

MODULE 6: Emissions Outlook

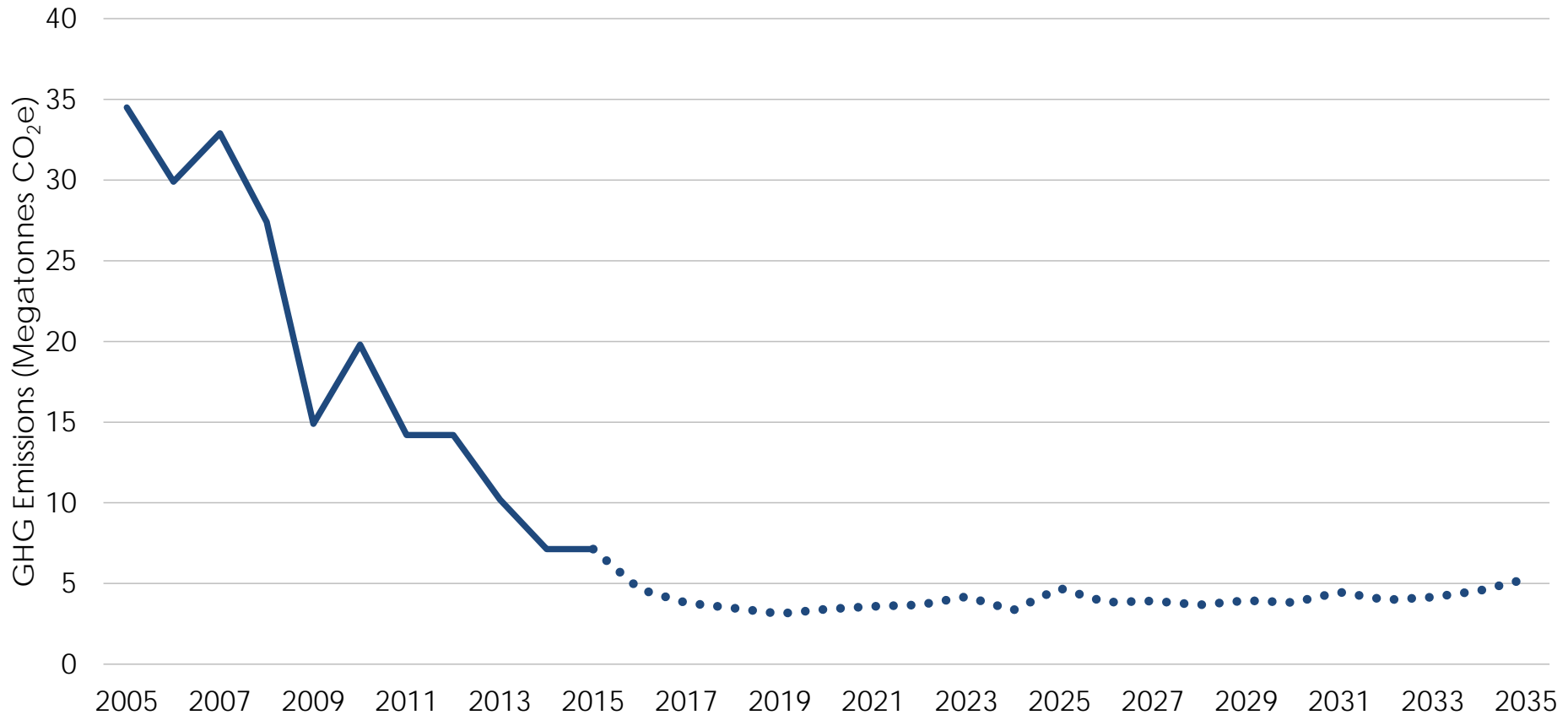
August 2016

Outlook for emissions

- The following slides provide an outlook for the following air emissions:
 - Greenhouse gas (GHG) emissions
 - Sulphur oxide emissions (SO_x)
 - Nitrogen oxide emissions (NO_x)
 - Fine particulate matter emissions less than $2.5 \mu\text{m}$ ($\text{PM}_{2.5}$)
 - Mercury emissions (Hg)

Electricity sector GHG emissions in Outlook B

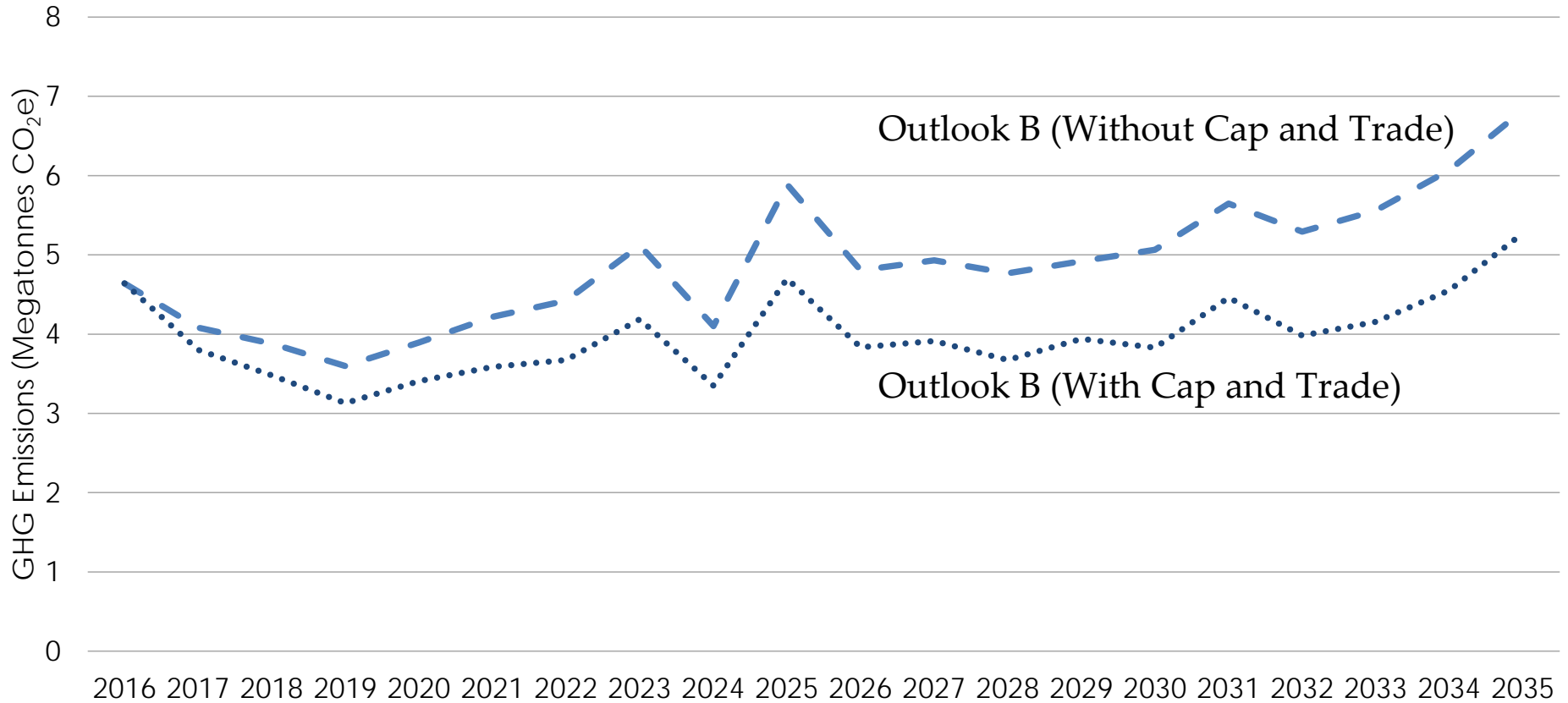
- Emissions decline in the near term, as additional renewable generation enters service, and remain relatively flat in the longer term, averaging 4 MT per year over the planning outlook
- Emissions expected to rise slightly following Pickering retirement but will remain well below historical levels



Cap and trade impacts

- With Cap and Trade in effect in 2017, the electricity sector will see the cost of carbon reflected in the wholesale electricity price when natural gas-fired resources are on the margin
- The Ontario market price for carbon will also be applied to electricity imports, which will reduce imports from higher emitting sources. At the same time, imports to Ontario from non-emitting jurisdictions such as Quebec could increase, other things being equal.
- Similarly, the addition of a carbon price to emitting Ontario generators would reduce the amount of electricity exported from natural gas-fired generators, and so reduce Ontario GHG emissions

Cap and trade impacts in Outlook B



Data for slide 3 and 5: GHG emissions in Outlook B

Historical Greenhouse Gas Emissions

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
GHG Emissions (Megatonnes CO ₂ e)	34.5	29.9	32.9	27.4	14.9	19.8	14.2	14.2	10.2	7.1	7.1

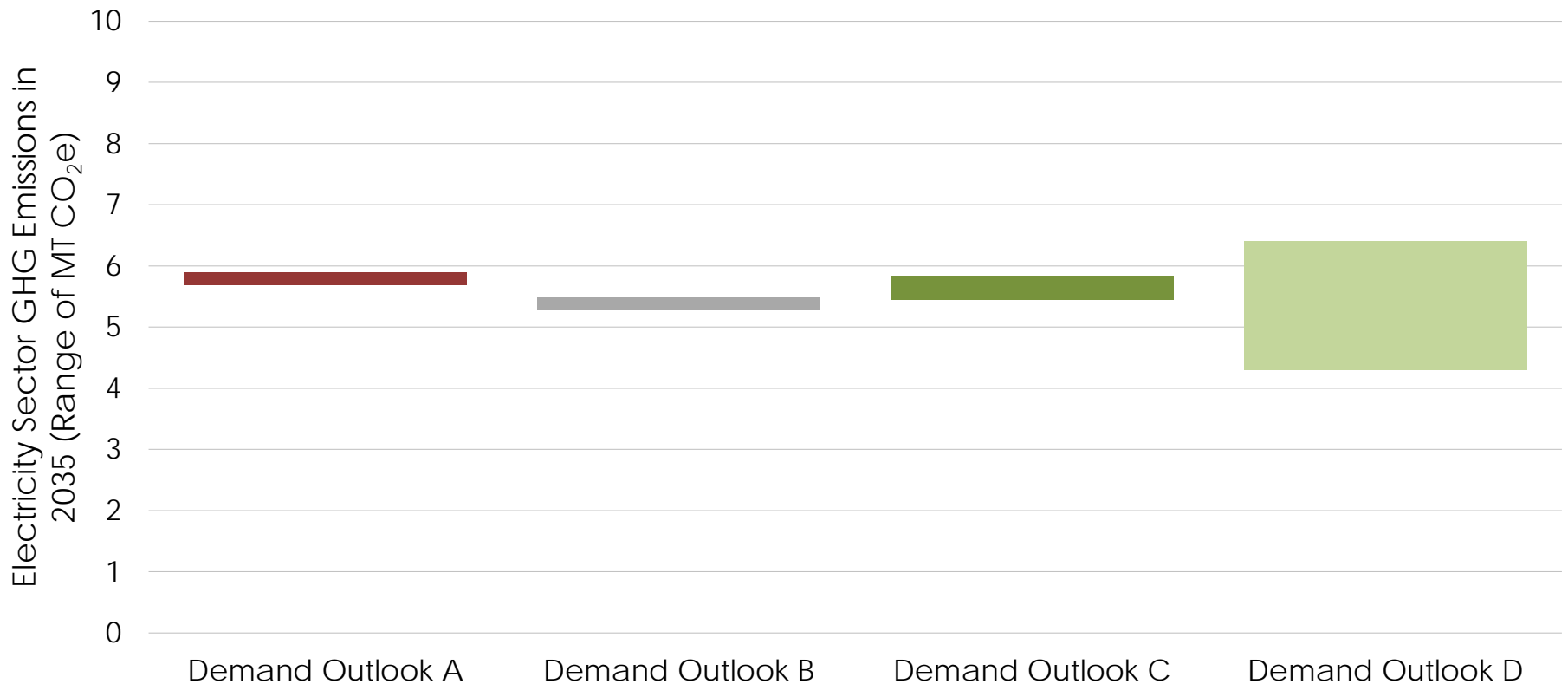
Greenhouse Gas Emissions in Outlook B

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GHG Emissions (Megatonnes CO ₂ e)	4.6	3.8	3.5	3.1	3.4	3.6	3.7	4.2	3.4	4.7
GHG Emissions, without Cap and Trade (Megatonnes CO ₂ e)	4.6	4.1	3.9	3.6	3.9	4.2	4.4	5.1	4.1	5.9

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
GHG Emissions (Megatonnes CO ₂ e)	3.8	3.9	3.7	3.9	3.8	4.5	4.0	4.2	4.6	5.3
GHG Emissions, without Cap and Trade (Megatonnes CO ₂ e)	4.8	4.9	4.8	4.9	5.1	5.6	5.3	5.6	6.1	6.8

For illustration, in higher demand outlooks consideration is given to keeping GHG emissions within the range of that in Outlook B

- Additional information about the resources associated with each demand outlook can be found in Module 7



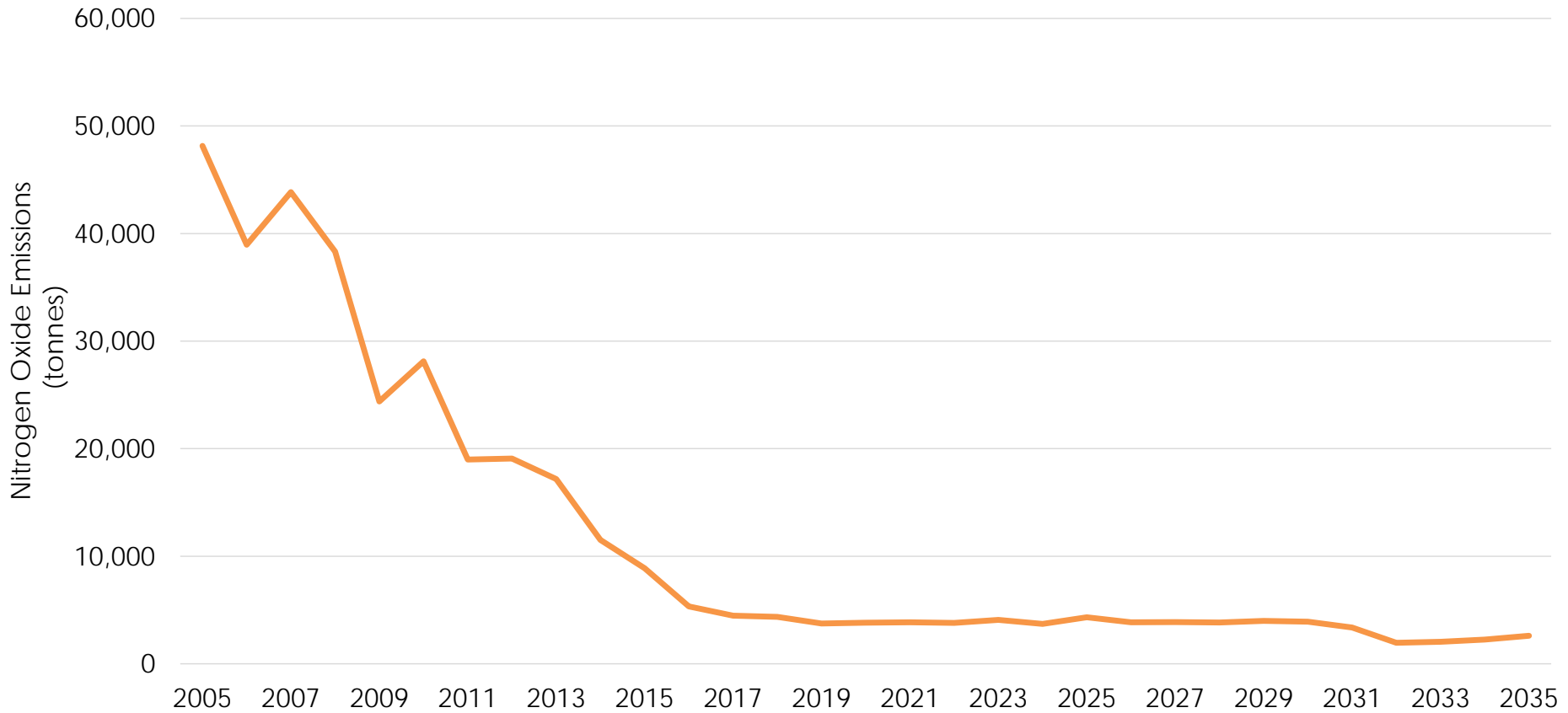
Data for slide 7: GHG emissions outlook

Greenhouse Gas Emissions Outlook

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
A – Solar, Wind, Gas	4.8	4.0	3.5	3.1	3.3	3.5	3.6	4.1	3.2	4.6
A – Nuclear, Gas	4.8	4.0	3.5	3.1	3.3	3.5	3.6	4.1	3.2	4.6
B	4.6	3.8	3.5	3.1	3.4	3.6	3.7	4.2	3.4	4.7
C1 - Wind, Waterpower, Demand Response, Firm Imports	4.6	3.8	3.5	3.2	3.6	3.9	3.5	3.9	3.3	4.5
C2 - Wind, Demand Response, Firm Imports, Gas	4.6	3.8	3.5	3.2	3.6	3.9	3.5	3.9	3.3	4.5
C3 - Wind, Demand Response, Nuclear, Firm Imports	4.6	3.8	3.5	3.2	3.6	3.9	3.5	3.9	3.3	4.5
D1 - Wind, Waterpower, Demand Response, Firm Imports	5.3	4.3	4.1	3.8	4.2	4.8	4.9	5.7	4.8	5.5
D2 - Wind, Waterpower, Demand Response, Firm Imports, Gas	5.3	4.3	4.1	3.8	4.2	4.8	4.9	5.7	4.9	5.6
D3 - Wind, Waterpower, Demand Response, Nuclear, Firm Imports	5.3	4.3	4.1	3.8	4.2	4.8	4.8	5.7	4.8	5.5
D4 - Wind, Waterpower, Demand Response, Nuclear, Firm Imports, Gas	5.3	4.3	4.1	3.8	4.2	4.8	4.9	5.7	4.9	5.6

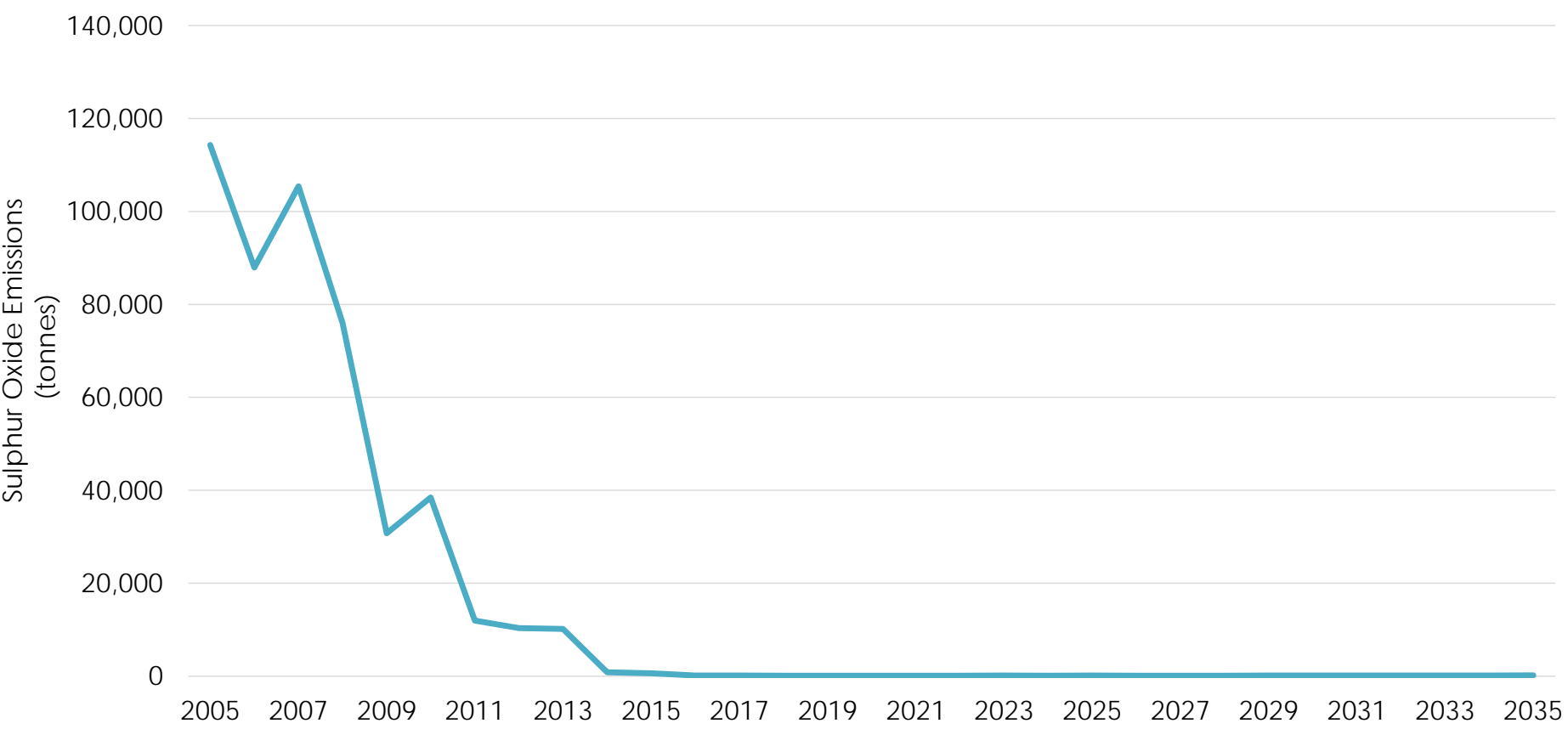
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
A – Solar, Wind, Gas	3.6	3.6	3.5	3.7	3.7	4.1	3.7	4.0	4.6	5.7
A – Nuclear, Gas	3.6	3.6	3.4	3.5	3.4	4.3	4.0	4.5	5.1	5.9
B	3.8	3.9	3.7	3.9	3.8	4.5	4.0	4.2	4.6	5.3
C1 - Wind, Waterpower, Demand Response, Firm Imports	3.8	4.0	3.8	4.5	4.4	5.0	4.3	4.8	5.4	5.6
C2 - Wind, Demand Response, Firm Imports, Gas	3.8	4.0	3.8	4.5	4.4	5.1	4.3	4.9	5.6	5.8
C3 - Wind, Demand Response, Nuclear, Firm Imports	3.9	4.0	3.9	4.4	4.3	5.1	4.4	4.5	5.1	5.4
D1 - Wind, Waterpower, Demand Response, Firm Imports	4.1	4.4	4.6	5.6	5.3	4.9	4.4	3.5	4.4	4.4
D2 - Wind, Waterpower, Demand Response, Firm Imports, Gas	4.1	4.4	4.6	5.7	5.7	6.7	5.9	4.6	5.6	6.4
D3 - Wind, Waterpower, Demand Response, Nuclear, Firm Imports	4.1	4.4	4.6	5.6	5.3	4.9	4.5	3.8	4.8	4.3
D4 - Wind, Waterpower, Demand Response, Nuclear, Firm Imports, Gas	4.3	4.6	4.9	6.0	5.7	5.8	5.3	4.4	5.4	6.2

Nitrogen oxide emissions in Outlook B



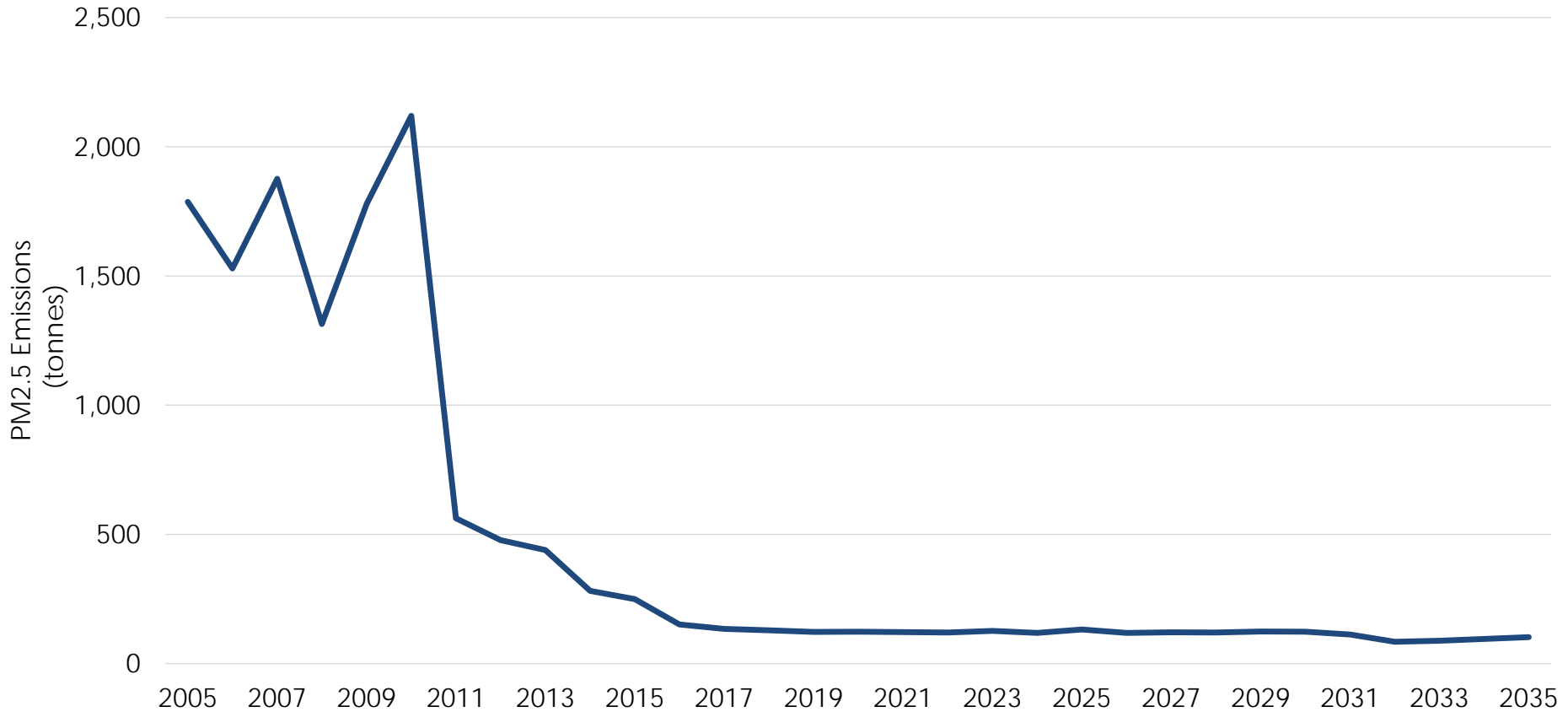
Source: Environment Canada (2005-2014), IESO (2015-2035)

Sulphur oxide emissions in Outlook B

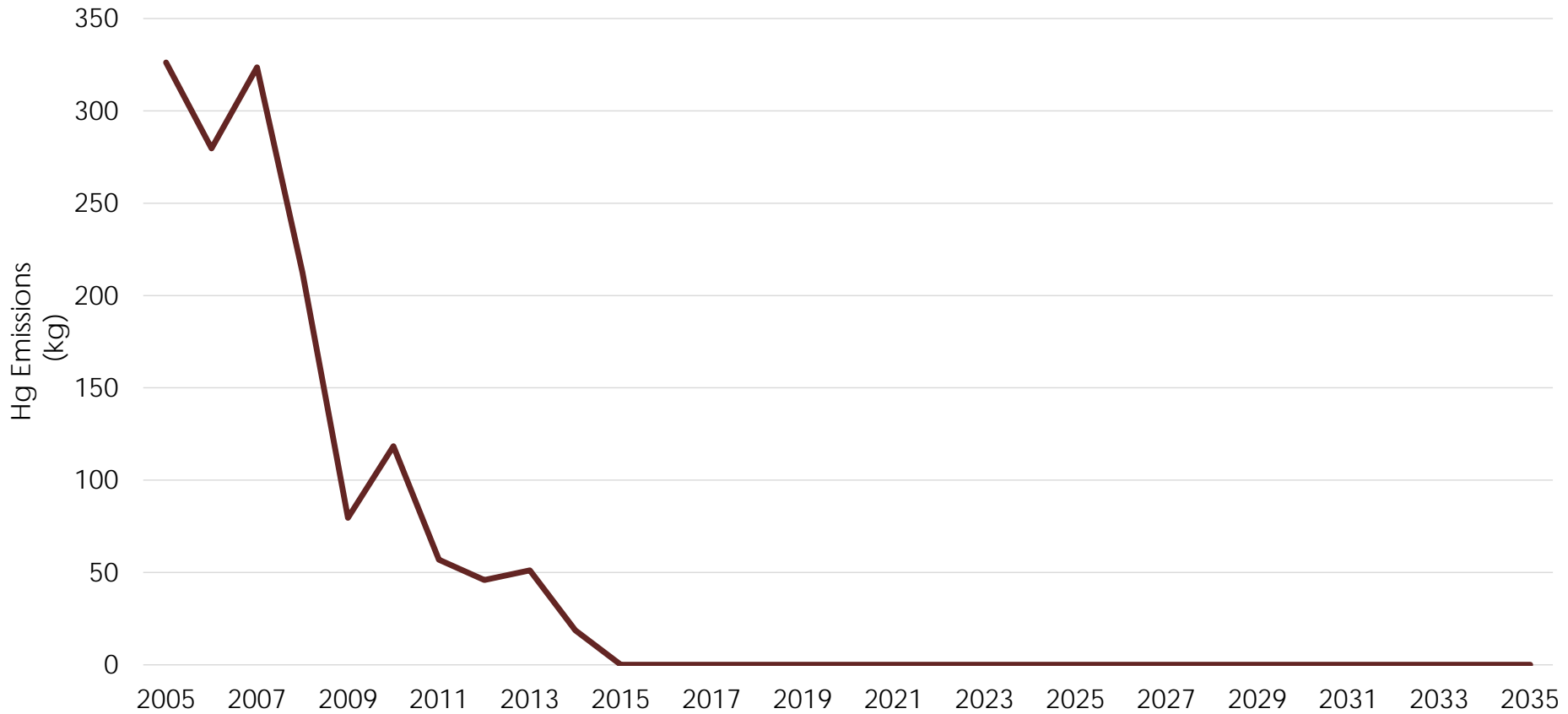


Source: Environment Canada (2005-2014), IESO (2015-2035)

Fine particulate matter (<2.5µm) emissions in Outlook B



Mercury emissions in Outlook B



Data for slides 9-12: Air contaminant emissions in Outlook B

Historical Air Contaminant Emissions

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Nitrogen oxide emissions (tonnes)	48,143	38,955	43,846	38,314	24,389	28,130	18,988	19,077	17,183	11,520	8,877
Sulphur oxide emissions (tonnes)	114,323	87,932	105,420	76,020	30,768	38,448	11,971	10,342	10,192	847	620
Fine particulate matter (<2.5µm) emissions (tonnes)	1,787	1,529	1,876	1,314	1,779	2,120	562	478	439	281	249
Mercury emissions (kg)	326	280	324	212	80	118	57	46	51	19	0

Air Contaminant Emissions in Outlook B

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Nitrogen oxide emissions (tonnes)	5,323	4,474	4,363	3,747	3,811	3,862	3,804	4,077	3,704	4,330
Sulphur oxide emissions (tonnes)	157	131	123	111	115	114	118	139	114	149
Fine particulate matter (<2.5µm) emissions (tonnes)	152	134	129	123	123	122	120	126	119	132
Mercury emissions (kg)	0	0	0	0	0	0	0	0	0	0

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Nitrogen oxide emissions (tonnes)	3,860	3,883	3,832	3,984	3,921	3,370	1,951	2,036	2,246	2,613
Sulphur oxide emissions (tonnes)	124	125	123	132	131	150	141	144	169	193
Fine particulate matter (<2.5µm) emissions (tonnes)	118	121	120	124	123	112	85	88	95	102
Mercury emissions (kg)	0	0	0	0	0	0	0	0	0	0