetts, and we continue to look for opportunities to develop and operate solar energy. In 2020, we commissioned the first utility-scale battery storage project in Alberta, located at our Summerview II wind facility. The project uses Tesla battery technology and has a capacity of 10 MW.

Our production from renewable electricity in 2020 offset the equivalent of approximately 2.9 million tonnes of CO₂e, or the removal of approximately 630,000 cars from North American roads. The estimated GHG offset is calculated using production data (MWh) from each renewable facility multiplied by the regional (provincial or state) grid emissions intensity. This supports our customers in achieving their renewable energy procurement and/or GHG emissions reduction goals. For more details on the types of environmental attributes we generate for customers, please refer to the Customers section of this MD&A.

Natural Gas

Natural gas plays an important role in the electricity sector, providing low-emission baseload and peaking generation to support system demands and intermittent renewable generation as part of a clean electricity transition. TransAlta operates simple-cycle, combined-cycle, and cogeneration facilities in Canada, the US and Australia. Natural gas facilities provide highly efficient electricity and, in the case of cogeneration, steam production, directly for customers and for the wholesale markets. TransAlta is a significant operator of natural gas electricity in Canada and Australia. We have started converting or repowering Alberta coal units to natural gas. We continue to see a role for natural gas in the future to support system demands and increasing demand for power from customers.

Coal Transition

Our conversion to gas transition plan in Alberta is expected to significantly reduce our environmental footprint. As a result of our coal retirements, conversion to gas and repowerings, our energy use, GHG emissions, air emissions, waste generation and water usage will significantly decline. Transitioning off coal will eliminate all of our mercury emissions, the majority of particulate matter and sulphur dioxide emissions ("SO₂"), as well as significantly reduce our NO_x emissions. The coal retirements eliminate significant GHGs, and the conversion of our Alberta coal facilities to natural gas reduces GHG emissions by 40-60 per cent and supports system reliability, affordability and the growth of renewable electricity in Alberta. Our converted or repowered facilities will also use lower carbon natural gas, compared to facilities in other jurisdictions, as new methane reduction regulations in Alberta and Canada will reduce GHGs in the production and processing phase with respect to flaring and venting of methane (fugitive GHG emissions).

In 2020, TransAlta announced plans to fast-track away from coal mining and coal-fired power generation in Canada by the end of 2021. At our Centralia coal facility in Washington State, one unit was retired in 2020 and the second unit will retire by the end of 2025. In 2022, our coal capacity will be 670 MW, a significant reduction from coal capacity of approximately 5,000 MW in 2015. Coal will be entirely eliminated from our operations by the end of 2025.

Energy Use

TransAlta uses energy in a number of different ways. We burn gas, diesel and coal (to the end of 2021 in Canada and the end of 2025 at Centralia) to generate electricity. We harness the kinetic energy of water and wind to generate electricity. We also generate electricity from the sun. In addition to combustion of fuel sources, we also track combustion of gasoline or diesel in our vehicles and the electricity use and fuel use for heating (such as natural gas) in the buildings we occupy. Knowledge of how much energy we use allows us to optimize and create energy efficiencies. As an electricity generator, we continually and consistently look for ways to optimize and create efficiencies related to the use of energy. For example, in 2019, we supported a study conducted by Stanford University to understand how to improve wind production. The research showed that angling turbines slightly away from the wind can boost energy produced and even out variable supply.

The following table captures our energy use (millions of gigajoules). Energy use declined by 19 per cent in 2020 over 2019, primarily as a result of reduced coal use. Minor revisions were made to our energy use data in 2020 as a result of accrual adjustments from 2019 and 2018. Historical 2019 total energy use was revised from 345 million gigajoules to 346 million gigajoules as a result of these changes. Due to rounding, there was no impact to our reported 2018 total.

Year ended Dec. 31	2020	2019	2018
Hydro	—	—	—
Wind & Solar	—	—	—
North American Gas	30	30	28
Australia Gas	21	20	20
Alberta Thermal	135	168	203
Centralia	93	128	107
Corporate and Energy Marketing	—	—	—
Total energy use (million gigajoules)	279	346	358

Air Emissions

Our coal facilities emit air emissions that we track, analyze and report to regulatory bodies. We also work on mitigation solutions depending on the type of air emission. We report our major air emissions from coal, which includes NO_x, SO₂, particulate matter and mercury. We will continue reducing air emissions in our existing fleet through our conversion and retirement of coal units in Alberta and Washington State. In 2020, we accelerated our target of 95 per cent SO₂ and 50 per cent NO_x emission reductions over 2005 levels by moving the target date from 2030 to 2026. In addition, we increased the stringency of our reduction levels for NO_x to 80 per cent. Since 2005, we have reduced SO₂ emissions by 83 per cent and NO_x by 68 per cent. We continue to capture 80 per cent of mercury emissions at our coal facilities and, by the end of 2025, mercury emissions will be eliminated following the conversions to gas, Sundance Unit 5 repowering and the retirement of the Centralia facility. Particulate matter and SO₂ emissions will also be virtually eliminated or considered negligible.

None of our Alberta coal facilities are located within 50 kilometres of dense or urban populations, but our Centralia thermal facility in Washington State is 40 kilometres from a dense or urban population. As per guidance from SASB, "a facility is considered to be located near an area of dense population if it is located within 49 kilometres of an area of dense population" (being deemed to be a "minimum population of 50,000 persons"). The Centralia thermal facility has two units and we retired one unit in 2020 and will retire the additional unit by the end of 2025, at which time air emissions from our coal facilities will be eliminated.

Our gas facilities emit low levels of NO_x that trigger reporting obligations to national regulatory bodies. These gas facilities also produce trace amounts of SO₂ and particulate matter, but at levels that are deemed negligible and do not trigger any reporting requirements or compliance issues. Many of our gas facilities are located in very remote and unpopulated regions, away from dense urban areas. Our Sarnia, Windsor, Ottawa and Fort Saskatchewan gas facilities are our only facilities with air emissions within 49 kilometres of dense or urban environments.

Our total air emissions in 2020 decreased compared with 2019 levels. Specifically, NO_x was reduced 19 per cent, particulate matter was reduced 36 per cent and SO₂ was reduced 26 per cent over 2019 levels. Mercury emissions also decreased by 12 per cent over 2019 levels (which is not reflected in the table below due to rounding). Reductions in emissions were largely due to an increase in co-firing (gas and coal) at our Alberta thermal facilities and a reduction in production from our Centralia coal facility. Historical NO_x incurred minor revisions in 2020 to include NO_x emissions from our Highvale mine. The revision increased 2018 NO_x from 28,000 to 29,000 tonnes. There was no change to reported 2019 tonnes as the revision was minor and, with rounding, the volume remains consistent.

The following table represents our material air emissions. Figures have been rounded to the nearest one thousand with the exception of mercury, which are rounded to the nearest ten as totals are considerably lower:

Year ended Dec. 31	2020	2019	2018
Sulphur dioxide (tonnes)	12,000	16,000	19,000
Nitrogen oxides (tonnes)	21,000	26,000	29,000
Particulate matter (tonnes)	5,000	8,000	8,000
Mercury (kilograms)	60	60	70

Water

Our principal water use is for cooling and steam generation in our coal and gas facilities but our hydro operations also require water flow for operations. Water for coal and gas operations is withdrawn primarily from rivers where we hold permits to withdraw water and must adhere to regulations on the quality of discharged water. The difference between withdrawal and discharge, representing consumption, is due to several factors, which include evaporation loss and steam production for customers. Typically, TransAlta withdraws in the range of 220-240 million m³ of water across our fleet. In 2020, we withdrew approximately 240 million m³ (2019 - 260 million m³) and returned approximately 200 million m³ (2019 - 220 million m³) or 85 per cent. Overall, water consumption was approximately 40 million m³ (2019 - 40 million m³). Water withdrawal and consumption was lower in 2020 primarily due to decreased production from our Alberta thermal and Centralia thermal facilities.

Centralia 2019 water data were revised in 2020 as a result of identified discrepancies, which resulted in overreported raw water intake or water withdrawal for sustainability reporting. The issue was specific to 2019 data only. Water from our Centralia facility is also reported to the Department of Ecology ("DOE") in Washington State. There were no issues with our data submitted to the DOE, as the information generated for sustainability reporting followed a separate data collection process. As a result, Centralia 2019 water withdrawal was revised from approximately 52 million m³ to 26 million m³. The Centralia business unit has performed a full review of its water reporting process and our corporate function will review its internal assurance process to support avoidance of any future reoccurrence of this event.

Our 2019 company-wide water withdrawal, total water consumption and water intensity were also revised as a result of this change. Overall water withdrawal reduced from approximately 290 million m³ to 260 million m³ (result of rounding), total water consumption reduced from 70 million m³ to 40 million m³ (result of rounding) and our company-wide water intensity reduced from 2.48 m³/MWh to 1.55 m³/MWh.

In 2020, we established a new water consumption reduction target to reduce fleet-wide water consumption (withdrawals minus discharge) by 20 million m³ or 40 per cent in 2026 over a 2015 baseline. Water consumption in 2015 was 45 million m³. This target is in line with the UN's Sustainable Development Goals ("SDGs"), specifically "Goal 6: Clean Water and Sanitation." Our water consumption will fluctuate somewhat over the period of 2020-2025 as we transition off coal, convert and repower gas facilities and ramp production upwards.

The following represents our total water consumption (million m³) over the last three years. Figures below have been rounded to the nearest 10 million m³:

Year ended Dec. 31	2020	2019	2018
Water withdrawal	240	260	250
Water discharge	200	220	210
Total water consumption (million m³)	40	40	40

Our largest water withdrawal and discharge occurs at our Sarnia gas cogeneration facility (which produces both electricity and steam for our customer). The facility operates as a once-through, non-contact cooling system for our steam turbines. Despite large withdrawals from the adjacent St. Clair River to support our Sarnia operations, we return approximately 93 per cent of the water withdrawn. Water from this source is currently at "low risk" as per analysis from the SASB-endorsed Aqueduct Water Risk Atlas tool.

The Aqueduct Water Risk Atlas tool highlights that water risk is high at our interior and southern Western Australia facilities due to high interannual variability in the region. Interannual variability refers to wider variations in regional water supply from year to year. Our water supply at these facilities is provided at no cost under PPAs with our mining customers, hence our risk is significantly mitigated. In addition, our customers have developed conservation and re-use strategies aimed at recycling water for mining operational needs. All water used in the region is sourced from scheme water, and with respect to gas and diesel turbine water use, water wash techniques and frequency of activities are continually modified to minimize consumption and environmental impact. Water used in our operations is returned to our customers, who repurpose this water for vegetation and dust suppression in their mining operations.

At the South Hedland facility in Western Australia, water risk is also high due to the risk of flooding in the region. The South Hedland facility was built above normal flood levels to mitigate potential risk from flooding. During a category 4 cyclone event in the area and associated flooding in the region in 2019, the South Hedland facility stayed dry and continued to generate power for the region. In addition, the South Hedland facility has developed a Water Efficiency Management Plan with Water Corporation WA, the principal supplier of water, wastewater and drainage services in Western Australia. Initiatives are aimed at reducing water consumption and costs through innovative technology and efficiencies identified through facility management.

In southern Alberta, our hydroelectric facilities have played an increasingly important water management role following the flood of 2013. In 2016, we signed a five-year agreement with the Government of Alberta to manage water on the Bow River at our Ghost Reservoir facility to aid in potential flood mitigation efforts, as well as at our Kananaskis Lakes System (which includes Interlakes, Pocaterra and Barrier) for drought mitigation efforts.

Waste

The importance of environmental protection and managing waste is outlined in our Total Safety Management Policy as a corporate responsibility for TransAlta, and a responsibility of each employee and contractor working on TransAlta's behalf. Our waste data is reported annually to a number of different regulatory bodies.

In 2020, our operations generated approximately 1.1 million tonnes equivalent of waste (2019 - 1.5 million tonnes). Of total waste generated, 98 per cent was non-hazardous waste and two per cent was hazardous waste. In 2020, only 0.1 per cent of total waste generated was directed to landfill. From the remaining 99.9 per cent, 45 per cent was returned to the mine (ash from coal combustion), 47 per cent was reused or sold to third parties, three per cent was recycled and five per cent was stored.

In 2020, we established a new waste reduction target that by 2022 TransAlta will reduce total waste generation by 80 per cent over a 2019 baseline of 1.5 million tonnes equivalent of waste generation. This is in line with the UN's SDGs, specifically, "Goal 12: Responsible Consumption and Production."

Our reuse waste or byproduct waste is generally sold to third parties. Byproduct sales and associated annual revenue generation typically ranges from \$15 million to \$20 million. Our operating teams are diligent at not only minimizing waste, but also maximizing recoverable value from waste. We have invested in equipment to capture byproducts from the combustion of coal, such as fly ash, bottom ash, gypsum and cenospheres, for subsequent sale. These non-hazardous materials add value to products like cement and asphalt, wallboard, paints and plastics.

Given our transition off coal, we will no longer produce fly ash waste in Canada past the end of 2021 and past the end of 2025 in the US. The Corporation is looking at recovering fly ash that was returned to its original source at Highvale mine to replace this supply, which is used extensively in the concrete industry. By turning the recovered product into something marketable, it will continue to aid in reducing the amount of cement produced and consequent emissions while offering new job and economic growth opportunities. This innovative technology contributes to a circular economy and will reduce reclamation liabilities for TransAlta.

Biodiversity

The importance of environmental protection and biodiversity is outlined in our Total Safety Management Policy as a corporate responsibility for TransAlta, and a responsibility of each employee and contractor working on TransAlta's behalf. We consider the biodiversity impact at all of our existing operations (with greater focus being given to mining operations) and the biodiversity impacts of all new growth projects are evaluated in line with regulatory compliance and with respect to TransAlta's focus on biodiversity, which is to support biodiversity health.

Growth

Each new TransAlta development project must complete an in-depth environmental assessment (as prescribed by the local regulation and in line with our own assessment practices) describing baseline environmental conditions, identifying potential effects and developing mitigation for identified environmental sensitivities prior to construction and operation. These assessments have been specifically designed to meet the environmental information requirements of the respective regions in which we operate while identifying alignment with the intent of the standards and/or regulations applicable to these jurisdictions (e.g., Wildlife Directive for Alberta Wind Energy Projects, US Fish & Wildlife Service Land-Based Wind Energy Guidelines, etc.). Typically, our renewable projects are greenfield development projects that require a higher level of evaluation compared to a number of our gas projects, which integrate into existing industrial facilities.

In addition, TransAlta provides a detailed wildlife mitigation plan to environmental regulators outlining specific measures that will be employed to mitigate the effects that project construction and operation activities may have on wildlife, wildlife habitat and specific wildlife features identified during environmental studies completed during the development stage.

Each greenfield development project has a detailed stakeholder consultation plan designed to ensure all potentially impacted host landowners, stakeholders, agencies, businesses, non-governmental organizations ("NGOs"), environmental NGOs and Indigenous communities understand the nature of the projects, have multiple and varied opportunities for engagement and feedback, and are able to engage in meaningful dialogue and discussion with TransAlta and its representatives. The ultimate goal is addressing, solving and mitigating stakeholder or Indigenous community biodiversity concerns before filing major permit applications for all of our projects.

Day-to-Day Operations

At our Alberta thermal operations, we have a Wildlife Monitoring Program designed to monitor wildlife abundance and species diversity in the study area over time. Based on these surveys, TransAlta has seen primarily stable or increasing biodiversity in the area, with various new bird species being detected over the years and incidents of vehicle collisions decreasing due to lower speed limit restrictions. Some animal population sizes fluctuate in the area based on weather conditions and available ground cover.

Our natural gas operations have a relatively limited impact on biodiversity. The facilities are frequently constructed adjacent to existing industrial operations, and TransAlta may not always be the holder of the environmental permits. The land area these facilities occupy is also generally relatively small. One exception is our Sarnia cogeneration facility. This facility is made up of 260 acres of brownfield industrial land, some of which contains areas with tall grasses and potential wildlife. Care will be taken at the time of redevelopment of this land to minimize impact to species at risk through the completion of species-at-risk surveys as well as performing certain construction activities outside of nesting periods. For all sites that are under our environmental scope, we adhere to all relevant environmental compliance permits.

At our hydro facilities, a major focus is on reducing the impact on fish and fish habitat. We adhere to provincial and federal regulations and operate in accordance to facility approvals. We continue to work towards operational improvement and regularly review our Environmental Operational Management Plans to ensure our operating parameters are met.

At our wind and solar operations, the business unit has established the WiSPER (Wind Stewardship Planning and Environmental Reporting) Program. The goal of the program is to provide continuous improvement and ongoing environmental monitoring programs beyond TransAlta's regulatory requirements. This is achieved through periodic audit and inspection programs, and through collaboration with industry and the scientific community to address environmental concerns and impacts. An Operational Environmental Management Plan has been developed for each renewable asset to ensure that our facilities use environmentally sound and responsible practices that are based on a philosophy of continuous improvement of environmental protection through a program of inspection, monitoring and review.

Examples of WiSPER initiatives to support our biodiversity focus include our Avian Protection Program (installation of covers to protect birds from possible electrocution), a bird and bat mortality database (records all injuries and mortalities), environmentally sensitive resource monitoring (monitoring sensitive wildlife features in and around our operating wind facilities such as raptor nests and sharp-tailed grouse leks), long-term dataset collections (e.g., wildlife studies pre-construction and post-construction) and community wind education programs.

For further details on our environmental strategy, please refer to the Environmental Incidents and Spills discussion and the Land Use discussion of this MD&A.

Land Use

The largest land use associated with our operations is for surface mining of coal. Of the three mines we have operated, the Whitewood mine in Alberta is completely reclaimed and the land certification process is ongoing. Our Centralia mine in Washington State is currently in the reclamation phase and we have adopted a target to fully reclaim this mine by 2040.

Our Highvale mine in Alberta is actively mined with certain sections undergoing reclamation. The Highvale mine will close at the end of 2021 as part of discontinuing coal-fired power generation in Canada at the end of 2021. In 2020, our reclamation team updated our mine reclamation plans. The updated plans align with community priorities for the reclaimed land. These reclamation plans were submitted to the regulator and we are seeking approval on these plans. The regulator timeline for approval can be anywhere from one to three years. Our reclamation plans at Highvale are set out on a life-cycle basis and include contouring disturbed areas, re-establishing drainage, replacing topsoil and subsoil, re-vegetation and land management. Our mining practice incorporates progressive reclamation where the final end use of the land is considered at all stages of planning and development. Associated with our plans, we have recently announced a target to have the Highvale mine fully reclaimed by 2046.

In 2020, the Centralia mine planted 81,000 Douglas Fir trees on land that was reclaimed in previous years. However, further reclamation work at our Centralia was paused in 2020 due to the COVID-19 pandemic. At our Highvale mine, approximately 25 acres (10 hectares) were reclaimed in 2020.

Across our mining operations, to date we have reclaimed approximately 12,000 acres (4,800 hectares), which is approximately 38 per cent of land disturbed. Since 1991, we have planted approximately 2.5 million trees as part of this reclamation work.

Incidents and Spills

Protecting and minimizing our impact on the environment supports healthy ecosystems and mitigates our environmental compliance risk and reputational risk. We maintain procedures for environmental incidents similar to our safety practices, with tracking, analyzing and active management to minimize occurrences. With respect to biodiversity management (management of ecosystems, natural habitats and life in the areas we operate) we seek to establish robust environmental research and data collection to establish scientifically sound baselines of the natural environment around our facilities to ensure we can accurately evaluate the level of significance to biodiversity following an incident. We closely monitor the air, land, water and wildlife in these areas to identify and curtail potential impacts.

In 2020, environmental incidents were separated into two categories: significant environmental incidents and regulatory non-compliance environmental incidents. We define regulatory non-compliance environmental incidents as events involving a non-compliance event that did not have an impact on the environment. For example, a technical issue with a computer system for gathering real-time data could cause us to be out of compliance with local regulation or our EMS, but there is no direct consequence for the physical environment. All other events are captured as significant environmental incidents if there is some level of impact to the environment. In 2020, we recorded six significant environmental incidents (2019 - three incidents). Our six significant environmental incidents (all bird and bat strikes – further details below) will not cause any long-term impacts on the environment and the associated ecosystem and did not trigger any enforcement action. The Corporation is working to ensure our classification is accurate as a true significant environmental incident is one that causes harm to the environment and poses a long-term impact on a local ecosystem. In 2020 we note that we did not experience an incident with such an impact. We recorded two regulatory non-compliance environmental incidents in 2020 (2019 – six incidents). Both of these incidents occurred at our Sarnia facility and were related to an exceedance of discharge from our sumps during water treatment. Both incidents had negligible environmental impact.

Our six significant environmental incidents in 2020 occurred at our Summerview (Alberta), Antrim (New Hampshire) and Big Level (Pennsylvania) wind facilities. Four New Hampshire state-listed bat carcasses were found during the post-construction biological survey in Antrim (three little brown bats and one eastern small-footed bat). One Pennsylvania state-listed bird (yellow-bellied flycatcher) was found during the post-construction biological survey at Big Level. A ferruginous hawk, a listed species in Alberta, was found during an ongoing inspection during normal operation. In each

case, root cause analysis investigations were performed, and we found no causal factors or root causes related to human behaviour or equipment failure being involved in the incidents. For all incidents, we collaborated with authorities and there were no enforcement actions with respect to the mortalities. Despite inconclusive findings, smart bat curtailment optimization is contemplated in Antrim and the biological monitoring studies continues at relevant sites.

Significant environmental incidents by business segment follow:

Year ended Dec. 31	2020	2019	2018
Hydro	—	—	—
Wind & Solar	6	3	—
North American Gas	—	—	—
Australia Gas	—	—	—
Alberta Thermal	—	—	1
Centralia	—	—	—
Corporate and Energy Marketing	—	—	—
Total significant environmental incidents	6	3	1

Regulatory non-compliance environmental incidents by business segment follow:

Year ended Dec. 31	2020	2019	2018
Hydro	—	—	—
Wind & Solar	—	1	—
North American Gas	2	2	2
Australia Gas	—	—	—
Alberta Thermal	—	2	2
Centralia	—	1	2
Corporate and Energy Marketing	—	—	—
Total regulatory non-compliance environmental incidents	2	6	6

Some examples of mitigation measures TransAlta has taken include:

- Installation of artificial nest platforms to increase breeding opportunities for endangered ferruginous hawks in southern Alberta;
- Installation of bluebird nest boxes to increase breeding habitat for this sensitive species found at some of our southern Alberta wind facilities;
- Bobolink Management Plan at the Wolfe Island wind facility – creation of 50 acres of breeding habitat for bobolink (a sensitive bird species in Ontario) to offset the potential impacts of the Wolfe Island wind facility on this species; and
- Implementing operational bat curtailment at the Antrim, Big Level, Summerview and Kent Breeze wind facilities during the fall bat migration period (July to September) to reduce bat mortality at these sites by increasing the cut-in speed.

For 2021, we are removing our target for environmental incidents. This is because we do not tend to experience environmental incidents that have a large or lasting impact on the environment and an ecosystem, and we believe it is prudent to instead focus on other environmental areas that are more material for the Corporation. This will not change our internal focus on mitigation of environmental incidents. We continue to track and manage all environmental incidents, including all non-reportable (minor) environmental incidents, which helps us identify what causes an incident. Understanding the root cause of incidents helps with incident prevention planning and education.

Regarding spills and releases, typical spills that could occur at our operation sites are hydrocarbon-based. Spills generally happen in low environmental impact areas and are almost always contained and fully recovered. It is extremely rare for large spills to occur. Efforts are placed on providing a quick response to all spills to ensure assessment, containment and recovery of spilled materials result in minimal risk to the environment.

There is a potential that ash ponds associated with our coal facilities could fail. The probability of this occurring is low, but the impact could be significant. We follow applicable environmental regulations with respect to our ash ponds and satisfy ourselves that management is adequate given the robust regulations in the jurisdictions where we operate. Management includes periodic inspections and appropriate mitigation if issues are uncovered. An inspection in 2020 noted cracks in one of our ponds. In response, a restoration plan was developed to fix the issue. The total cost of mitigation was \$1 million.

The estimated volume of spills in 2020 was 4 m³ (2019 - 530 m³). Spill volumes in 2019 were higher due to a 527 m³ spill at our Sarnia cogeneration facility. This was not a traditional product spill and was a wastewater effluent limit exceedance from a sump. There was no enforcement action associated with this spill.

Weather

Abnormal weather events can impact our operations and give rise to risks. Due to the nature of our business, our earnings are sensitive to weather variations from period to period. Variations in winter weather affect the demand for electrical heating requirements. Variations in summer weather affect the demand for electrical cooling requirements. These variations in demand translate into spot market price volatility. Variations in precipitation also affect water supplies, which in turn affect our hydroelectric assets. Also, variations in sunlight conditions can have an effect on energy production levels from our solar facility. Variations in weather may be impacted by climate change resulting in sustained higher temperatures and rising sea levels, which could have an impact on our generating assets. Ice can accumulate on wind turbine blades in the winter months. The accumulation of ice on wind turbine blades depends on a number of factors, including temperature and ambient humidity. Accumulated ice can have a significant impact on energy yields and could result in the wind turbine experiencing more downtime. Extreme cold temperatures can also impact the ability of wind turbines to operate effectively and this could result in more downtime and reduced production. In addition, climate change could result in increased variability to our water and wind resources.

Our generation facilities and their operations are exposed to potential damage and partial or complete loss resulting from environmental disasters (e.g., floods, high winds, fires and earthquakes), equipment failures and other events beyond our control. Climate change can increase the frequency and severity of these extreme weather events. The occurrence of a significant event that disrupts the operation or ability of the generation facilities to produce or sell power for an extended period, including events that preclude existing customers from purchasing electricity, could have a material adverse effect. Our generation facilities could be exposed to effects of severe weather conditions, natural or man-made disasters and other potentially catastrophic events such as a major accident or incident at our sites. In certain cases, there is the potential that some events may not excuse us from performing our obligations pursuant to agreements with third parties. The fact that several of our generation facilities are located in remote areas may make access for repair of damage difficult. Please refer to the Governance and Risk Management section of this MD&A for further discussion on weather-related risks.

During the past three years, we have experienced no significant impacts to annual financial results due to deviations from expected weather patterns.