2019 Oct 19 Meetup

AESO 2019 LONG TERM OUTLOOK

How ‘Clean’ will Alberta’s grid be in 2039?

Presenter: Ken Hogg M.Eng., P. Eng.

Founder: Alberta Renewable Energy Alliance

OUTLINE

- Historical GHG emissions in Canada and Alberta
- AESOs (Alberta Electric System Operator) 2019 LTO (Long Term Outlook) to 2039
- AESOs Reference Case Assumptions regarding Generation Mix
- AREAs (Alberta Renewable Energy Alliance) Recommendations to increase deployment of renewable generation
- Impact of AESO versus AREA recommendations related to GHG emissions

Environment and Climate Change Canada | Environnement et Changement climatique Canada

2019 NATIONAL INVENTORY REPORT 1990–2017: GREENHOUSE GAS SOURCES AND SINKS IN CANADA

CANADA'S SUBMISSION TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

PART 1

Canada

Environment and Climate Change Canada / Environnement et Changement climatique Canada

2019 National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada

Canada's Submission to the United Nations Framework Convention on Climate Change

Part 3

Canada

Figure ES–2 **Breakdown of Canada's Emissions by IPCC Sector (2017)***

Total: 716 Mt CO_2 eq

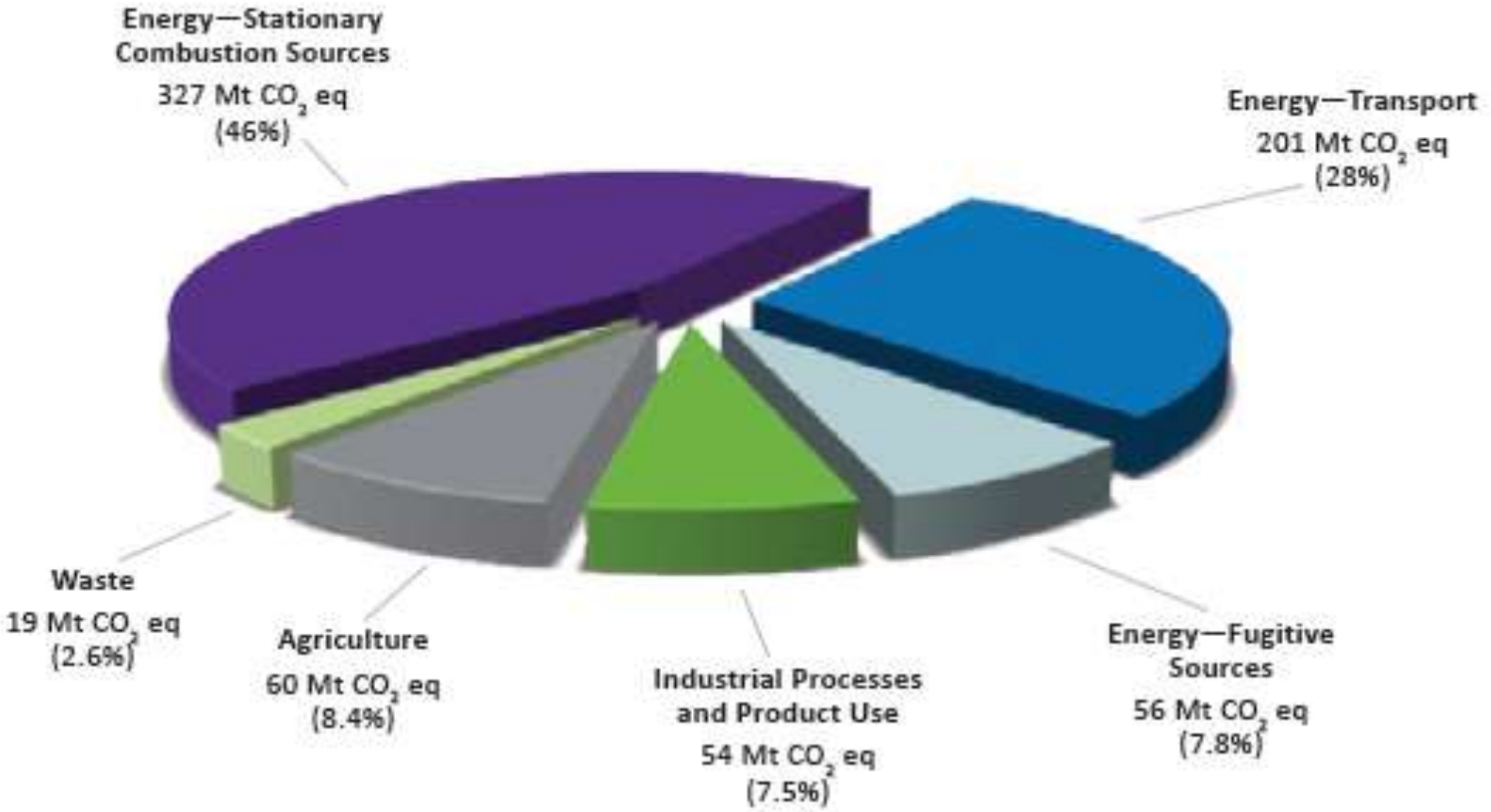


Figure ES–7 **Breakdown of Canada's Emissions by Economic Sector (2017)**

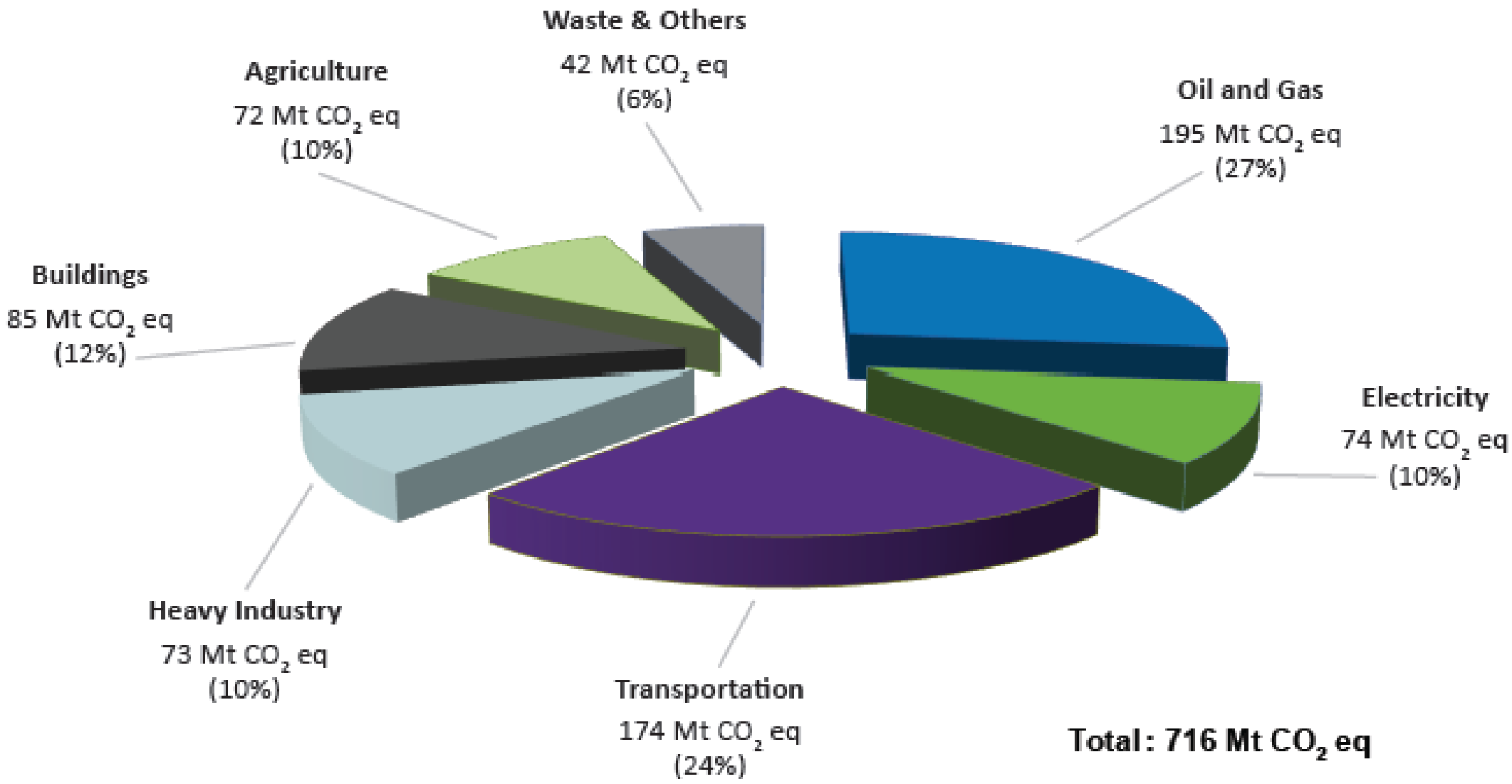
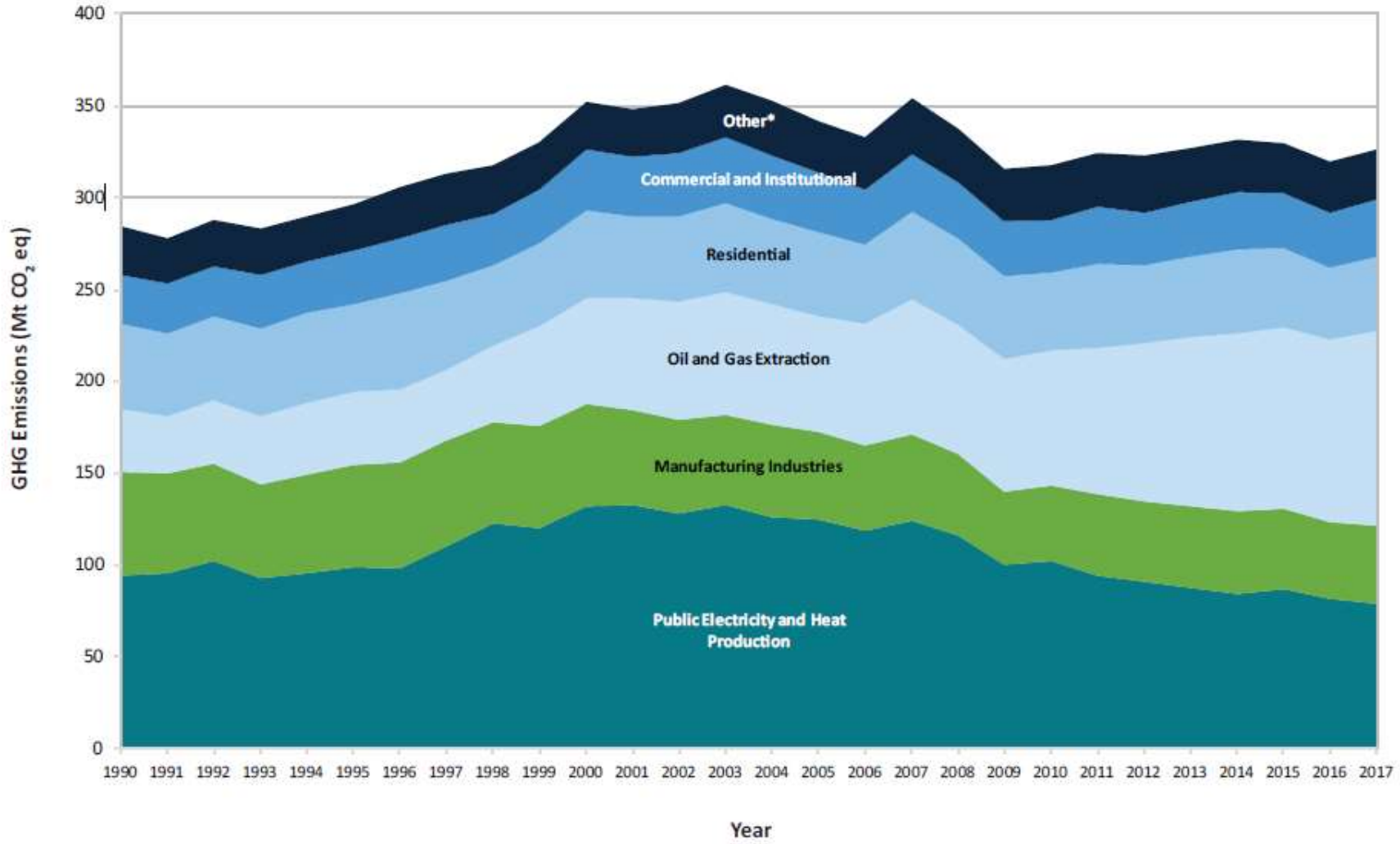


Figure 2–7 **Trends in Canadian GHG Emissions from Stationary Combustion Sources (1990–2017)**



*Other includes Petroleum Refining, Construction, Mining and Agriculture and Forestry

Figure 2–13 **Trends in Canadian GHG Emissions from Transport (1990–2017)**

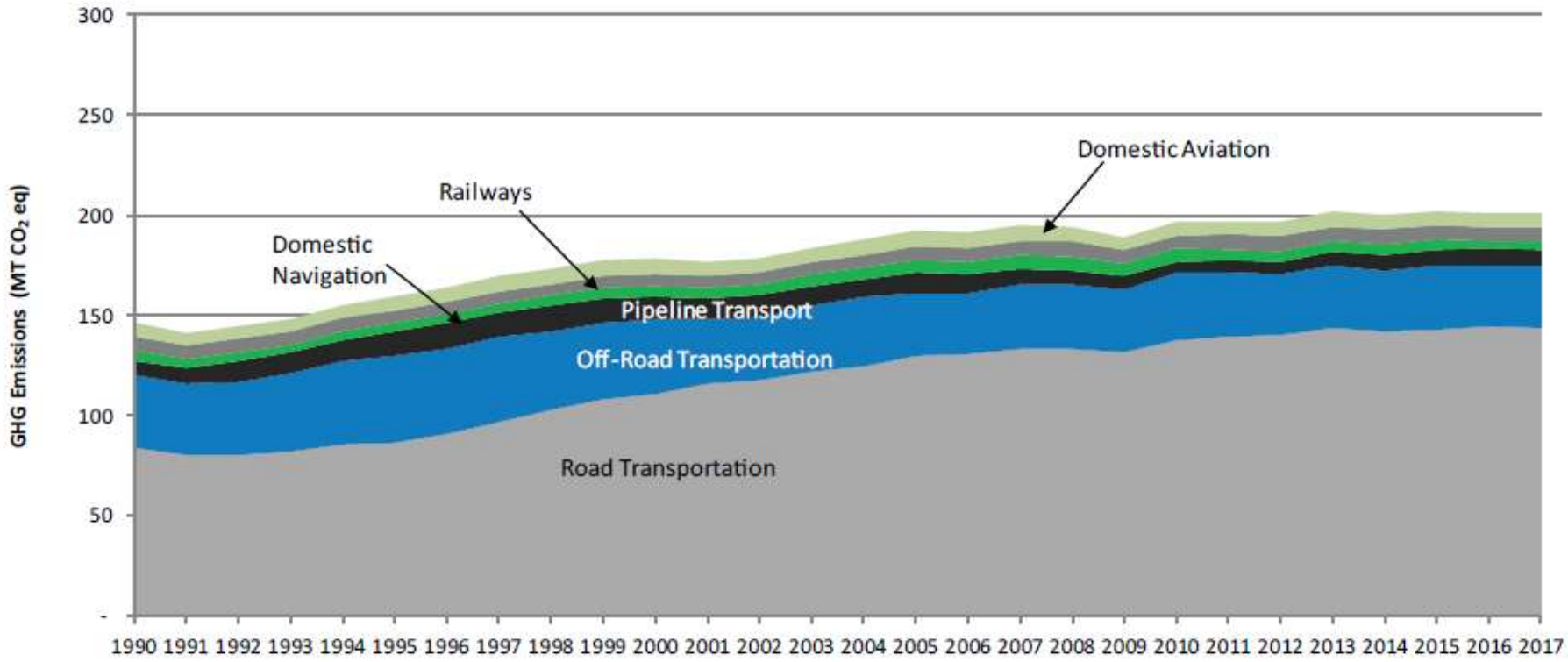


Figure 2–16 **Trends in Canadian GHG Emissions from Fugitive Sources (1990–2017)**

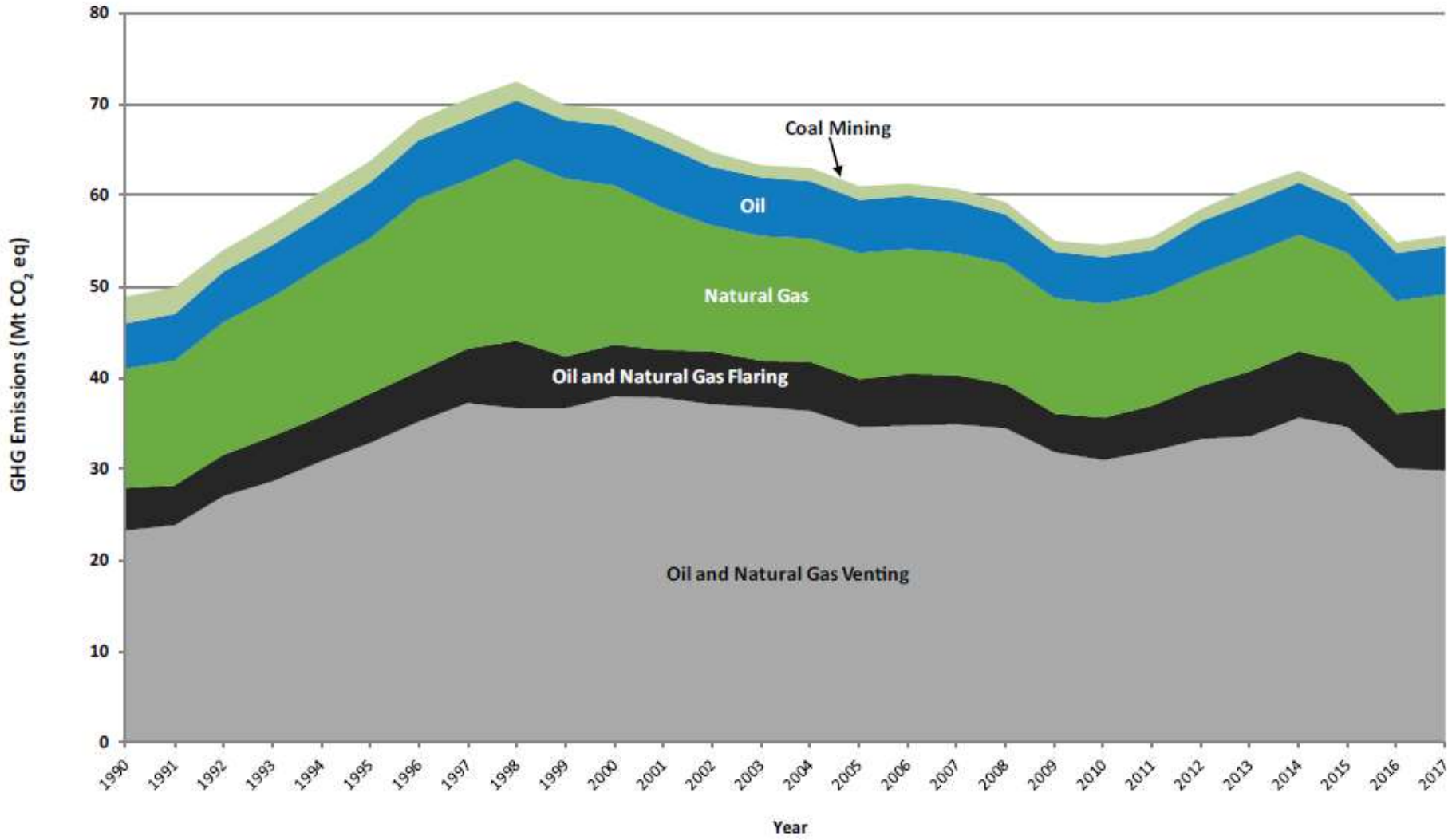


Figure 2–17 **Trends in Canadian GHG Emissions from IPPU Sources (1990–2017)**

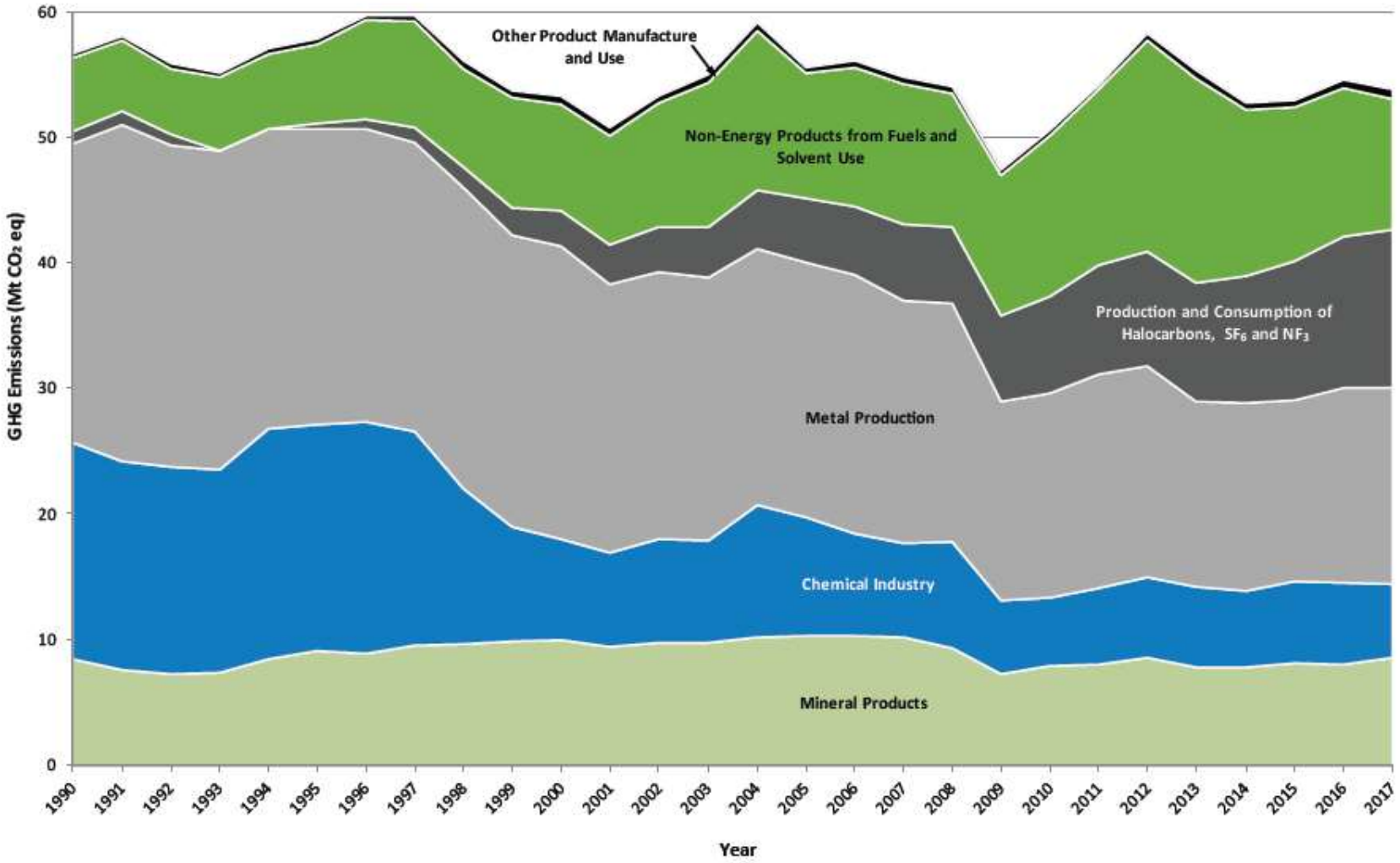


Figure 2–18 **Trends in Canadian GHG Emissions from Agriculture Sources (1990–2017)**

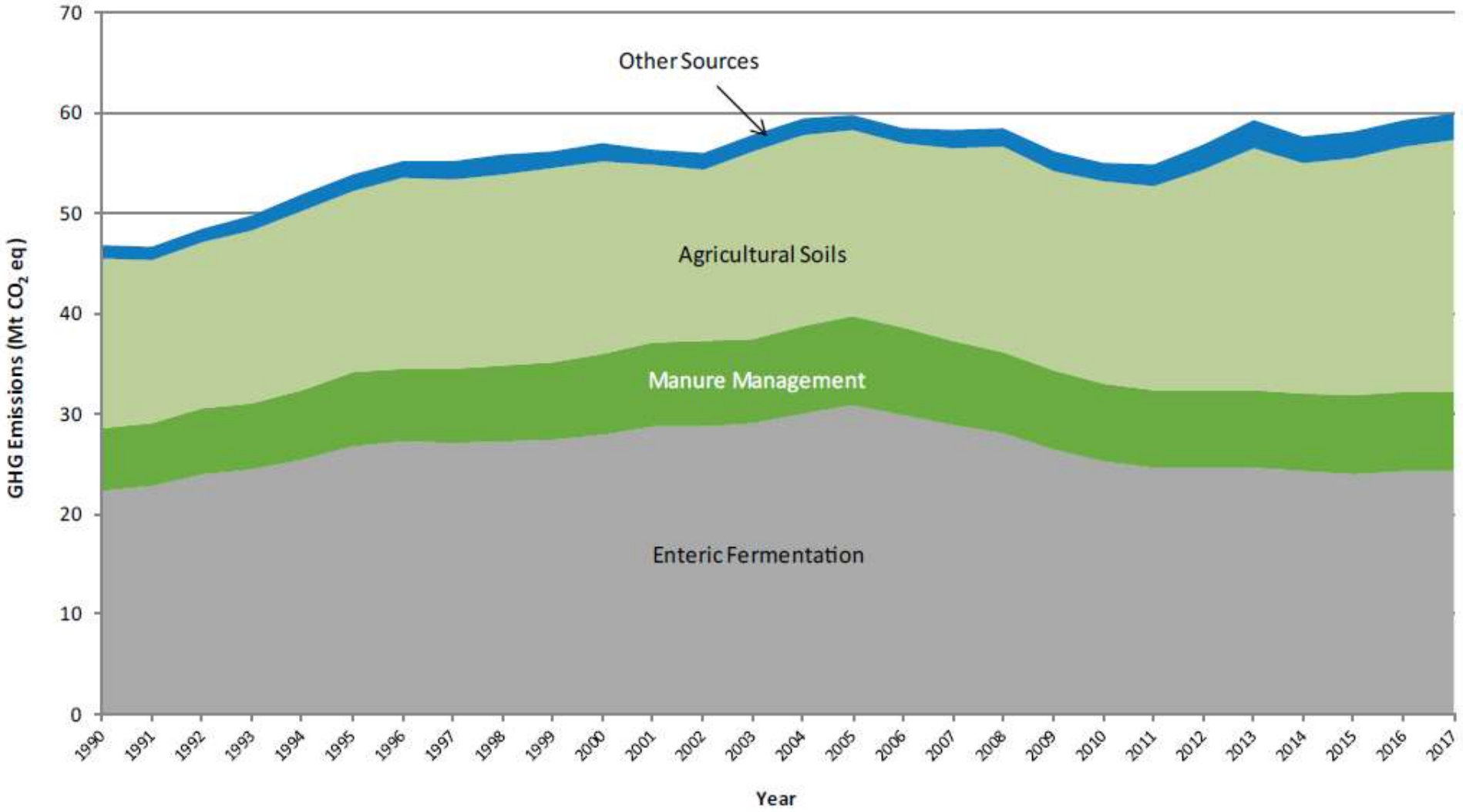


Figure 2–23 **Trends in Canadian GHG Emissions from Waste (1990–2017)**

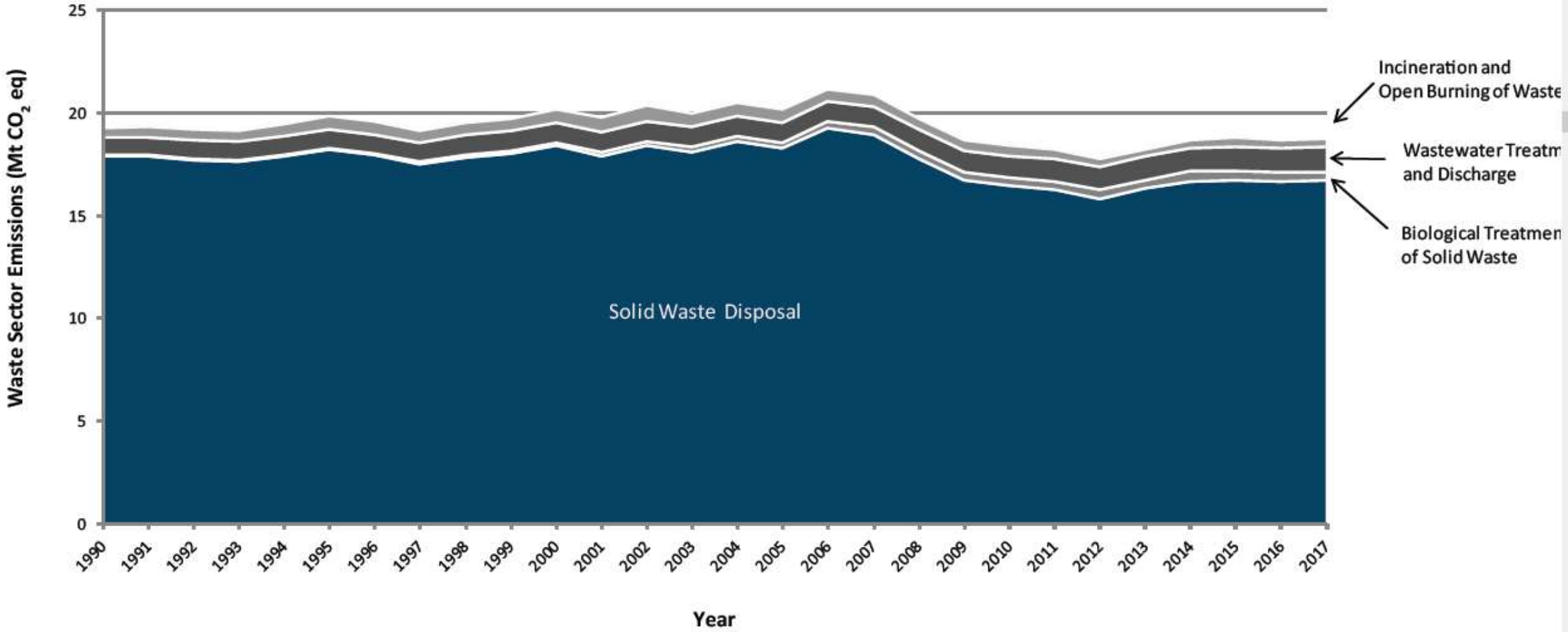


Table A11-18 GHG Emission Summary for Alberta, Selected Years

Greenhouse Gas Categories	1990	2005	2012	2013	2014	2015	2016	2017
	kt CO_2 eq							
TOTAL	**173 000**	**231 000**	**261 000**	**271 000**	**276 000**	**275 000**	**264 000**	**273 000**
ENERGY	**151 000**	**199 000**	**227 000**	**238 000**	**244 000**	**242 000**	**231 000**	**241 000**
a. Stationary Combustion Sources	**95 200**	**128 000**	**148 000**	**156 000**	**161 000**	**163 000**	**158 000**	**167 000**
Public Electricity and Heat Production	39 600	51 900	46 900	48 100	49 100	51 300	45 700	46 500
Petroleum Refining Industries	3 000	4 000	4 100	4 200	4 500	4 700	4 900	5 400
Oil and Gas Extraction	29 200	49 700	70 700	76 100	79 300	82 000	83 500	90 000
Mining	248	298	271	232	161	127	123	111
Manufacturing Industries	10 500	8 860	10 900	11 800	11 400	10 200	9 600	8 770
Construction	238	171	289	306	298	297	307	343
Commercial and Institutional	5 040	5 660	6 200	6 210	6 340	5 770	6 300	6 640
Residential	6 850	7 620	8 750	8 780	9 160	8 260	7 130	8 620
Agriculture and Forestry	477	240	337	338	346	346	358	379
b. Transport[1]	**22 300**	**34 000**	**40 200**	**42 800**	**44 000**	**41 800**	**40 000**	**40 500**
Domestic Aviation	1 130	1 350	1 440	1 550	1 510	1 480	1 400	1 370
Road Transportation	11 900	19 400	25 700	27 300	28 300	26 400	25 800	26 000
Light-Duty Gasoline Vehicles	4 200	3 680	3 150	3 320	3 370	3 040	3 120	2 970
Light-Duty Gasoline Trucks	3 400	5 140	6 080	6 550	7 020	6 910	7 380	7 320
Heavy-Duty Gasoline Vehicles	1 720	3 200	3 280	3 570	3 390	3 180	3 390	3 350
Motorcycles	13	28	38	41	44	44	47	47
Light-Duty Diesel Vehicles	21	51	88	97	100	90	77	78
Light-Duty Diesel Trucks	16	52	80	85	107	122	119	137
Heavy-Duty Diesel Vehicles	2 180	7 200	12 900	13 600	14 200	13 000	11 600	12 100
Propane and Natural Gas Vehicles	395	97	2	2	0.97	0.96	1	2
Railways	1 760	2 780	x	x	2 910	2 530	1 890	1 690
Domestic Navigation	0.28	-	x	x	-	7	3	1
Other Transportation	7 460	10 400	10 000	11 000	11 300	11 300	11 000	11 400
Off-Road Agriculture & Forestry	2 520	3 430	3 080	3 090	3 030	2 870	2 490	2 580
Off-Road Commercial & Institutional	165	295	309	349	392	363	237	196
Off-Road Manufacturing, Mining & Construction	1 520	2 610	4 160	4 690	4 750	4 710	4 010	4 180
Off-Road Residential	20	128	115	116	126	119	128	131
Off-Road Other Transportation	1 940	751	520	543	611	606	609	610
Pipeline Transport	1 300	3 210	1 820	2 190	2 360	2 660	3 500	3 750
c. Fugitive Sources	**34 000**	**37 000**	**38 000**	**39 000**	**39 000**	**37 000**	**34 000**	**33 000**
Coal Mining	400	300	300	300	200	300	300	200
Oil and Natural Gas	33 000	37 000	38 000	39 000	39 000	37 000	33 000	33 000
Oil	4 000	4 300	4 400	4 400	4 300	4 100	3 900	4 000
Natural Gas	8 500	9 700	8 200	8 500	8 500	7 900	7 900	8 000
Venting	17 000	21 000	22 000	22 000	23 000	22 000	19 000	19 000
Flaring	3 560	2 010	2 900	3 440	3 180	2 860	2 220	2 440
d. CO_2 Transport and Storage	-	-	-	-	-	**0.04**	**0.09**	**0.09**
INDUSTRIAL PROCESSES AND PRODUCT USE	**6 580**	**11 000**	**15 400**	**13 400**	**11 700**	**13 100**	**12 600**	**12 300**
a. Mineral Products	**1 100**	**1 500**	**1 300**	**1 200**	**1 200**	**1 200**	**1 200**	**1 300**
Cement Production	790	1 100	980	900	890	940	930	1 000
Lime Production	110	120	120	110	120	110	110	120
Mineral Products Use	190	250	150	140	140	160	160	160
b. Chemical Industry[2]	-	-	-	-	-	-	-	-
Adipic Acid Production	-	-	-	-	-	-	-	-
c. Metal Production	-	-	-	-	-	**1**	**0.68**	**0.68**
Iron and Steel Production	-	-	-	-	-	1	0.68	0.68
Aluminum Production	-	-	-	-	-	-	-	-
SF_6 Used in Magnesium Smelters and Casters	-	-	-	-	-	-	-	-
d. Production and Consumption of Halocarbons, SF_6 and NF_3[3]	**0.27**	**710**	**1 300**	**1 400**	**1 500**	**1 700**	**1 800**	**1 900**
e. Non-Energy Products from Fuels and Solvent Use	**5 500**	**8 800**	**13 000**	**11 000**	**8 900**	**10 000**	**9 500**	**9 000**
f. Other Product Manufacture and Use	**17**	**38**	**43**	**44**	**48**	**52**	**61**	**72**
AGRICULTURE	**14 000**	**19 000**	**18 000**	**18 000**	**18 000**	**18 000**	**18 000**	**18 000**
a. Enteric Fermentation	**7 800**	**12 000**	**9 400**	**9 500**	**9 400**	**9 400**	**9 500**	**9 400**
b. Manure Management	**1 500**	**2 400**	**2 000**	**2 000**	**2 000**	**2 000**	**2 000**	**2 000**
c. Agricultural Soils	**4 100**	**4 500**	**5 600**	**6 000**	**6 000**	**6 000**	**5 900**	**6 000**
Direct Sources	3 400	3 600	4 500	4 900	4 900	4 900	4 800	5 000
Indirect Sources	700	900	1 000	1 000	1 000	1 000	1 000	1 000
d. Field Burning of Agricultural Residues	**4**	**0.70**	**0.60**	**1**	**1**	**1**	**0.80**	**0.80**
e. Liming, Urea Application and Other Carbon-containing Fertilizers	**300**	**400**	**700**	**800**	**800**	**900**	**700**	**600**
WASTE	**1 200**	**1 700**	**1 700**	**1 800**	**1 800**	**1 800**	**1 800**	**1 900**
a. Solid Waste Disposal	**1 100**	**1 500**	**1 500**	**1 500**	**1 600**	**1 600**	**1 600**	**1 700**
b. Biological Treatment of Solid Waste	-	**40**	**40**	**40**	**40**	**40**	**40**	**40**
c. Wastewater Treatment and Discharge	**63**	**86**	**120**	**120**	**120**	**120**	**120**	**120**
d. Incineration and Open Burning of Waste	**10**	**30**	**40**	**50**	**40**	**50**	**50**	**40**

The Pan-Canadian Framework on Clean Growth and Climate Change

The Pan-Canadian Framework on Clean Growth and Climate Change (PCF) was adopted on December 9, 2016 as Canada's plan to take ambitious action to fight climate change, build resilience to a changing climate, and drive clean economic growth. It is the first climate change plan in Canada's history to include joint and individual commitments by federal, provincial and territorial levels of government, and to have been developed with input from Indigenous Peoples, businesses, non-governmental organizations, and Canadians from across the country. The PCF is built on four pillars: pricing carbon pollution, complementary actions to reduce emissions across the economy, adaptation and climate resilience, and clean technology, innovation, and jobs. It includes more than fifty concrete actions that cover all sectors of the Canadian economy, and puts Canada on a path towards meeting our Paris Agreement greenhouse gas (GHG) emissions reduction target of 30% below 2005 levels by 2030.

Pricing carbon pollution is central to Canada's plan. It is the most efficient way to reduce greenhouse gas emissions and helps drive innovation and clean growth. Provinces and territories had the flexibility to implement either an explicit price-based system or cap-and-trade system. A federal carbon pollution pricing system will apply in any province or territory that requests it or that does not have a system in place that meets federal requirements. This federal system has two parts: a regulatory charge on fossil fuels, and a performance-based system for large industry, known as the output-based pricing system (OBPS). In most jurisdictions, the OBPS went into effect January 1, 2019, and the fuel charge took effect on April 1, 2019. Pricing systems in the territories will take effect July 1, 2019.

The complementary mitigation measures included in the PCF will enable Canada to achieve emissions reductions across all sectors. Expanding the use of clean electricity and low-carbon fuels are foundational actions that will reduce emissions across the economy. Canada is taking action to reduce energy use including by improving energy efficiency, encouraging fuel switching and developing "net-zero energy ready" building codes. Canada's climate plan is supported by historic investments in public transit ($28.7 billion); green infrastructure ($26.9 billion) such as renewable energy, smart grid and electric vehicle charging stations; clean technology initiatives ($2.3 billion); and the Low Carbon Economy Fund ($2 billion).

The PCF also recognizes the importance of building climate resilience and sets out measures to help Canadians understand, plan for and take action to adapt to the unavoidable impacts of climate change. Canada launched the Canadian Centre for Climate Services to improve access to climate science, serve as the authoritative federal source for climate information and resources and strengthen capacity to incorporate climate change considerations in adaptation decision-making. As well, implementation of the Disaster Mitigation and Adaptation Fund ($2 billion) will help address climate risks and protect communities from natural disasters.

To support clean growth, Canada is unrolling investments of $2.3 billion in clean technology including nearly $1.4 billion in financing dedicated to supporting clean technology firms and $400 million to support the development and demonstration of clean technologies. In addition, the Government of Canada's Clean Growth Hub provides a single point of contact for access to clean technology knowledge, expertise, and relationships across the federal government. Canada's most recent greenhouse gas emissions projections (ECCC 2018a) estimated that Canada's GHG emissions in 2030 will be 223 million tonnes lower than projected prior to the PCF. This improvement in Canada's emissions outlook reflects the breadth and depth of Canada's climate plan. When the PCF is fully implemented, it will put Canada on a path towards meeting our 2030 target and to continue to achieve emission reductions beyond 2030.

Federal, provincial and territorial governments collectively report on how our climate commitments are translating into action; the second Annual Synthesis Report on the Status of PCF Implementation was released in December 2018 (ECCC 2018b). Continued collaboration between federal, provincial, and territorial governments as well as partnerships with Indigenous Peoples and engagement with Canadians remain a cornerstone of PCF implementation.

reduce emissions across the economy, adaptation and climate resilience, and clean technology, innovation, and jobs. It includes more than fifty concrete actions that cover all sectors of the Canadian economy, and puts Canada on a path towards meeting our Paris Agreement greenhouse gas (GHG) emissions reduction target of 30% below 2005 levels by 2030.

Pricing carbon pollution is central to Canada's plan. It is the most efficient way to reduce greenhouse

Figure 8–1 **Comparison of Emission Trends (2018 NIR vs 2019 NIR)**

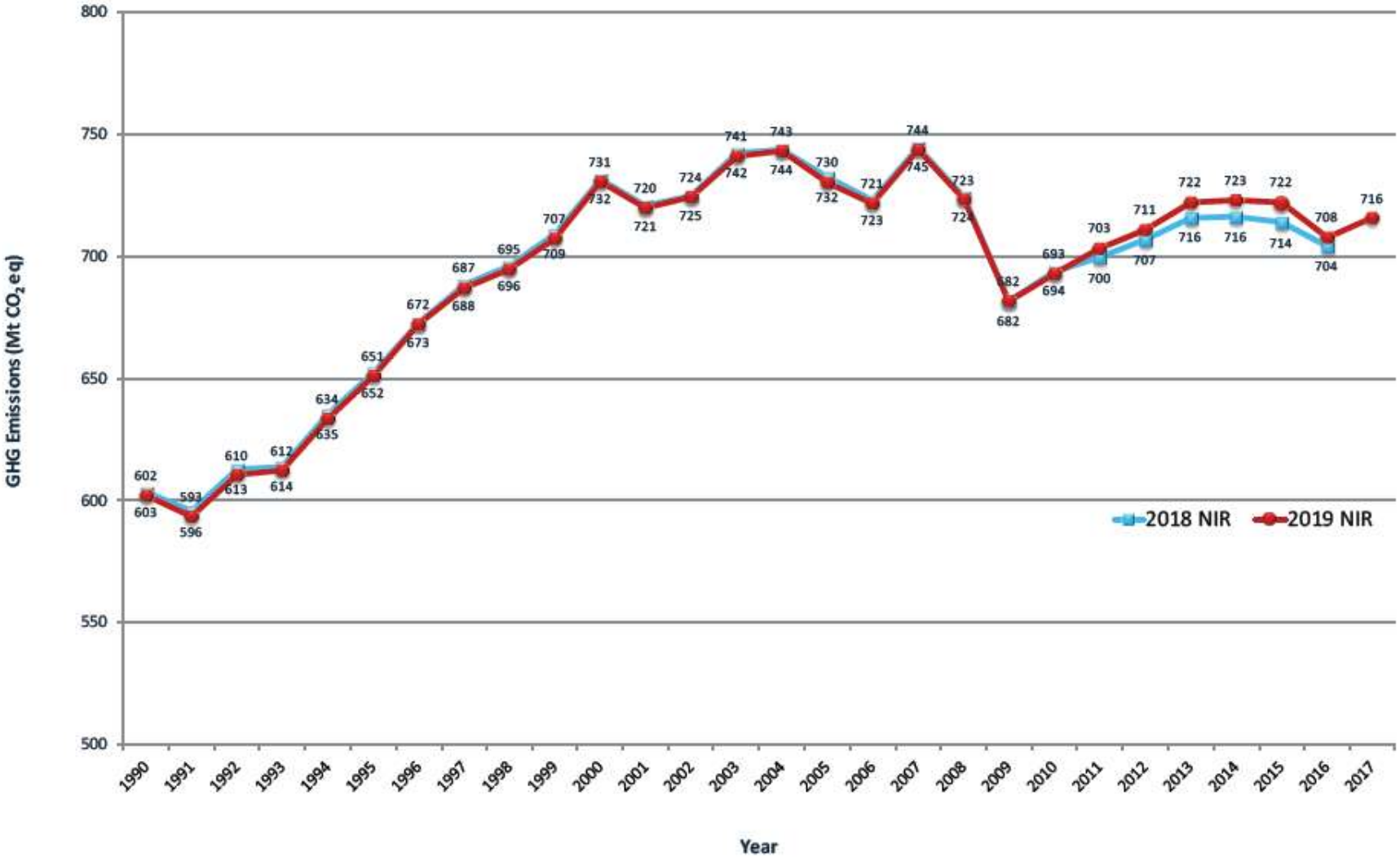
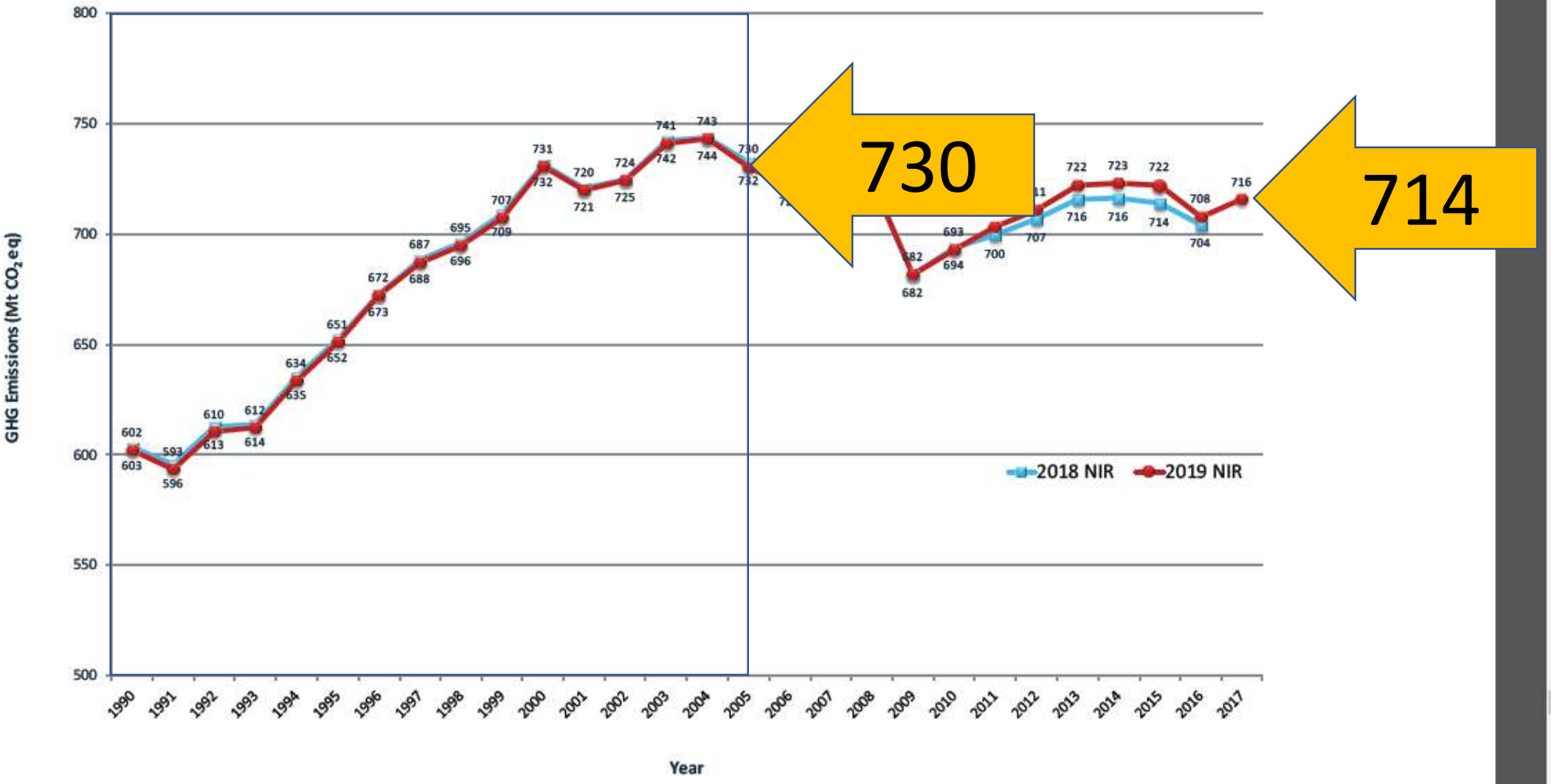
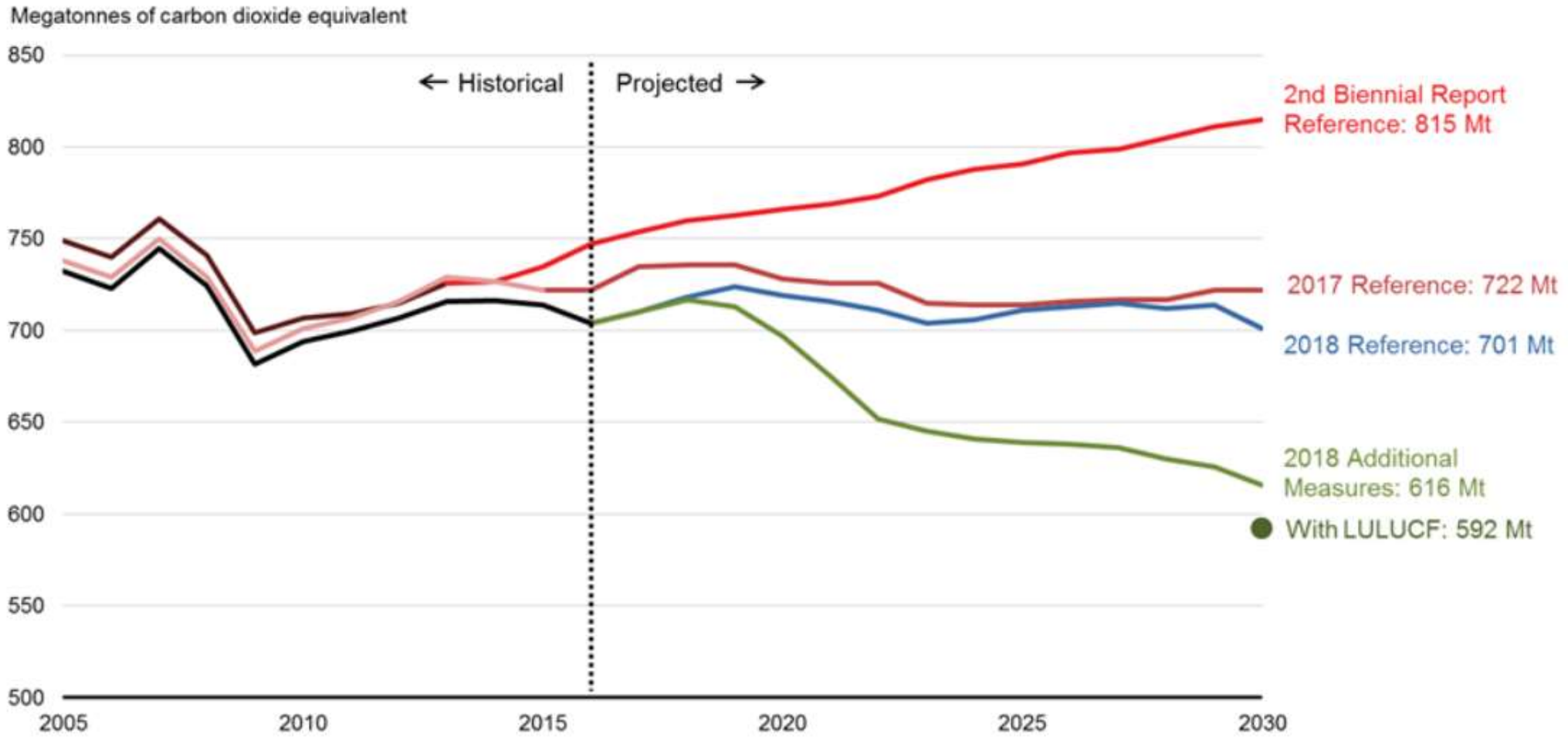


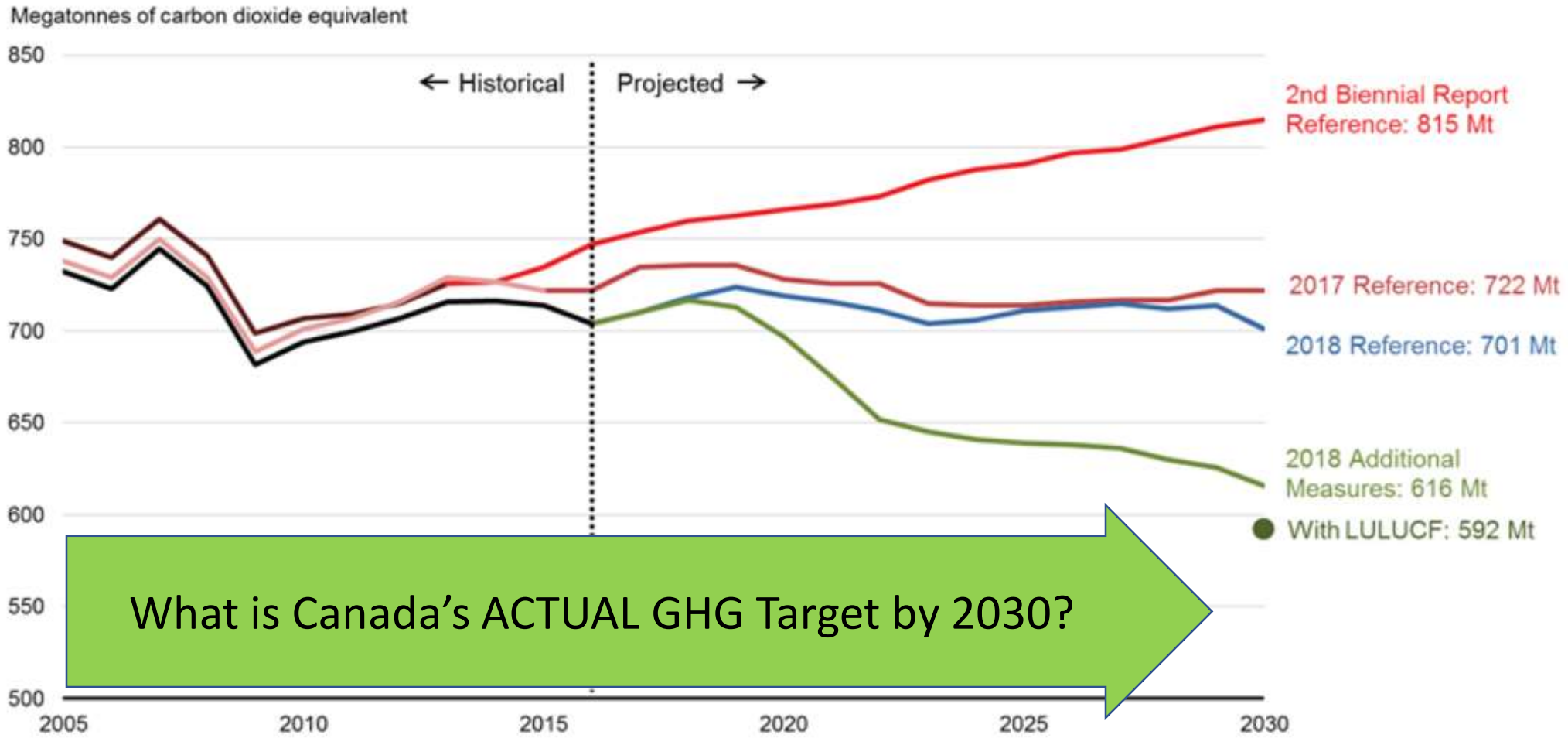
Figure 8–1 **Comparison of Emission Trends (2018 NIR vs 2019 NIR)**



Historical greenhouse gas emissions and projections, Canada, 2005 to 2030

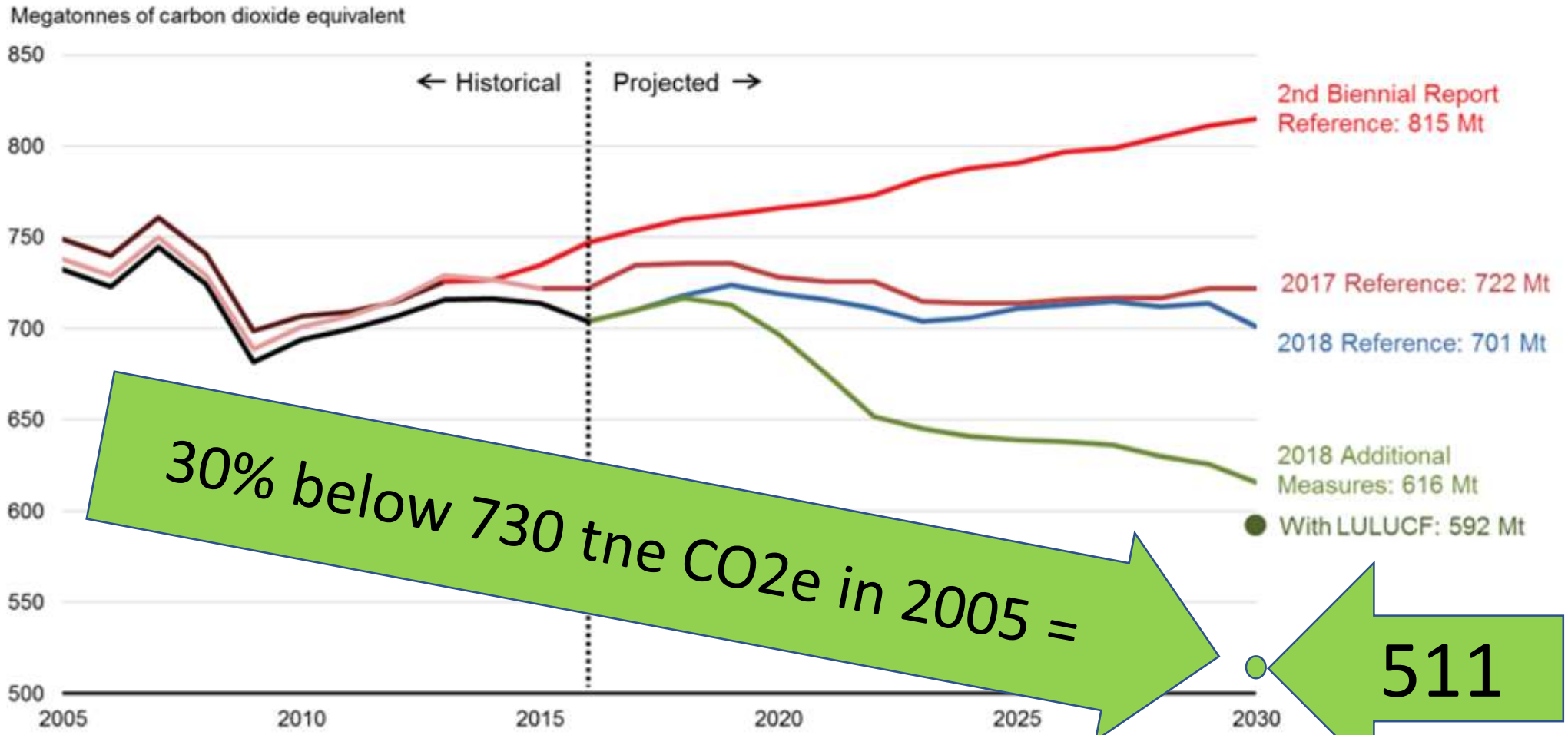


Historical greenhouse gas emissions and projections, Canada, 2005 to 2030



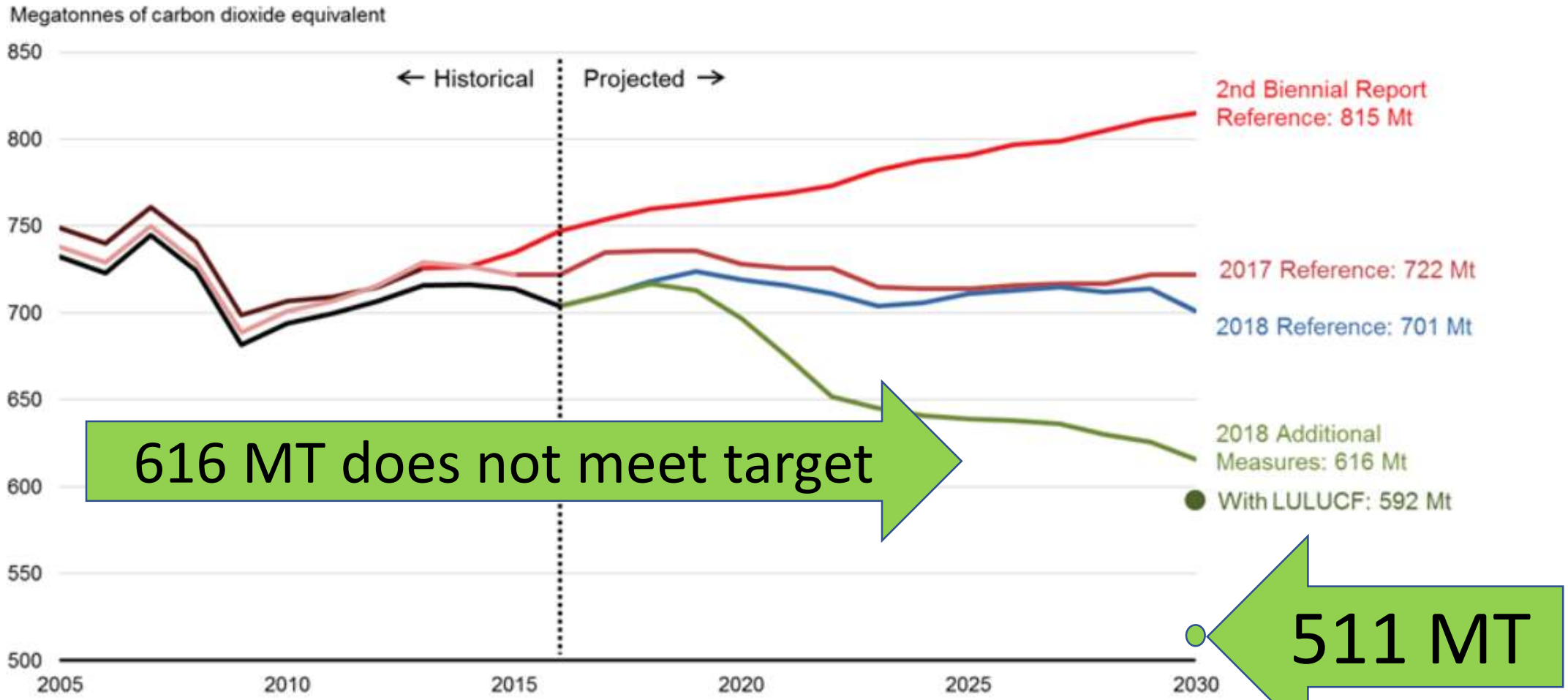
What is Canada's ACTUAL GHG Target by 2030?

Historical greenhouse gas emissions and projections, Canada, 2005 to 2030



30% below 730 tne CO2e in 2005 = 511

Historical greenhouse gas emissions and projections, Canada, 2005 to 2030



Where would you focus GHG reductions efforts in Alberta?

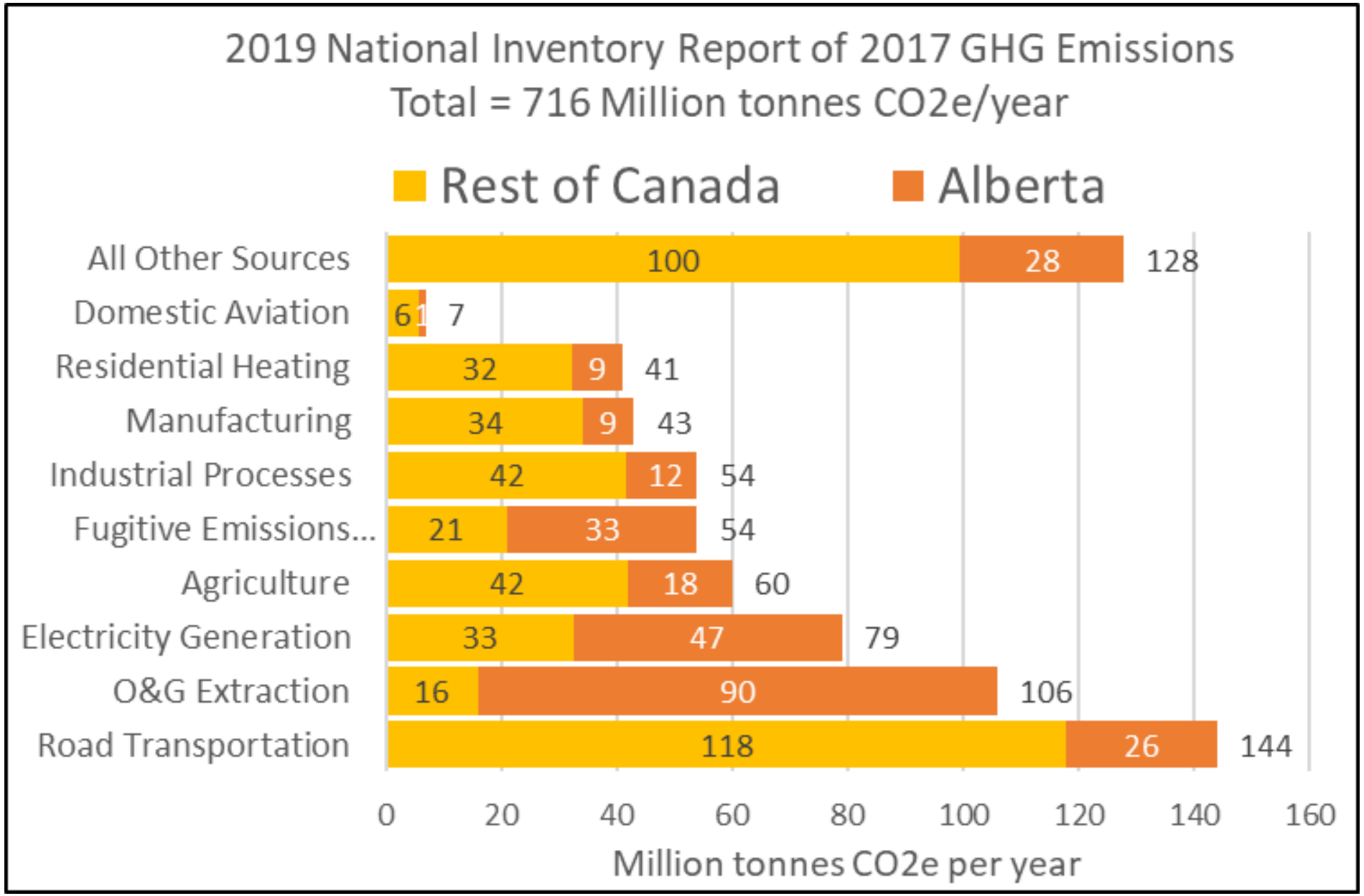
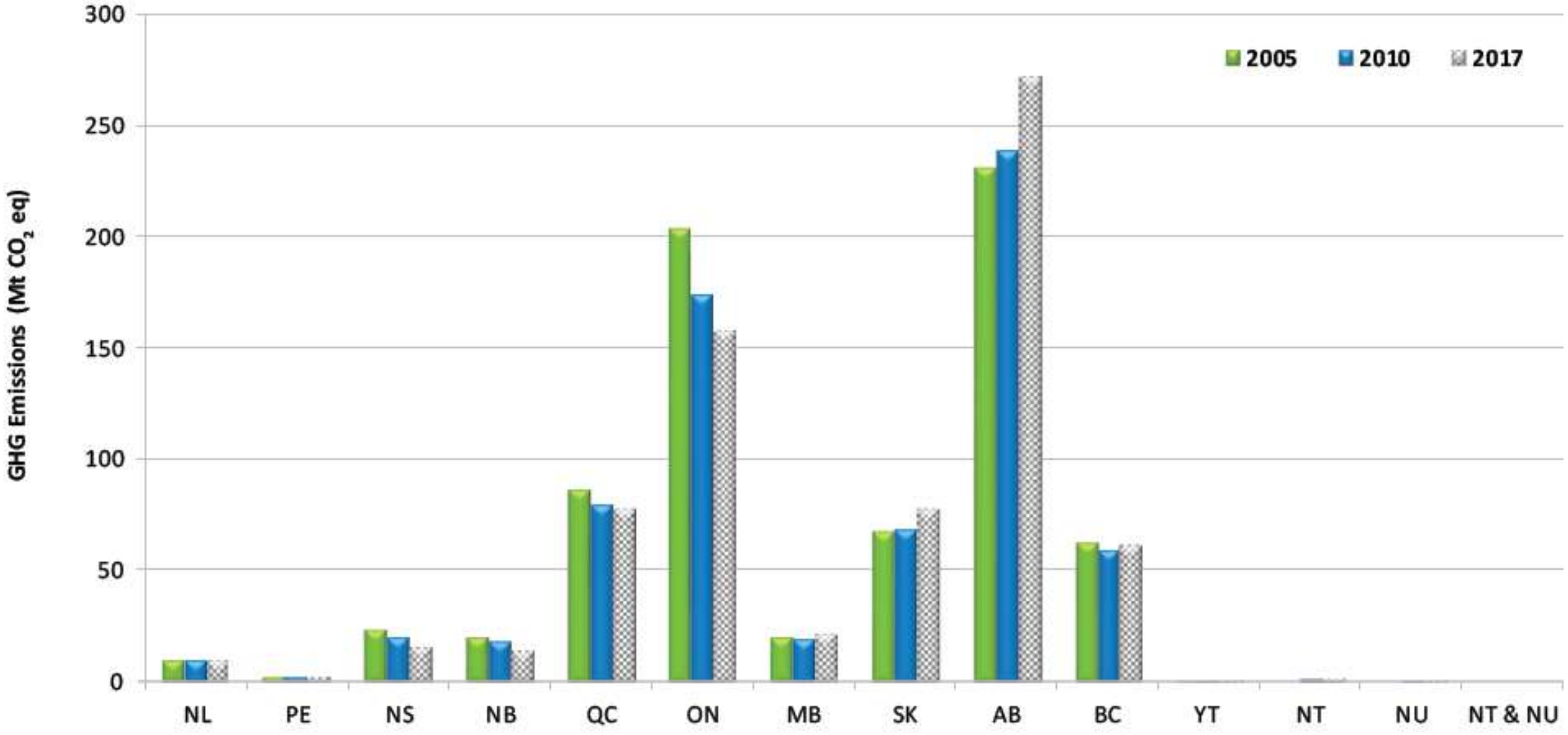


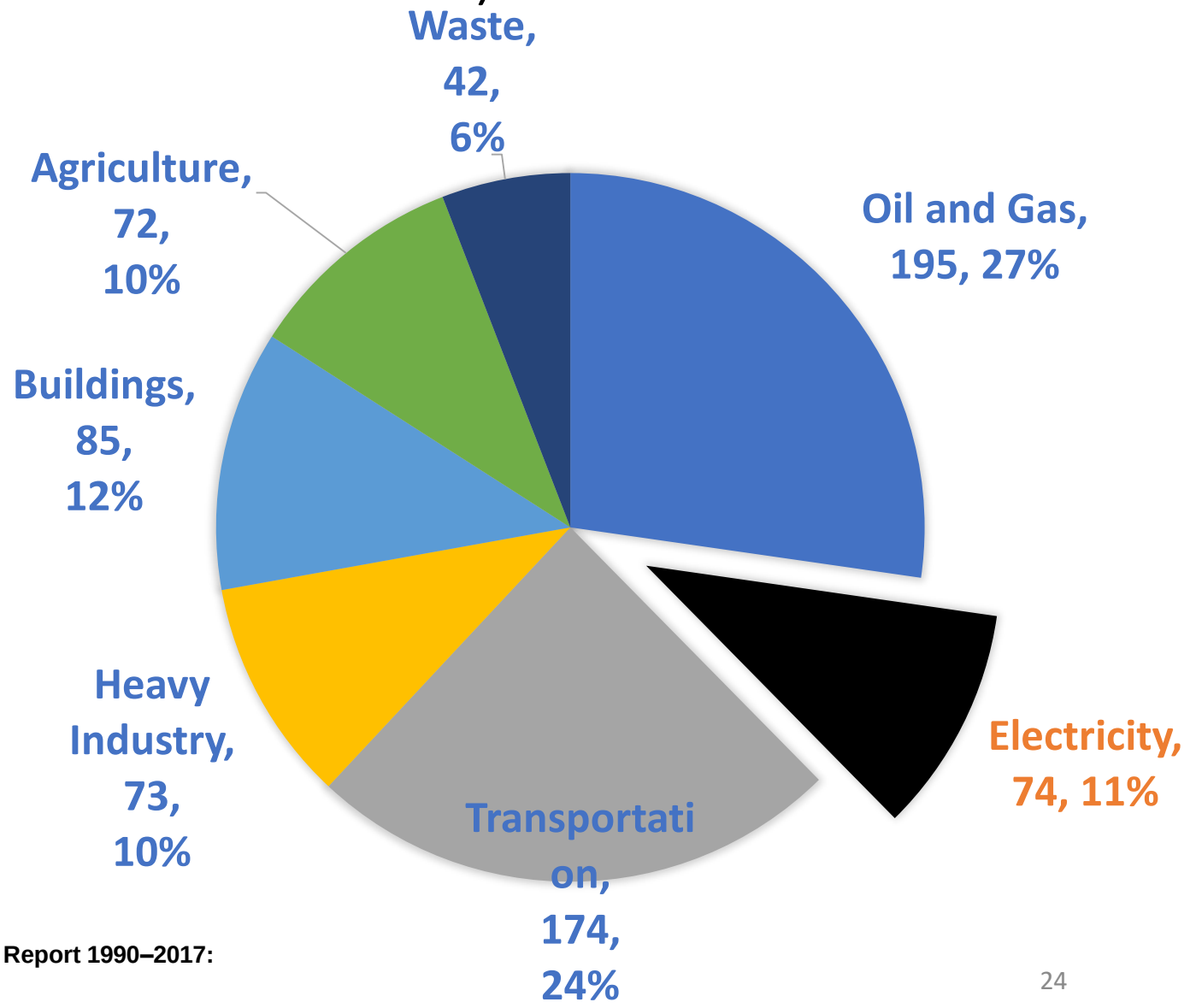
Figure ES–8 **Emissions by Province and Territory in 2005, 2010 and 2017**



Source: Environment Canada and Climate Change (2019) National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.

2017 Canadian GHG emissions – By Economic Sector (Total 716 MT CO2e)

74 Million Tonnes CO2e arise from **electricity generation** annually



Source: Environment Canada and Climate Change (2019) National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.

Canada Generation in 2017 was powered by

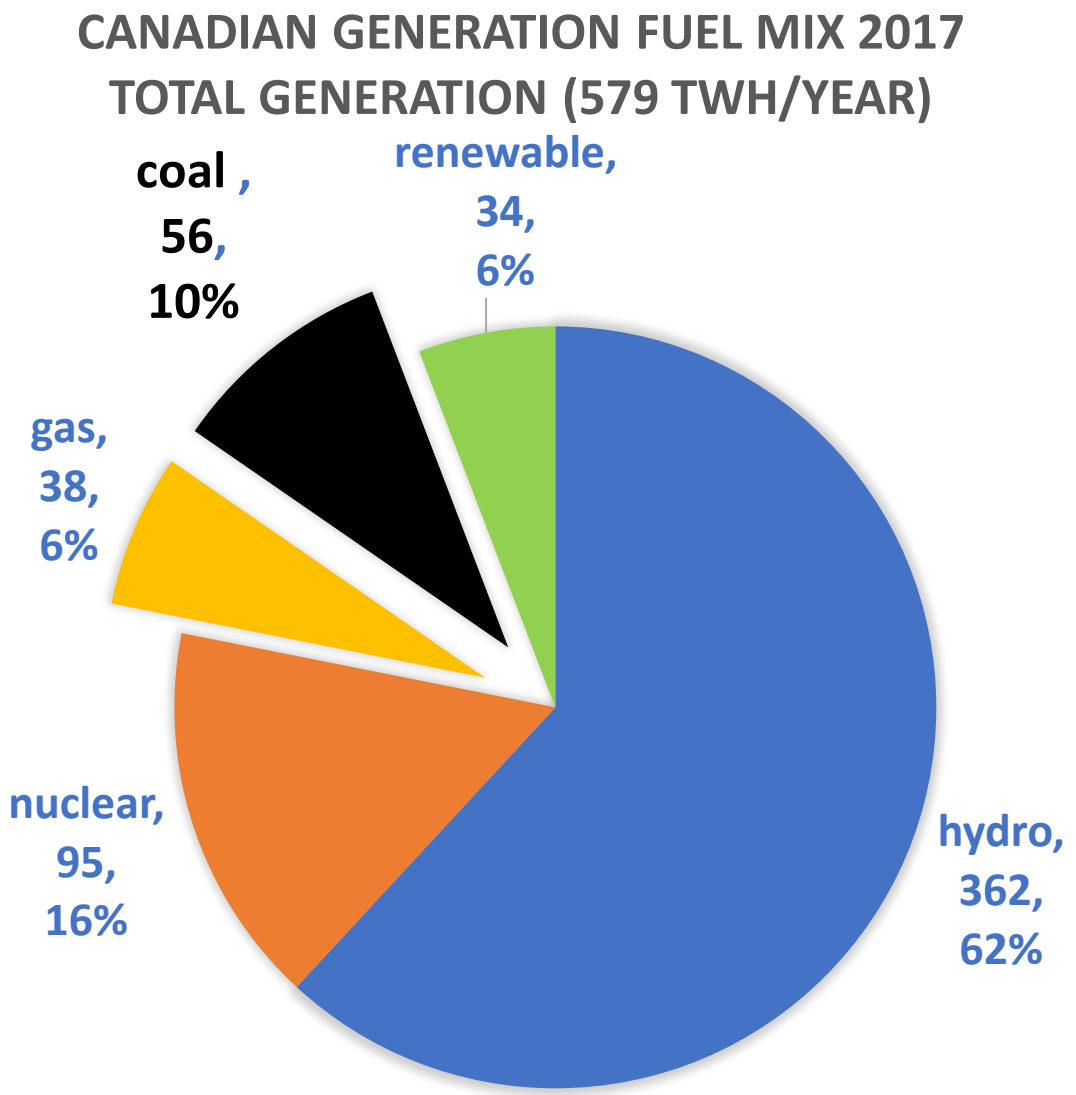
84%

Zero Carbon Sources

Renewables = 6%

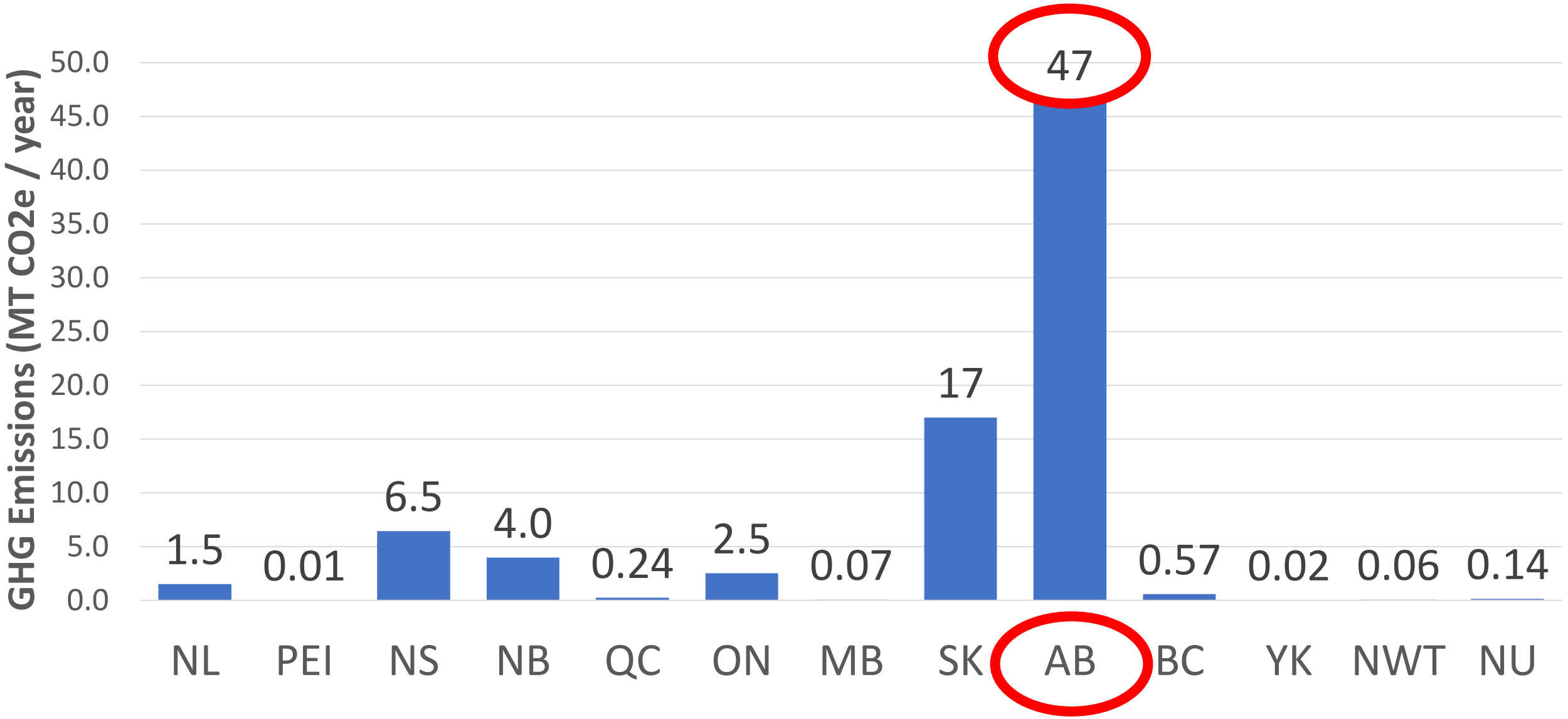
Large Hydro = 62 %

Nuclear = 16%



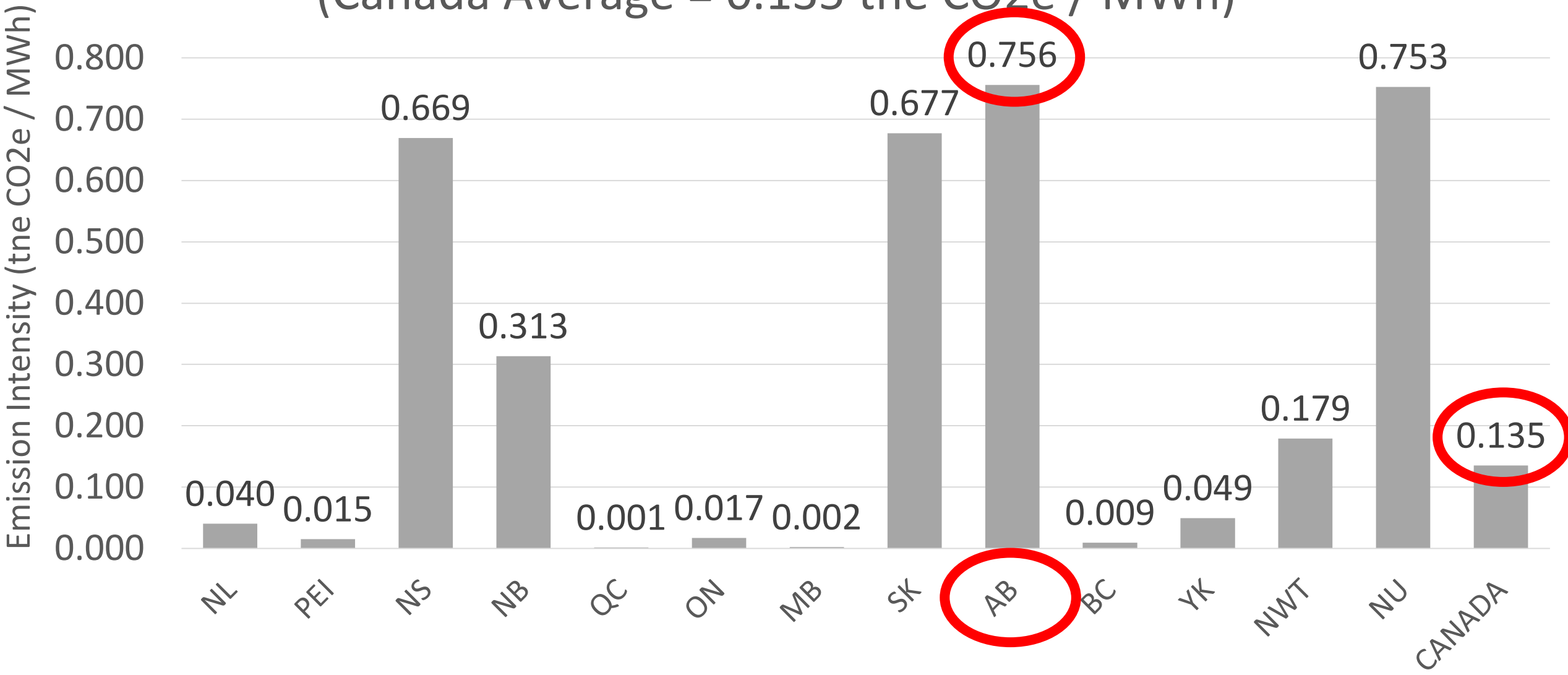
Source: Environment Canada and Climate Change (2019) National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.

2017 GHG Emissions from Public Electricity Generation



Source: Environment Canada and Climate Change (2019) National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.

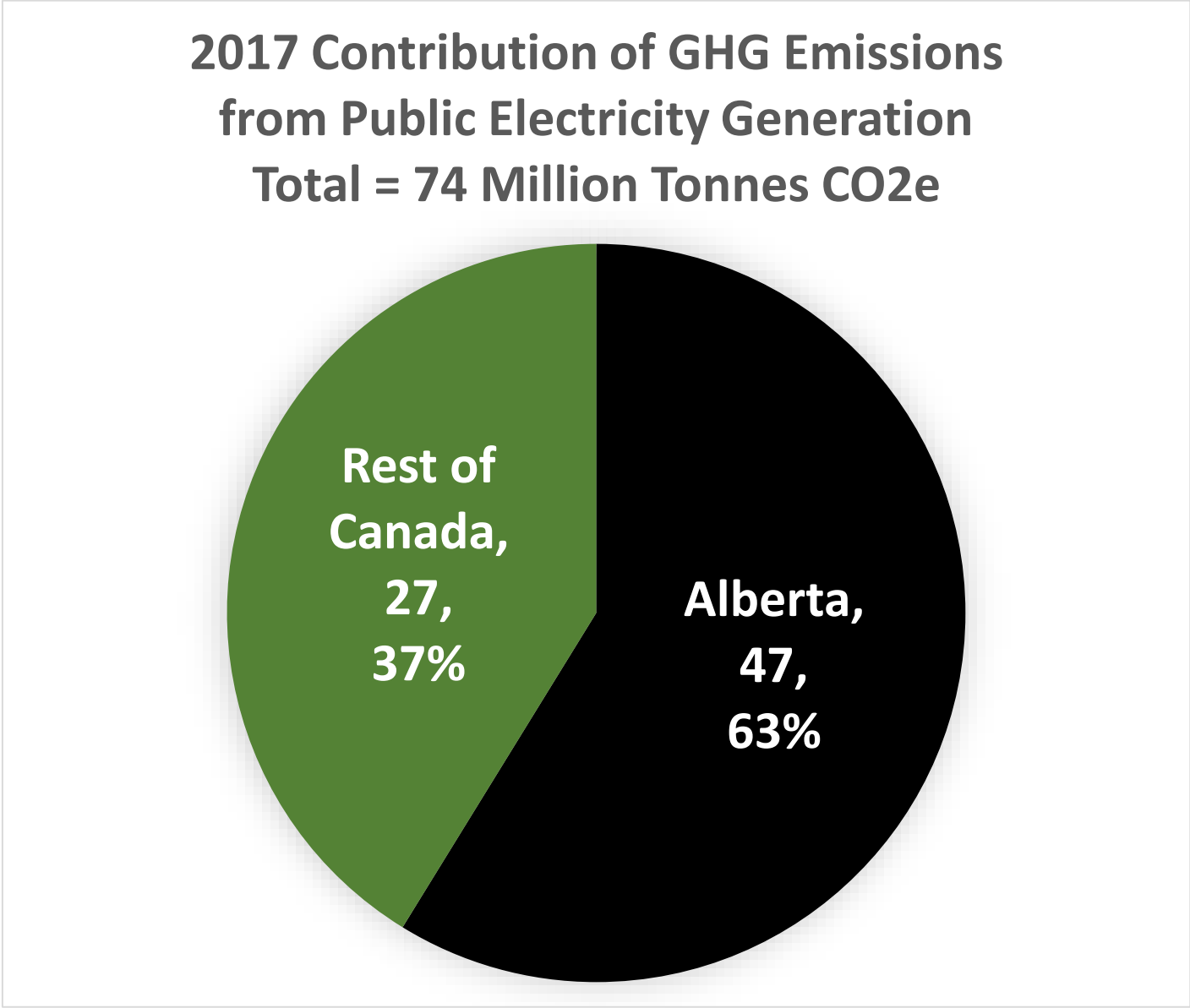
2017 Emission Intensity from Public Electricity Generation (Canada Average = 0.135 tne CO2e / MWh)



Source: Environment Canada and Climate Change (2019) National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.

Alberta emits

63% of Canada's GHG emissions from electricity generation



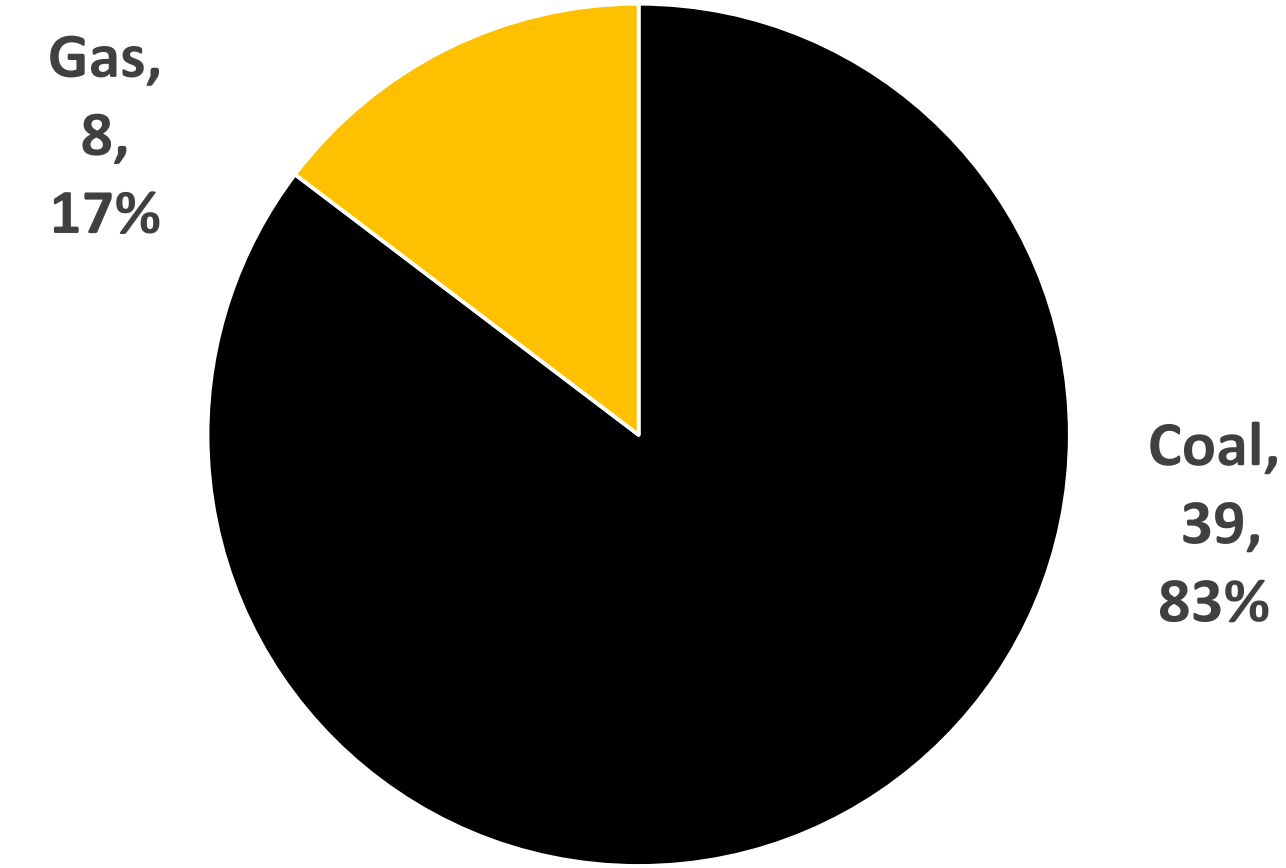
Source: Environment Canada and Climate Change (2019) National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.

Coal is the major contributor of Alberta Power generation GHG emissions

COAL emits 83%

of Power Generation Emissions

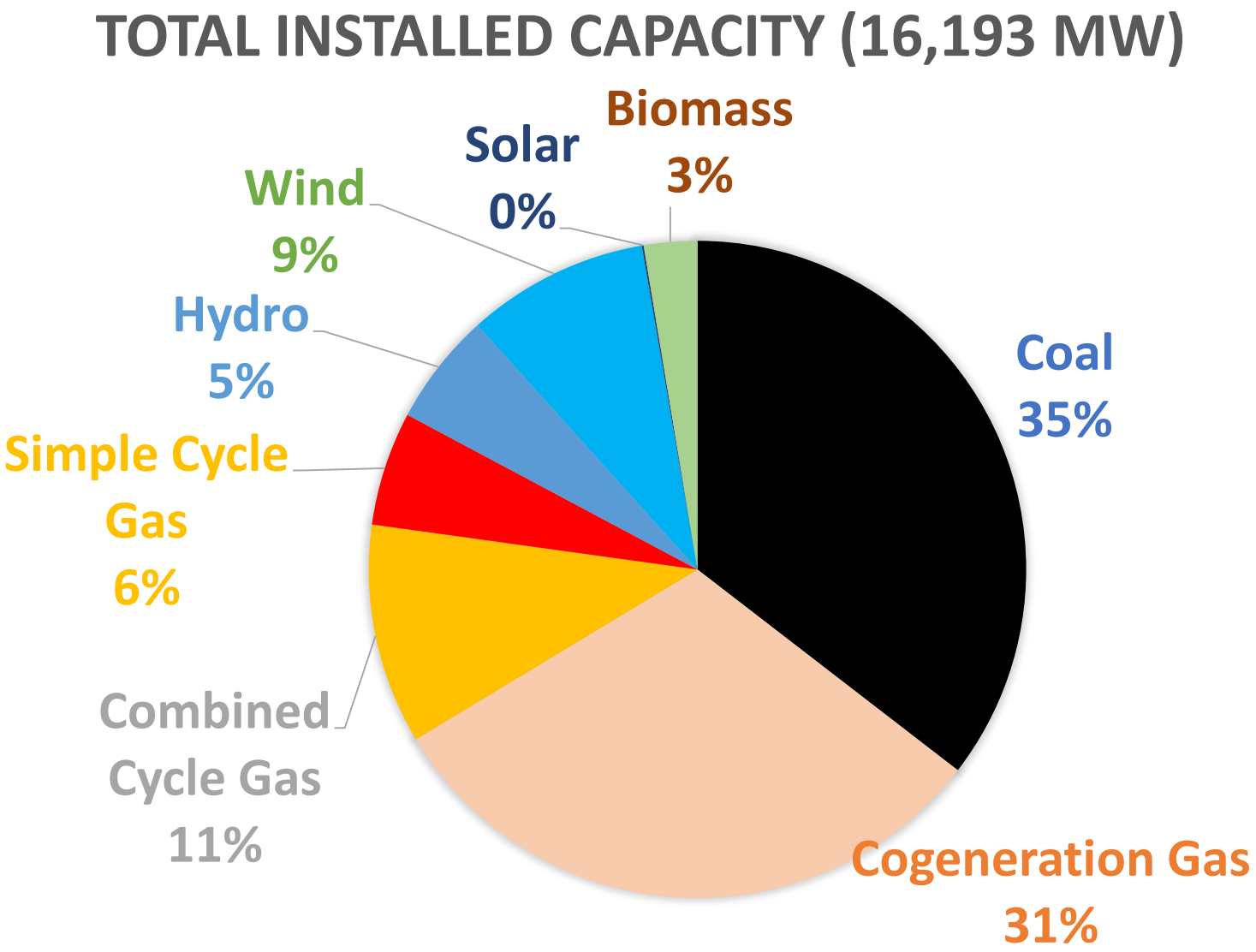
Alberta 2017 GHG emissions from Public Power Generation
Total 47 Million Tonnes CO2e



Source: Environment Canada and Climate Change (2019) National Inventory Report 1990–2017: Greenhouse Gas Sources and Sinks in Canada.

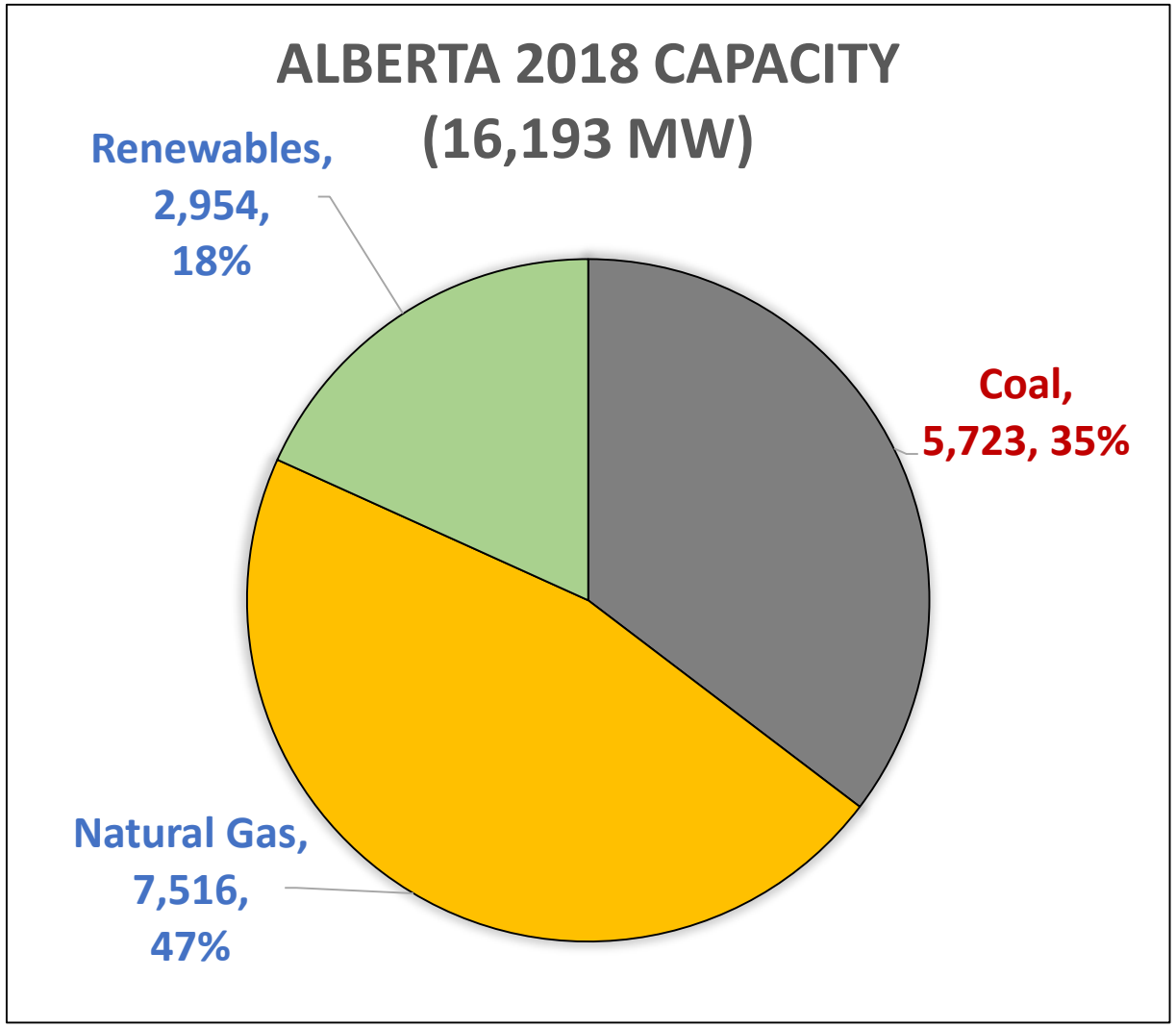
AESO 2019 LTO

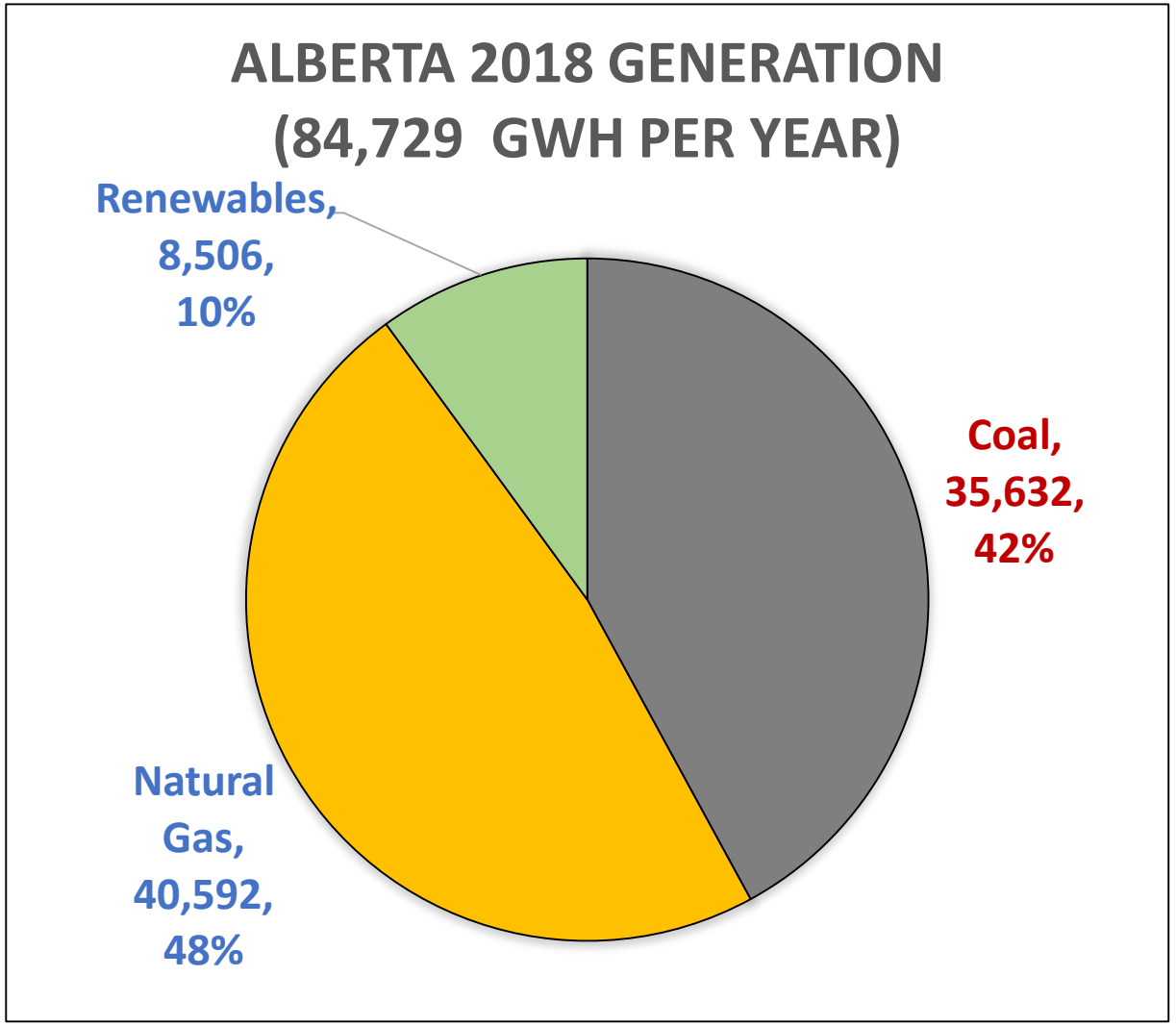
2018 energy source mix in the Alberta grid



Installed **Capacity** (MW) versus **Generation** (GWh per year)

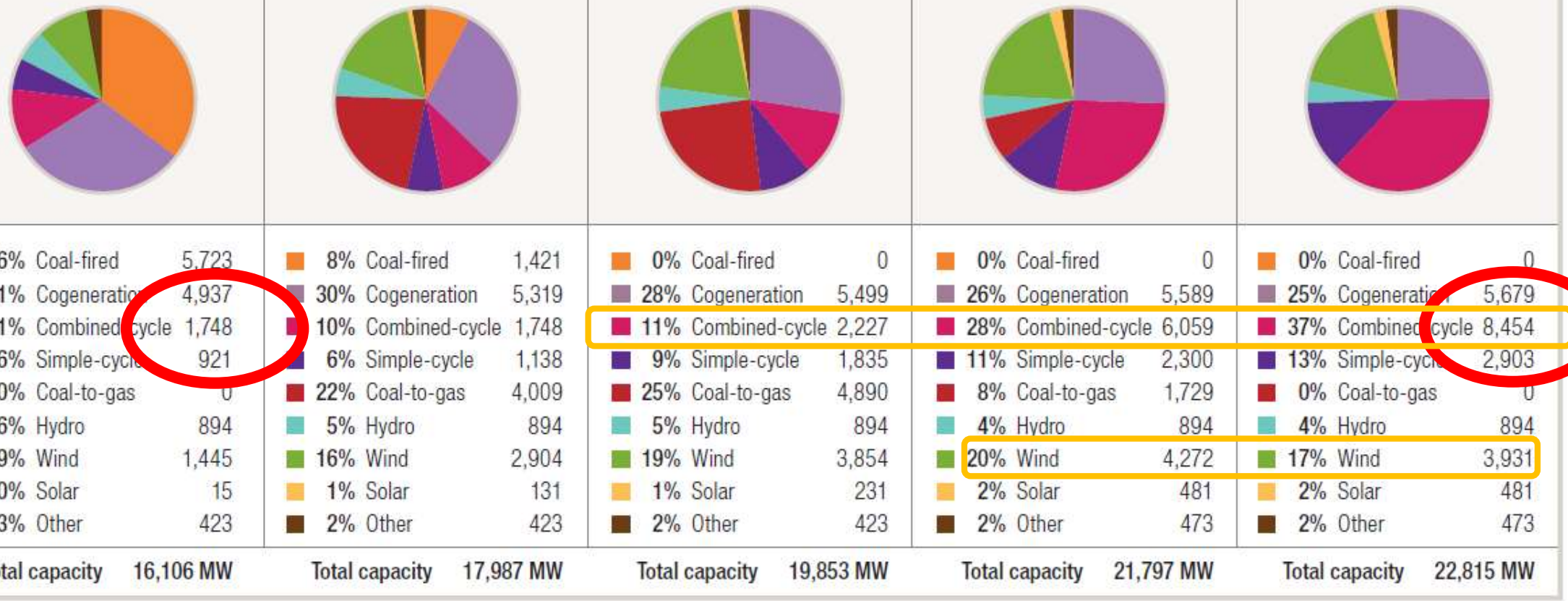
Source: AESO 2019 LTO data file





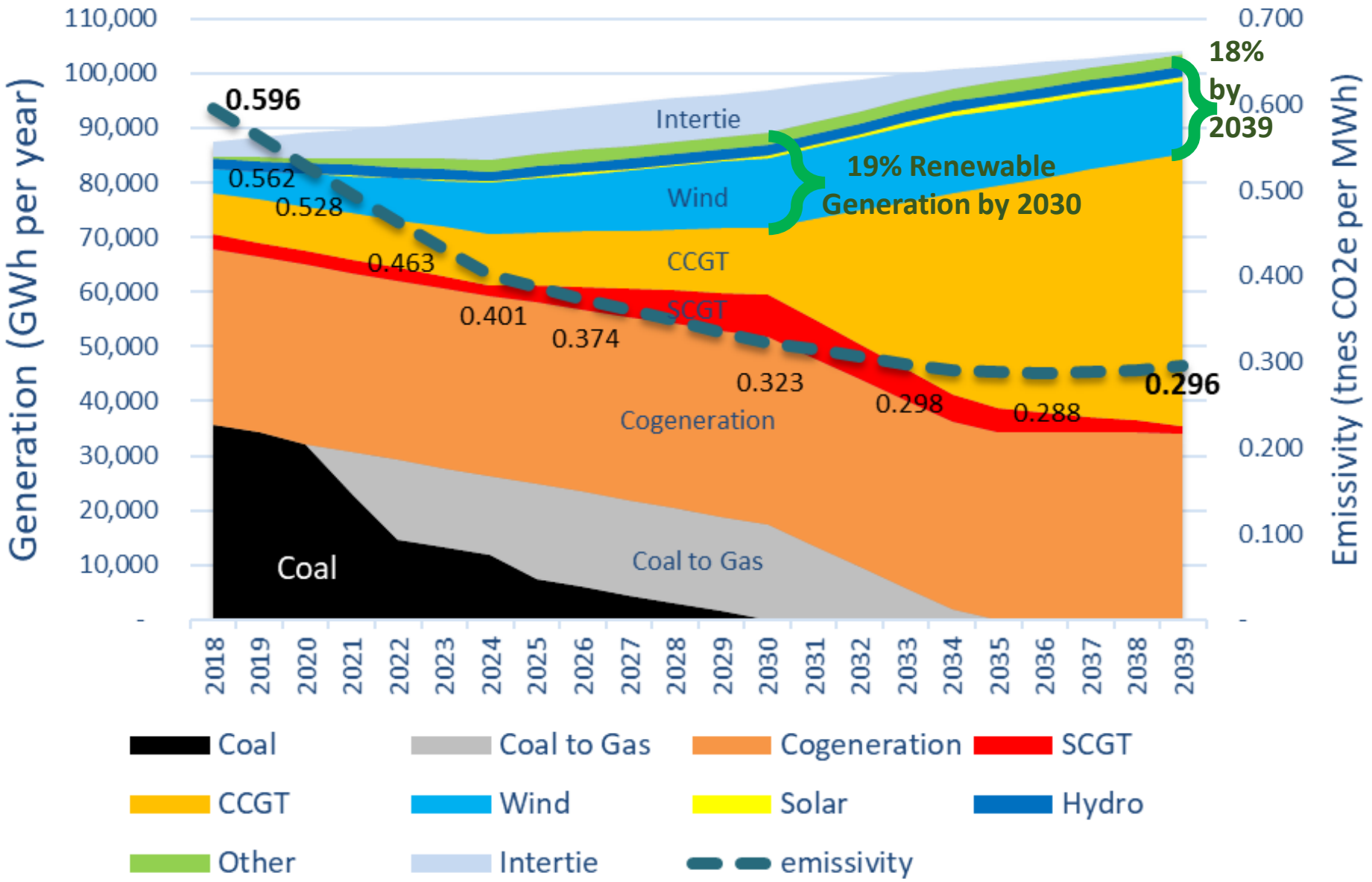
AESO forecasts that 15 new 450 MW CCGT units will be installed from 2030 to 2039

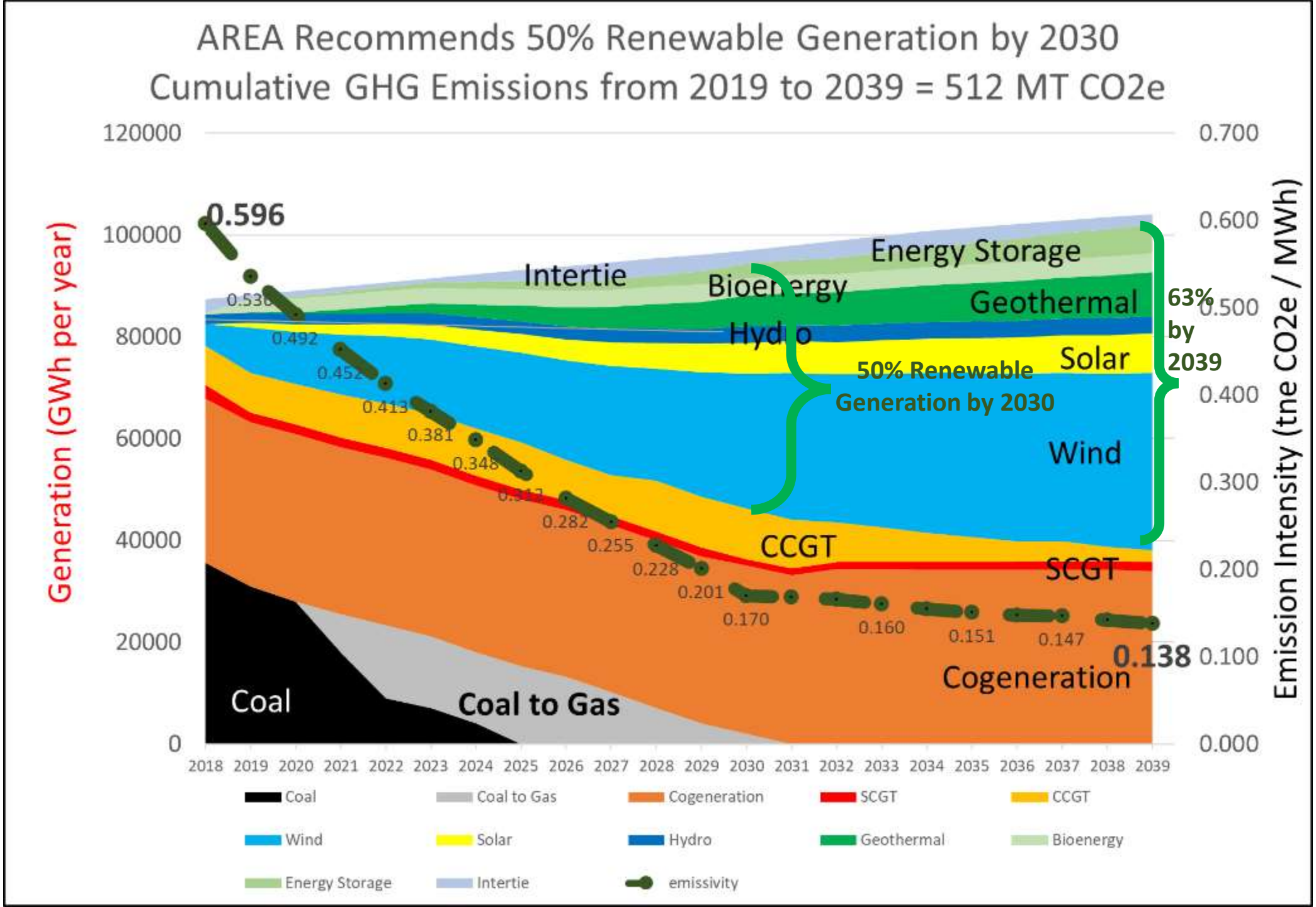
FIGURE 7: Reference Case Generation Scenario Capacity



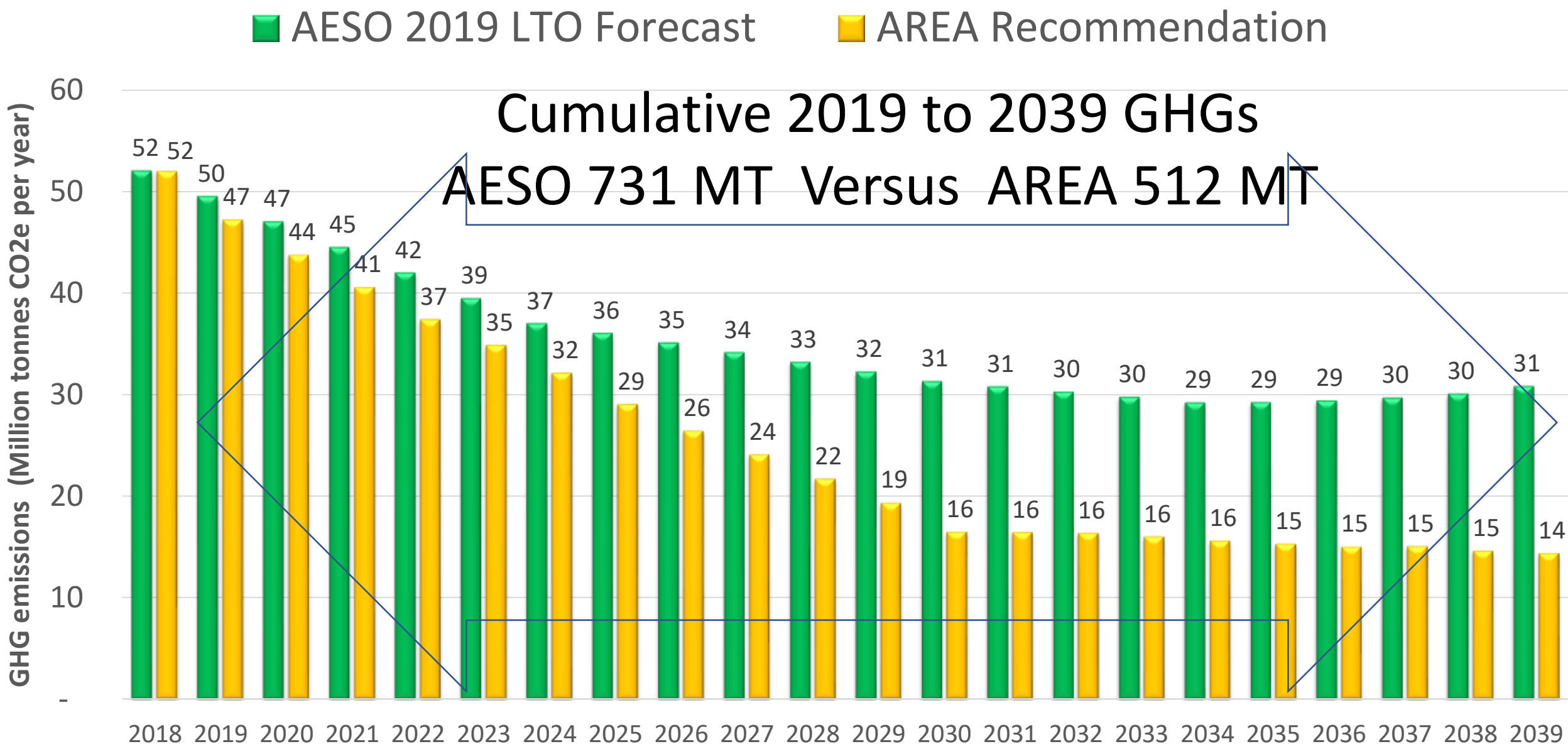
Existing AIL peak: 11,471 MW		2024 AIL peak: 12,703 MW		2030 AIL peak: 13,319 MW		2034 AIL peak: 13,806 MW		2039 AIL peak: 14,274 MW	
36% Coal-fired	5,723	8% Coal-fired	1,421	0% Coal-fired	0	0% Coal-fired	0	0% Coal-fired	0
31% Cogeneration	4,937	30% Cogeneration	5,319	28% Cogeneration	5,499	26% Cogeneration	5,589	25% Cogeneration	5,679
11% Combined-cycle	1,748	10% Combined-cycle	1,748	11% Combined-cycle	2,227	28% Combined-cycle	6,059	37% Combined-cycle	8,454
6% Simple-cycle	921	6% Simple-cycle	1,138	9% Simple-cycle	1,835	11% Simple-cycle	2,300	13% Simple-cycle	2,903
0% Coal-to-gas	0	22% Coal-to-gas	4,009	25% Coal-to-gas	4,890	8% Coal-to-gas	1,729	0% Coal-to-gas	0
6% Hydro	894	5% Hydro	894	5% Hydro	894	4% Hydro	894	4% Hydro	894
9% Wind	1,445	16% Wind	2,904	19% Wind	3,854	20% Wind	4,272	17% Wind	3,931
0% Solar	15	1% Solar	131	1% Solar	231	2% Solar	481	2% Solar	481
3% Other	423	2% Other	423	2% Other	423	2% Other	473	2% Other	473
Total capacity	16,106 MW	Total capacity	17,987 MW	Total capacity	19,853 MW	Total capacity	21,797 MW	Total capacity	22,815 MW

AESO Forecasts 19% Renewable Generation by 2030
Cumulative GHG Emissions 2019 to 2039 = 731 MT CO2e

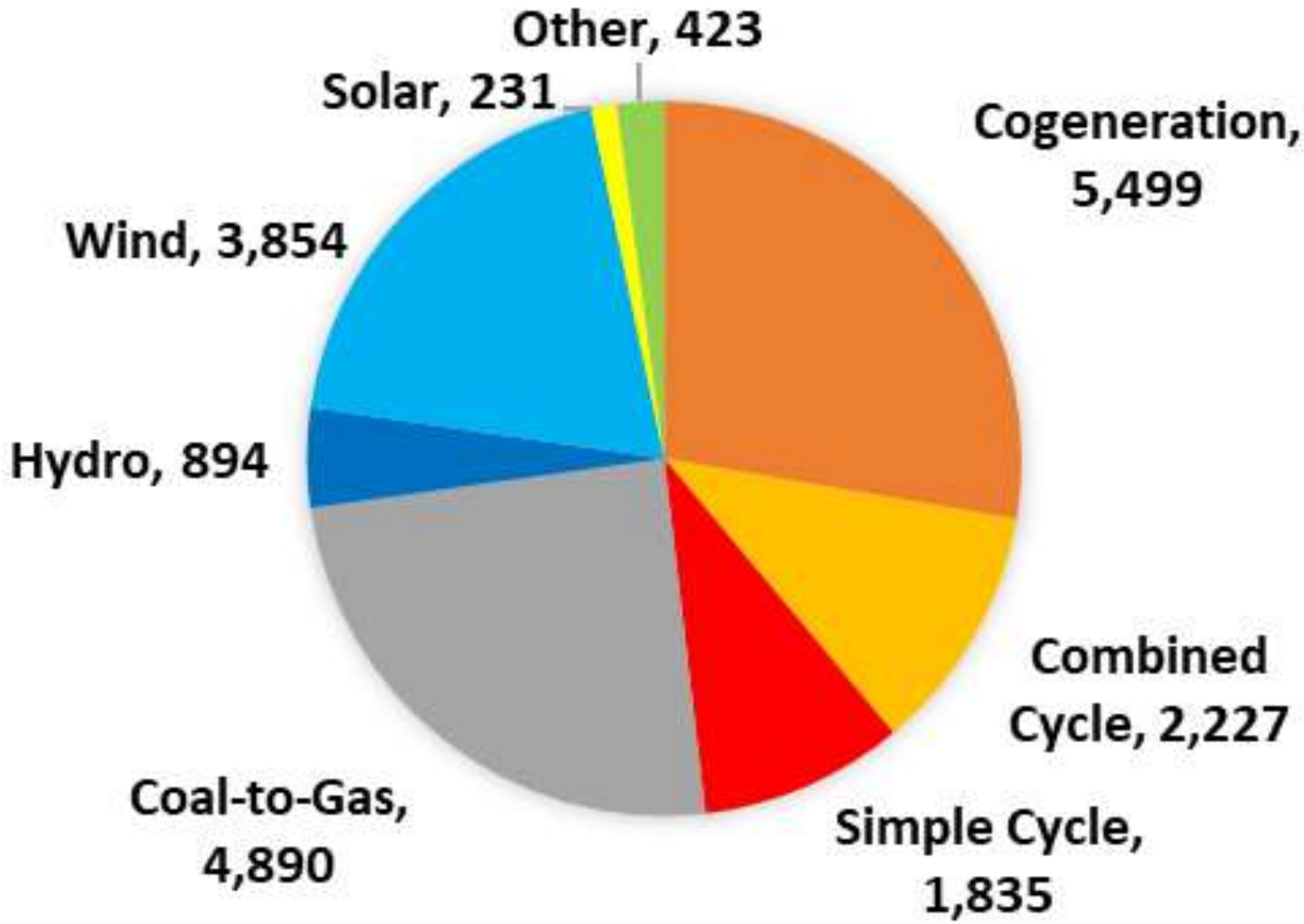



AREA Recommends 50% Renewable Generation by 2030
Cumulative GHG Emissions from 2019 to 2039 = 512 MT CO2e
Generation (GWh per year)
Emission Intensity (tne CO2e / MWh)
120000
100000
80000
60000
40000
20000
0
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.596
0.536
0.492
0.452
0.413
0.381
0.348
0.317
0.282
0.255
0.228
0.201
0.170
0.160
0.151
0.147
0.138
Intertie
Energy Storage
Bioenergy
Geothermal
Hydro
Solar
Wind
CCGT
SCGT
Cogeneration
Coal
Coal to Gas
50% Renewable Generation by 2030
63% by 2039
2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039
Coal
Coal to Gas
Cogeneration
SCGT
CCGT
Wind
Solar
Hydro
Geothermal
Bioenergy
Energy Storage
Intertie
emissivity

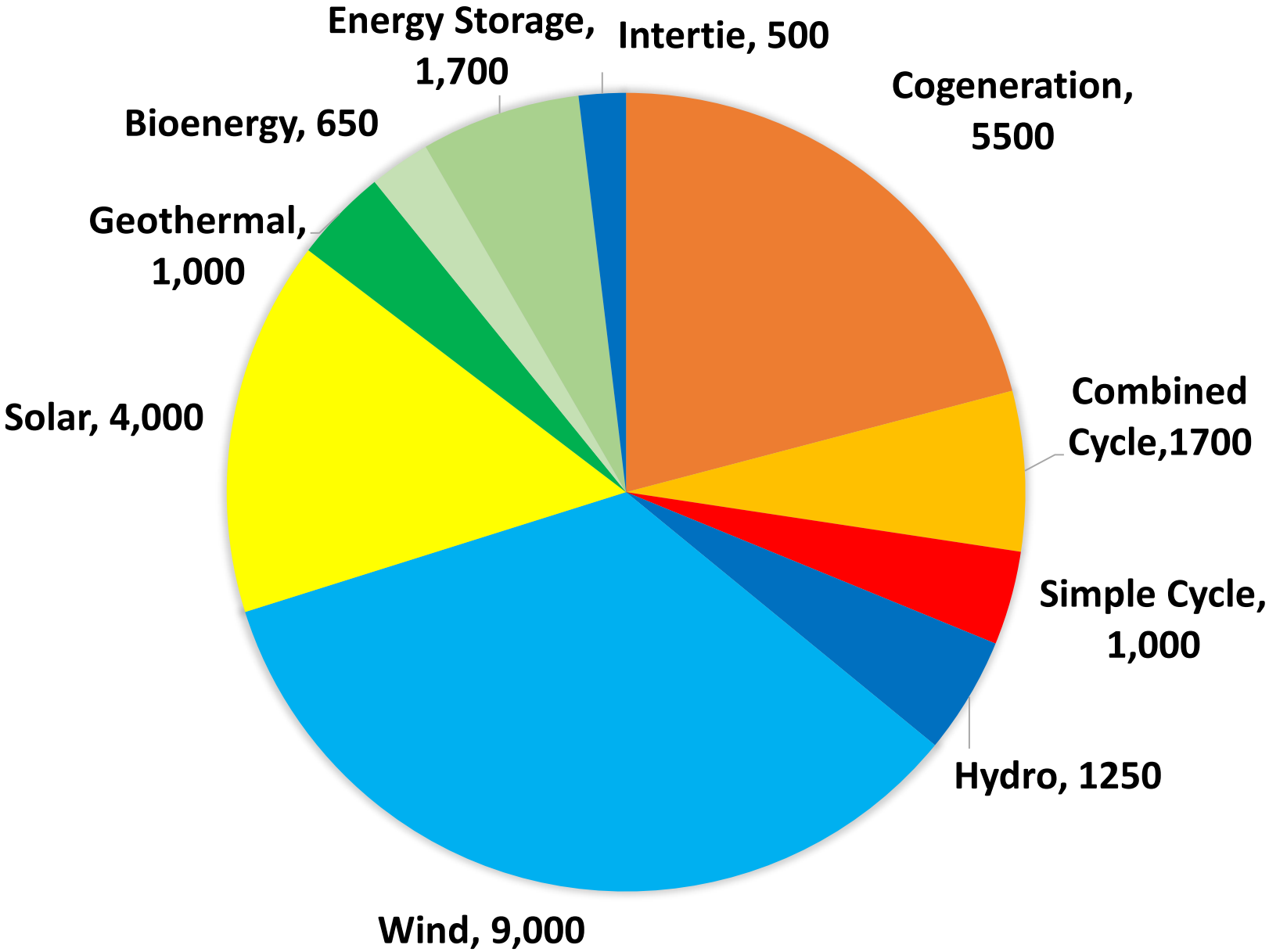
Annual GHG Emissions Estimates 2018 to 2039
(Million Tonnes CO2e per year)



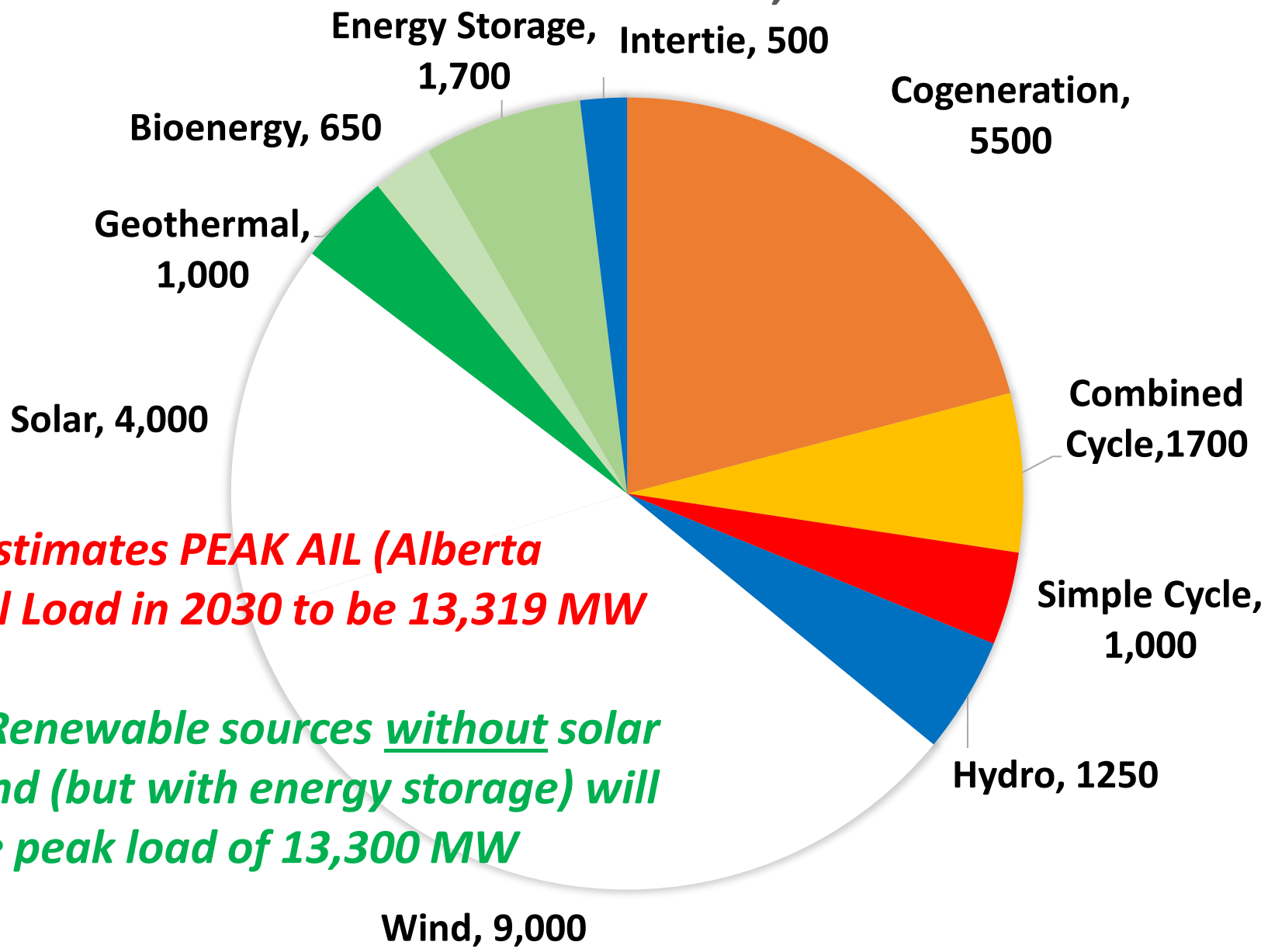
AESO 2030 LTO
TOTAL CAPACITY = 19,853 MW



AREA HIGH RENEWABLES 2030
TOTAL CAPACITY = 26,300 MW



AREA HIGH RENEWABLES 2030
TOTAL CAPACITY = 26,300 MW



AESO estimates PEAK AIL (Alberta Internal Load in 2030 to be 13,319 MW

AREA Renewable sources without solar and wind (but with energy storage) will provide peak load of 13,300 MW

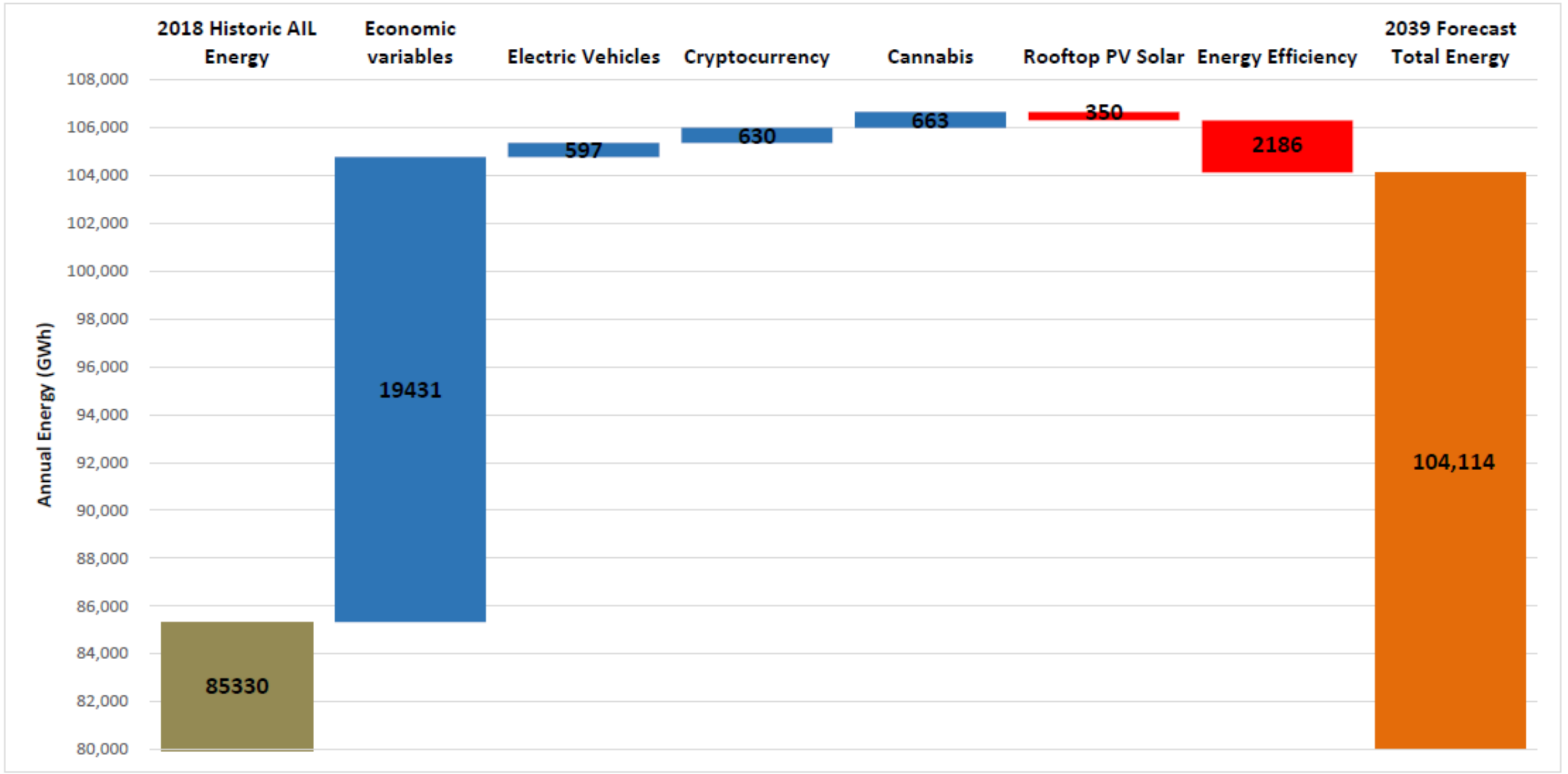
Question

- What future new loads were forecast?

Answer

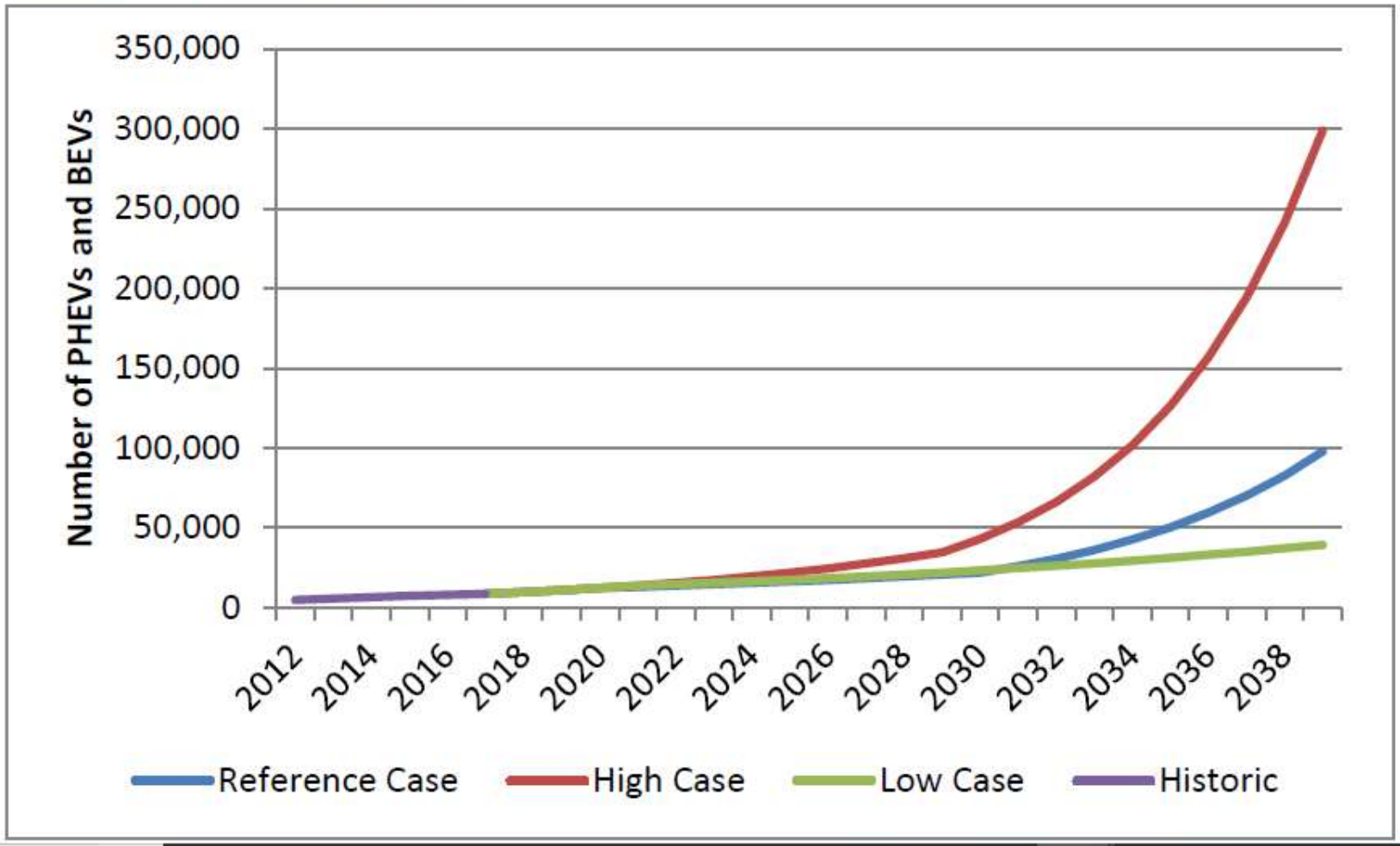
Source: Page 61 of AESO 2019 LTO

FIGURE 6: Composition of Load Growth 2018-2039 (Reference Case)



The Low Growth Scenario uses the Low EV adoption case, while the High Growth and Diversification Scenarios use the High EV adoption case and the Reference Case Scenario uses the Reference EV adoption case. Figure 7 shows the results of each case included in the electric vehicles analysis.

FIGURE 7: EV Scenario Results



Question

- When assessing costs and LCOE (Levelized Cost of Energy), what carbon prices were forecasted to 2039?

Answer

Source: Page 50 of AESO 2019 LTO

> LCOE estimates assumed an in-service date of Jan. 1, 2020 for all technologies and a 20-year economic life was modelled for all assets. The LCOE calculations assumed a carbon price of $20/tonne (t) in 2020, which was increased by 2 per cent annually thereafter. It was assumed that gas units would be benchmarked against a CO2 emission standard of 0.3663 t/MWh in 2020 and the emission standard would decrease by 0.0037 t/MWh each year. In this analysis, the LCOE for wind and solar did not consider any revenue from carbon offsets or carbon credits.

- AREA NOTE:
- 20 year life for all assets (includes Coal to Gas);
- All gas generation will be benchmarked against 0.3663 tne CO2/MWh and minimally reduced annually by 0.0037 tne CO2 thereafter;
- Carbon price $20/tne in 2020 to be minimally increased annually by 2% thereafter (which completely contradicts Federal legislation);
- **LCOE (Levelized Cost of Energy) for wind and solar did not consider any revenue from carbon offsets or carbon credits**

Question

- Why is energy storage not forecast to be part of the energy mix by 2039?

Answer

Source: Page 60 of AESO 2019 LTO

Storage

Alberta currently does not have any transmission-connected energy storage projects; however, multiple projects have applied for connection and some have received funding to support their development. Energy storage technologies that have applied for connection within Alberta include lithium-ion batteries, compressed air energy storage and pumped hydro storage. Currently across the U.S. and other global jurisdictions, energy storage technologies are being considered and installed for many purposes. These include energy price arbitrage, ancillary services, transmission and distribution investment deferral, voltage and frequency support, back-up supply, enabling intermittent generation dispatch, and emissions reductions.

There are multiple factors that make the economics of energy storage challenging in Alberta, including transmission charges and limited opportunities for revenues within the operating reserve markets.[8] While the current legislated framework does not prohibit the participation of energy storage in the energy and ancillary services markets, in practice the existing legislation, regulations and AESO Authoritative Documents do not fully contemplate the unique attributes and challenges associated with the participation of energy storage in Alberta's electricity system. The *AESO Energy Storage Roadmap*[9] will approach energy storage as a unique asset type, facilitate integration, and will be impartial to energy storage technology.

Question

- When assessing costs, what natural gas prices were forecasted to 2039?

Answer

Source: Page 50 of AESO 2019 LTO

Other cost assumptions included a transmission loss factor of 2.75 per cent based on available forward power prices, a trading charge of $0.47/MWh in 2020 and a commodity fuel charge[3] of 1.66 per cent of gas prices. Trading charges, fixed O&M and variable O&M costs were assumed to increase 2 per cent annually.

Question

- In AESOs Alternate Renewable Policy Scenario what was AESOs forecast for Renewable Capacity by 2039?

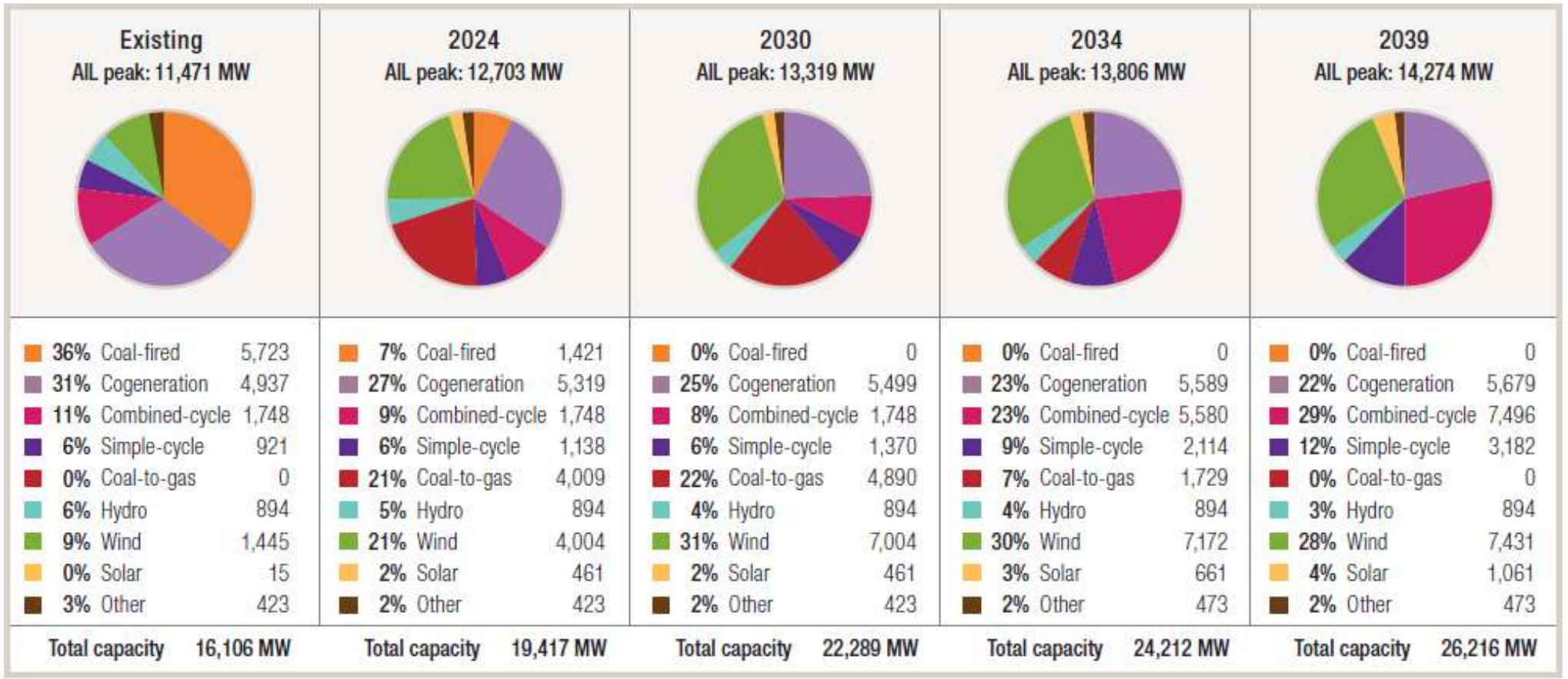
Answer

Source: Page 37 of AESO 2019 LTO

6.1.3 Alternate Renewable Policy Scenario Generation Results

The Alternate Renewable Policy Scenario has a large amount of renewable generation compared to the Reference Case. Over 6,800 MW of wind and 1,000 MW of solar capacity are added to the fleet at the end of the forecast period. Wind generation capacity is 28 per cent of the generation mix in 2039. This results in more simple-cycle additions, along with less combined-cycle generation capacity.

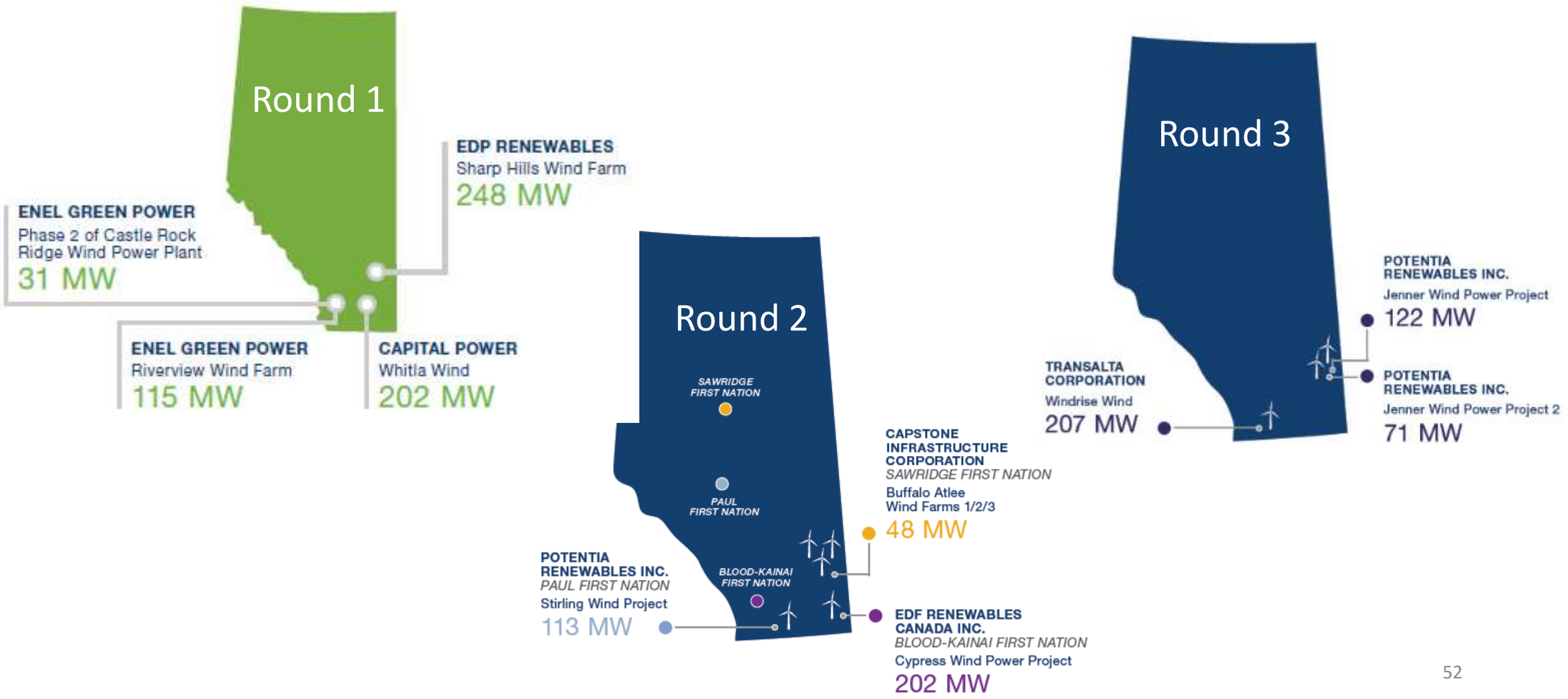
FIGURE 9: Alternate Renewable Policy Scenario – Generation Capacity



Question

- What impact has UCP government had in regard to incentives for Renewables?
- The 90 cents per watt rebate for residential solar photovoltaics has been cancelled
- See following slides regarding wind projects

Total of Three REP Rounds = 1,359 MW
But REP Round 4 was cancelled by UCP



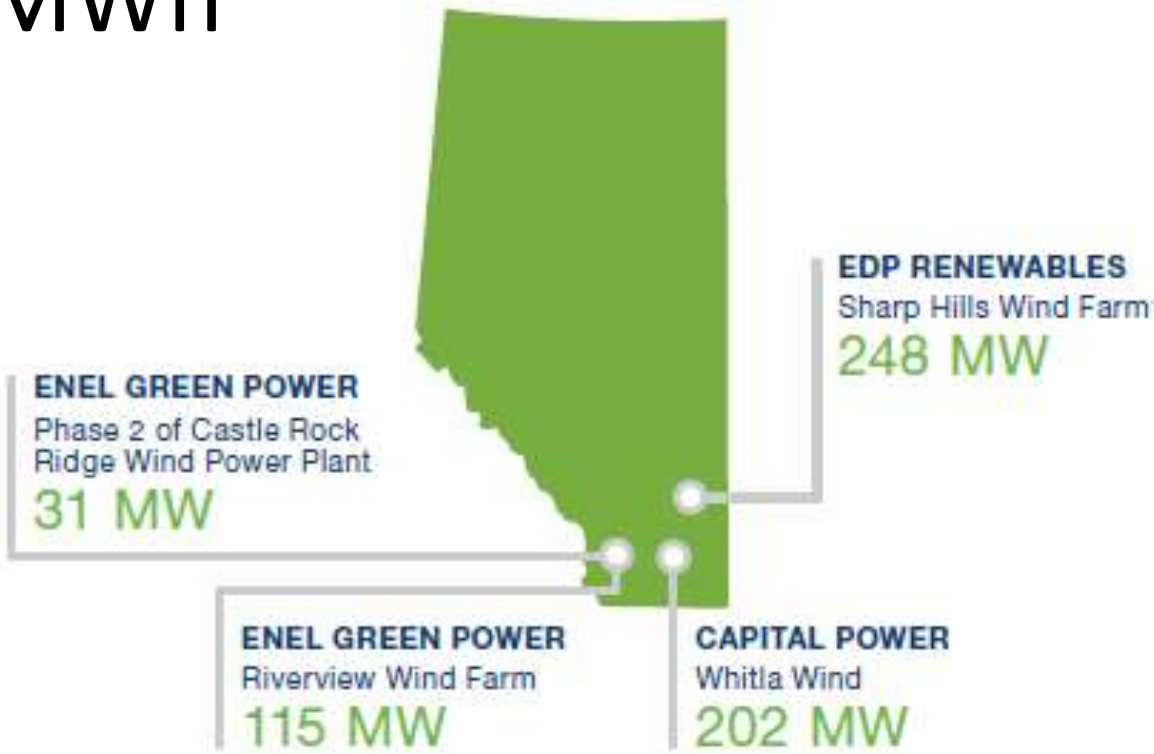
Round 1

596 MW

Average Price $37.35/MWh

Alberta's Renewable Electricity Program attracts lowest renewable pricing in Canada

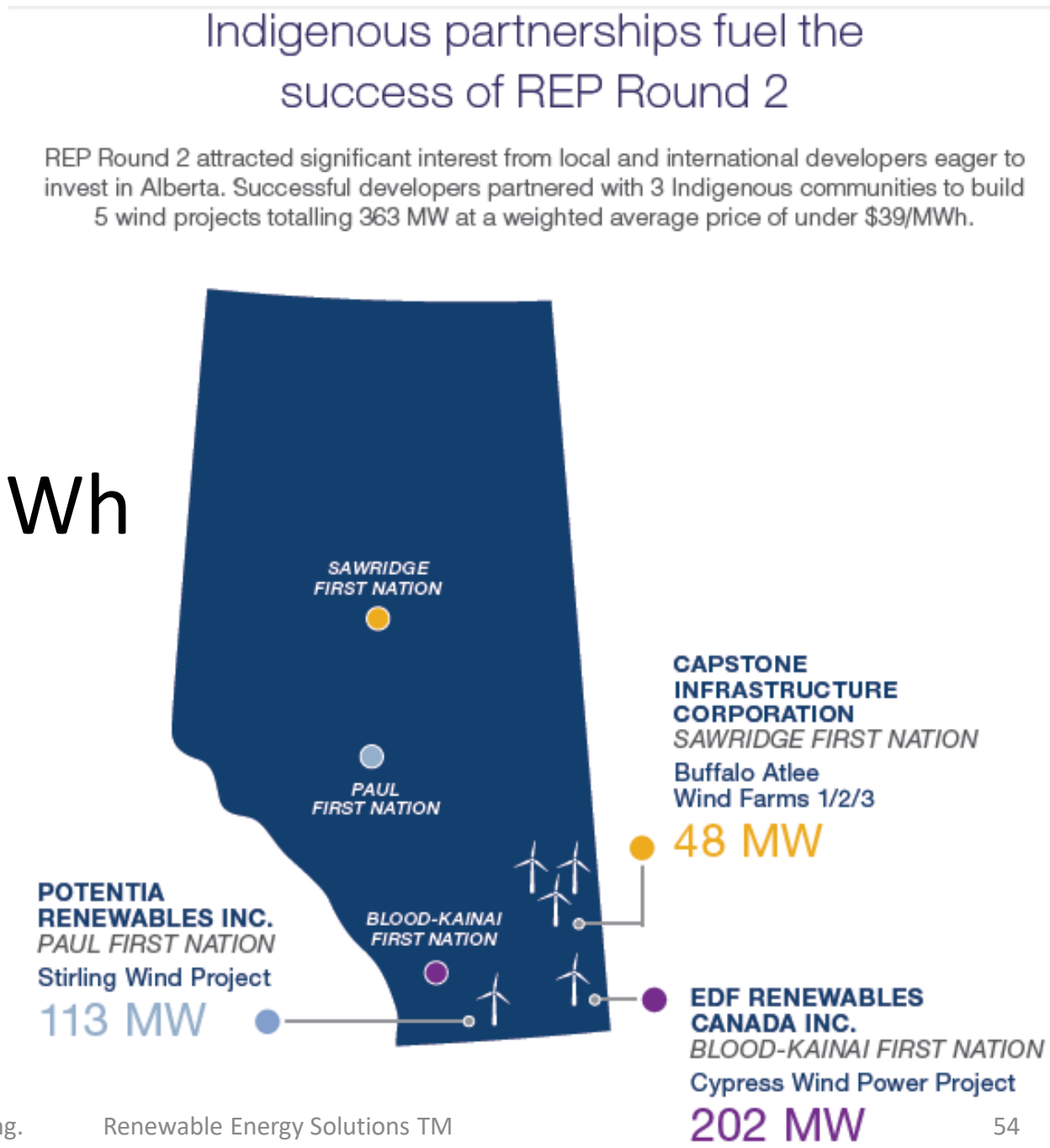
Round 1 of the Renewable Electricity Program successfully delivered nearly 600 MW of wind generation at bid prices that are competitive globally and record-setting in Canada. The four successful projects for Round 1 are:



Round 2

363 MW

Average Price $38.69/MWh



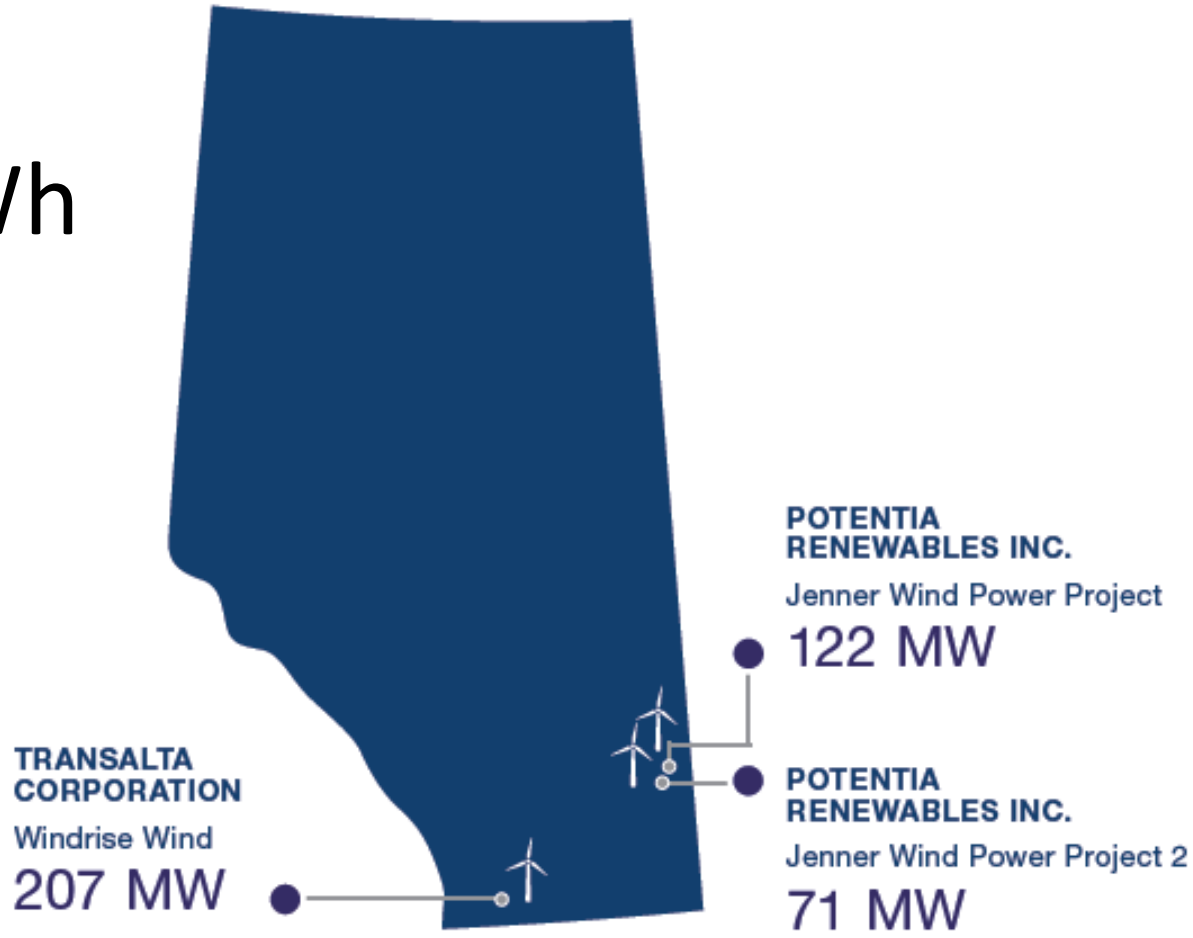
Round 3

400 MW

Average Price $40.14/MWh

REP Round 3 keeps the competitive momentum going

REP Round 3 demonstrates continued interest in investing in renewables in Alberta. Strong competition resulted in 3 successful wind projects totalling 400 MW at a weighted average price of approximately $40/MWh.



If further Questions
Contact:
Ken Hogg
kshogg@shaw.ca