

# Appendices Tables

## Appendix A Tables

Carbon footprint associated with misdiagnosis of asthma and COPD in Canada

### Asthma

Addressing asthma misdiagnosis and eliminating associated unnecessary inhaler use would reduce GHG emissions by ~54,500 metric tons of CO<sub>2</sub> equivalent (MT CO<sub>2</sub>e) annually (e-Table A-1).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. \*

**e-Table A-1. Carbon footprint associated with misdiagnosis of asthma in Canada**

A	Prevalence of clinically-diagnosed asthma*	3,800,000 people
B	Number of people in “A” who do not have objective evidence of disease †	1,254,000 people (A × 33%)
C	Number of people in “B” who are using asthma medications †	990,660 people (B × 79%)
	<b>Rescue inhalers</b>	
	<b>SABA</b>	
D	Number of people in “C” who are using a SABA	990,660 people (C × 100%)
	<b>MDI</b>	
E	Number of people in “D” who are using a SABA MDI ‡	931,220 people (D × 94%)
F	Estimated number of actuations used by each patient in “E” each year §	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)
G	Carbon footprint associated with SABA MDI use in people in “E” ¶	<b>12,735 MT CO<sub>2</sub>e</b> (E × F × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
H	Number of people in “D” who are using a SABA DPI ‡	59,440 people (D × 6%)
I	Estimated number of actuations used by each patient in “H” each year §	52 act per person per year (1 act/dose × 1 dose/week × 52 weeks/year)
J	Carbon footprint associated with SABA DPI use in people in “H” ¶	<b>28 MT CO<sub>2</sub>e</b> (H × I × 0.009 kg CO <sub>2</sub> e/act)
	<b>Controller inhalers</b>	
K	Number of people in “C” who are using an ICS or ICS/LABA daily †	326,918 people (C × 33%)
	<b>ICS</b>	

L	Number of people in “K” who are using an ICS <sup>#</sup>	137,305 people (K × 42%)
	<b>MDI</b>	
M	Number of people in “L” who are using an ICS MDI <sup>#</sup>	76,891 people (L × 56%)
N	Number of ICS MDI actuations used by each patient in “M” each year <sup>**</sup>	584 act per year (2 act/day × 365 days/year × 80% adherence)
O	Carbon footprint associated with ICS MDI (HFC-134a) use in people in “M” <sup>†</sup>	<b>5,905 MT CO<sub>2</sub>e</b> (M × N × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
P	Number of people in “L” who are using an ICS DPI <sup>#</sup>	60,414 people (L × 44%)
Q	Number of ICS MDI actuations used by each patient in “P” each year	584 act per year (2 act/day × 365 days/year × 80% adherence)
R	Carbon footprint associated with ICS DPI use in people in “P” <sup>†</sup>	<b>318 MT CO<sub>2</sub>e</b> (P × Q × 0.009 kg CO <sub>2</sub> e/act)
	<b>ICS/LABA</b>	
S	Number of people in “K” who are using an ICS-LABA <sup>††</sup>	189,612 people (K × 58%)
	<b>MDI</b>	
T	Number of people in “S” who are using an ICS/LABA MDI <sup>‡</sup>	89,118 people (S × 47%)
	HFC-134a-containing MDI	
U	Number of people in “T” who are using an ICS/LABA MDI using HFC-134a as propellant <sup>**</sup>	78,424 people (T × 88%)
V	Number of ICS/LABA MDI actuations used by each patient in “U” each year	584 act per year (2 act/day × 365 days/year × 80% adherence)
W	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “U” <sup>†</sup>	<b>12,045 MT CO<sub>2</sub>e</b> (U × V × 0.1315 kg CO <sub>2</sub> e/act)
	HFC-227ea-containing MDI	
X	Number of people in “T” who are using an ICS/LABA MDI using HFC-227ea as propellant <sup>**</sup>	10,694 people (T × 12%)
Y	Number of ICS/LABA MDI actuations used by each patient in “X” each year	1,168 act per year (2 act/day × 365 days/year × 80% adherence)
Z	Carbon footprint associated with ICS/LABA MDI (HFC-227ea) use in people in “X” <sup>†</sup>	<b>4,353 MT CO<sub>2</sub>e</b> (X × Y × 0.3485 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
AA	Number of people in “S” who are using an ICS/LABA DPI <sup>‡</sup>	89,118 people (S × 53%)
AB	Number of ICS/LABA DPI actuations used by each patient in “AA” each year <sup>**</sup>	584 act per year (2 act/day × 365 days/year × 80% adherence)
AC	Carbon footprint associated with ICS/LABA DPI use in people in “AA” <sup>†</sup>	<b>468 MT CO<sub>2</sub>e</b> (AA × AB × 0.009 kg CO <sub>2</sub> e/act)
	<b>Total</b>	
AD	Carbon footprint of MDIs in misdiagnosed patients	35,039 MT CO <sub>2</sub> e (G + O + W + Z)
AE	Carbon footprint of DPIs in misdiagnosed patients	814 MT CO <sub>2</sub> e (J + R + AC)
<b>AF</b>	<b>Total inhaled carbon footprint</b> due to misdiagnosed patients	<b>35,853 MT CO<sub>2</sub>e</b> (AD + AE)

**Act:** actuations; **DPI:** dry-powder inhaler; **ICS:** inhaled corticosteroid; **LABA:** long-acting beta<sub>2</sub>-agonist; **MT CO<sub>2</sub>e:** metric tons of CO<sub>2</sub> equivalent; **MDI:** metered dose inhaler; **SABA:** short-acting beta<sub>2</sub>-agonist

Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.

\* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup>.

<sup>†</sup> Percentage of people with clinically-diagnosed asthma who do not have objective evidence of disease derived from Aaron, Vandemheen, et al. <sup>2</sup>.

‡ Market sales for SABA MDI and DPI devices derived from Janson, Henderson, et al. <sup>3</sup>.  
 § We consider an averaged use of 1 dose of SABA per week. This reflects a conservative definition, given that guidelines define well-controlled asthma as no more than 2 uses (doses) of SABA per week. <sup>4,5</sup> Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation.  
 ¶ Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup>.  
 # Market sales for ICS MDI and DPI devices are derived from Lavorini, Corrigan, et al. <sup>7</sup>.  
 \*\* Although this analysis focuses on people with overdiagnosed asthma who report using asthma medications *daily*, we herein consider an 80% adherence rate, to account for non-intentional non-adherence.  
 †† Market sales for ICS/LABA MDI and DPI devices are derived from a government report PMPRB <sup>8</sup>.

## COPD

In COPD, eliminating misdiagnosis would still save ~25,500 MT CO<sub>2</sub>e annually in Canada (e-

### Table A-2).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. \*

**e-Table A-2. Carbon footprint associated with misdiagnosis of COPD in Canada**

A	Prevalence of clinically-diagnosed COPD*	2,000,000 people
B	Number of people in “A” who do not have objective evidence of disease †	880,000 people (A × 44%)
C	Number of people in “B” who are using COPD medications †	589,600 people (B × 67%)
	<b>Rescue inhalers</b>	
	<b>SABA</b>	
D	Number of people in “C” who are using a SABA ‡	560,120 people (C × 95%)
	<b>MDI</b>	
E	Number of people in “D” who are using a SABA MDI ‡	526,513 people (D × 94%)
F	Number of SABA MDI actuations used by a single patient in “E” each year §	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)
G	Carbon footprint associated with SABA MDI use in people in “E” ¶	<b>7,201 metric tons of CO<sub>2</sub>e</b> (E × F × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
H	Number of people in “D” who are using a SABA DPI ‡	33,607 people (D × 6%)
I	Estimated number of SABA DPI actuations used by a single patient in “H” each year §	52 act per person per year (1 act/dose × 1 dose/week × 52 weeks/year)
J	Carbon footprint associated with SABA DPI use in people in “H” ¶	<b>16 MT CO<sub>2</sub>e</b> (H × I × 0.009 kg CO <sub>2</sub> e/act)
	<b>SAMA</b>	
K	Number of people in “C” who are using a SAMA ‡	29,480 people (C × 5%)
	<b>MDI</b>	
L	Number of people in “K” who are using a SAMA MDI ‡	29,480 people (K × 100%)
M	Estimated number of SAMA MDI actuations used by a single patient in “L” each year §	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)

N	Carbon footprint associated with SAMA MDI use in people in “L” †	<b>403 MT CO<sub>2</sub>e</b> ( $L \times M \times 0.1315 \text{ kg CO}_2\text{e/act}$ )
	<b>Controller inhalers</b>	
	<b>LABA</b>	
O	Number of people in “C” who are using a LABA ‡	35,376 people ( $C \times 6\%$ )
	<b>DPI</b>	
P	Number of people in “O” who are using a LABA DPI	35,376 people ( $O \times 100\%$ )
Q	Estimated number of LABA DPI actuations used by a single patient in “P” each year #	270 act per person per year ( $1 \text{ act/dose} \times 2 \text{ times/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )
R	Carbon footprint associated with LABA DPI use in people in “P” †	<b>86 MT CO<sub>2</sub> equivalent</b> ( $P \times Q \times 0.009 \text{ kg CO}_2\text{e/act}$ )
	<b>LAMA or LAMA/LABA</b>	
S	Number of people in “C” who are using a LAMA or a LAMA/LABA ‡	318,384 people ( $C \times 54\%$ )
	<b>DPI</b>	
T	Number of people in “S” who are using a LAMA DPI or a LAMA/LABA DPI	318,384 people ( $s \times 100\%$ )
U	Estimated number of a LAMA DPI or a LAMA/LABA DPI actuations used by a single patient in “T” each year #	157 act per person per year ( $1 \text{ act/dose} \times 1 \text{ time/day} \times 365 \text{ days/year} \times 43\% \text{ adherence}$ )
V	Carbon footprint associated with a LAMA DPI or a LAMA/LABA DPI use in people in “T” †	<b>450 MT CO<sub>2</sub> equivalent</b> ( $T \times U \times 0.009 \text{ kg CO}_2\text{e/act}$ )
	<b>ICS/LABA</b>	
W	Number of people in “C” who are using an ICS/LABA ‡	235,840 people ( $C \times 40\%$ )
	<b>MDI</b>	
X	Number of people in “W” who are using an ICS/LABA MDI ‡	110,845 people ( $W \times 47\%$ )
	<b>HFC-134a-containing MDI</b>	
Y	Number of people in “X” who are using an ICS/LABA MDI using HFC-134a as propellant **	97,543 people ( $X \times 88\%$ )
Z	Number of ICS/LABA MDI actuations used by each patient in “Y” each year#	270 act per year ( $1 \text{ act/dose} \times 2 \text{ doses/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )
AA	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “Y” †	<b>3,465 MT CO<sub>2</sub>e</b> ( $Y \times Z \times 0.1315 \text{ kg CO}_2\text{e/act}$ )
	<b>HFC-227ea-containing MDI</b>	
AB	Number of people in “X” who are using an ICS/LABA MDI using HFC-227ea as propellant **	13,301 people ( $X \times 12\%$ )
AC	Number of ICS/LABA MDI actuations used by each patient in “AB” each year #	270 act per year ( $1 \text{ act/dose} \times 2 \text{ doses/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )
AD	Carbon footprint associated with ICS/LABA MDI (HFC-227ea) use in people in “AB” †	<b>3,465 MT CO<sub>2</sub>e</b> ( $AB \times AC \times 0.3485 \text{ kg CO}_2\text{e/act}$ )
	<b>DPI</b>	
AE	Number of people in “W” who are using an ICS/LABA DPI ‡	124,995 people ( $W \times 53\%$ )
AF	Number of ICS/LABA DPI actuations used by each patient in “AE” each year #	270 act per year ( $1 \text{ act/dose} \times 2 \text{ doses/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )
AG	Carbon footprint associated with ICS/LABA DPI use in people in “AE” †	<b>304 MT CO<sub>2</sub>e</b> ( $AE \times AF \times 0.009 \text{ kg CO}_2\text{e/act}$ )
	<b>LAMA/LABA/ICS</b>	
AH	Number of people in “C” who are using a LAMA/LABA/ICS ‡	23,584 people ( $C \times 0.04\%$ )
	<b>DPI</b>	

AI	Number of people in “AH” who are using a LAMA/LABA/ICS DPI ‡	23,584 people (AH × 100%)
AJ	Estimated number of LAMA/LABA/ICS DPI actuations used by a single patient in “AI” each year §	157 act per person per year (1 act/dose × 1 time/day × 365 days/year × 43% adherence)
AK	Carbon footprint associated with SAMA DPI use in people in “AI” ¶	<b>33 MT CO<sub>2</sub> equivalent</b> (AI × AJ × 0.009 kg CO <sub>2</sub> e/act)
	<b>Total</b>	
AL	Carbon footprint of MDIs in misdiagnosed patients	12,320 MT CO <sub>2</sub> e (G + N + AA + AD)
AM	Carbon footprint of DPIs in misdiagnosed patients	889 MT CO <sub>2</sub> e (J + V + AG + AK)
AN	<b>Total inhaler carbon footprint</b> due to misdiagnosed patients	<b>13,209 MT CO<sub>2</sub>e (AL + AM)</b>
<p><b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>DPI:</b> Dry-powder inhaler; <b>LABA:</b> long-acting beta<sub>2</sub>-agonist; <b>LAMA:</b> long-acting muscarinic antagonist; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO<sub>2</sub> equivalent; <b>SABA:</b> short-acting beta<sub>2</sub>-agonist; <b>SAMA:</b> short-acting muscarinic antagonist</p>		
<p>Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.</p>		
<p>* Prevalence of clinically-diagnosed COPD is derived from Public Health Agency of Canada <sup>1</sup>.  † Percentage of people without objective evidence of disease and percentage of people using COPD medications derived from Hill, Goldstein, et al. <sup>9</sup>.  ‡ Market sales for MDI and DPI devices are derived from Janson, Henderson, et al. <sup>3</sup>.  § Good control is defined as 1 use (dose) of short-acting reliever per week, as per Soler-Cataluna, Marzo, et al. <sup>10</sup>. Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation.  ¶ Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup>.  # Percentage of people adherent to their controller medication is derived from Toy, Beaulieu, et al. <sup>11</sup>.  ** Market sales for ICS/LABA MDI and DPI devices are derived from a government report. <sup>8</sup>.</p>		

## Appendix B Tables

Carbon footprint associated with excess use of asthma and COPD rescue therapy in Canada

### Asthma

In asthma, the excess use of SABA therapy due to poor symptom control drives GHG emissions amounting to ~81,300 metric tons of CO<sub>2</sub> equivalent (**e-Table B-1**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. \*

**e-Table B-1. Carbon footprint associated with excess SABA inhaler use in asthma in Canada**

A	Prevalence of clinically-diagnosed asthma *	3,800,000 people
	<b>SABA overuse</b>	
B	Number of people with clinically-diagnosed asthma who are using a SABA	3,800,000 people (A × 100%)
	<b>Mild overuse: &gt;150 to 375 uses (doses) of SABA per year †</b>	
C	Number of people in “B” who use a SABA >150 to 375 times per year ‡	798,000 people (B × 21%)
	<b>MDI</b>	
D	Number of people in “C” who are using a SABA MDI §	750,120 people (C × 94%)
E	Number of excess actuations of SABA MDI required for each person in “D” over one year ‡	225 act per person per year (2 act/dose × 113 excess doses/year)
F	Carbon footprint associated with excess SABA MDI use by people in “D” ¶	<b>22,194 MT CO<sub>2</sub> equivalent</b> (D × E × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
G	Number of people in “C” who are using a SABA DPI §	47,880 people (C × 6%)
H	Number of excess actuations of SABA DPI required for each person in “G” over one year ‡	113 act per person per year (1 act/dose × 113 excess doses/year)
I	Carbon footprint associated with excess SABA DPI use by people in “G” ¶	<b>48 MT CO<sub>2</sub> equivalent</b> (G × H × 0.009 kg CO <sub>2</sub> e/act)
	<b>Moderate overuse: &gt;375 to 750 uses of SABA per year</b>	
J	Number of people in “B” who use a SABA >375 to 750 times per year ‡	266,000 people (B × 7%)
	<b>MDI</b>	
K	Number of people in “J” who are using a SABA MDI §	250,040 people (J × 94%)
L	Number of excess actuations of SABA MDI required for each person in “K” over one year ‡	825 act per person per year (2 act/dose × 413 excess doses/year)
M	Carbon footprint associated with excess SABA MDI use by people in “K” ¶	<b>27,126 MT CO<sub>2</sub> equivalent</b> (K × L × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	

N	Number of people in “J” who are using a SABA DPI <sup>§</sup>	15,960 people (J × 6%)
O	Number of excess actuations of SABA DPI required for each person in “N” over one year <sup>‡</sup>	413 act per person per year (1 act/dose × 413 excess doses/year)
P	Carbon footprint associated with excess SABA DPI use by people in “N” <sup>¶</sup>	<b>59 MT CO<sub>2</sub> equivalent</b> (N × O × 0.009 kg CO <sub>2</sub> e/act)
<b>Severe overuse: &gt;750 uses of SABA per year</b>		
Q	Number of people in “B” who use a SABA >750 times per year <sup>‡</sup>	76,000 people (B × 2%)
<b>MDI</b>		
R	Number of people in “Q” who are using a SABA MDI <sup>§</sup>	71,440 people (Q × 94%)
S	Number of excess actuations of SABA MDI required for each person in “R” over one year <sup>‡</sup>	1,200 act per person per year (2 act/dose × 600 excess doses/year)
T	Carbon footprint associated with excess SABA MDI use by people in “R” <sup>¶</sup>	<b>11,273 MT CO<sub>2</sub> equivalent</b> (R × S × 0.1315 kg CO <sub>2</sub> e/act)
<b>DPI</b>		
U	Number of people in “Q” who are using a SABA DPI <sup>§</sup>	4,560 people (Q × 6%)
V	Number of excess actuations of SABA DPI required for each person in “U” over one year <sup>‡</sup>	600 act per person per year (1 act/dose × 600 excess doses/year)
W	Carbon footprint associated with excess SABA DPI use by people in “U” <sup>¶</sup>	<b>25 MT CO<sub>2</sub> equivalent</b> (U × V × 0.009 kg CO <sub>2</sub> e/act)
<b>Total</b>		
X	Carbon footprint of SABA MDI overuse	60,594 MT CO <sub>2</sub> e (F + M + T)
Y	Carbon footprint of SABA DPI overuse	132 MT CO <sub>2</sub> e (I + P + W)
Z	<b>Total carbon footprint of SABA inhaler overuse</b>	<b>60,726 MT CO<sub>2</sub>e (X + Y)</b>
<p><b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO<sub>2</sub> equivalent; <b>SABA:</b> short-acting beta<sub>2</sub>-agonist</p>		
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.		
<p>* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup>.  <sup>†</sup> Overuse is defined as requiring &gt;150 uses (doses) of a short-acting beta<sub>2</sub>-agonist (SABA) over a year.<sup>12</sup> This reflects a conservative definition, given that guidelines define well-controlled asthma as no more than 2 uses (doses) of SABA per week.<sup>4,5</sup> Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).  <sup>‡</sup> Percentages of people overusing SABA are derived from Nwaru, Ekstrom, et al. <sup>12</sup>. We calculated the mid-point estimate for mild and moderate SABA overuse categories, and the low-point estimate for the severe overuse category. We did not count the first 150 uses (doses) in any category, as those doses are considered within the acceptable limit for good asthma control.  <sup>§</sup> Market sales derived from Janson, Henderson, et al. <sup>3</sup>.  <sup>¶</sup> Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup></p>		

Next, we must account for the GHG emissions that will be caused by increased controller therapy use in patients whose asthma control is optimized. In mild asthma, where addressing ICS underuse (due to under-prescription or non-adherence) would lead to increased ICS-related GHG emissions,



we show that a 10% decrease in the proportion of patients overusing SABAs results in a net reduction of ~800 metric tons of CO<sub>2</sub> equivalent, despite increased use of ICS therapy (**e-Table B-2**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **red-coloured font** to help visualize the lines where changes are made between the anticipated and current case. \*

**e-Table B-2. Anticipated carbon savings resulting from improving adherence to controller therapy and reducing excess SABA inhaler use in people with mild asthma in Canada**

A	Prevalence of clinically-diagnosed asthma * (after subtracting people with misdiagnosed asthma – e-Table A-1) †	2,546,000 people (3,800,000 – 1,254,000)	
B	Number of people in “A” who have mild asthma ‡	1,603,980 people (A × 63%)	
		Anticipated	Current case
<b>C</b>	<b>Number of people in “B” who are not overusing SABA §</b>	<b>1,283,184 people (B × (70% + 10%))</b>	<b>1,122,786 people (B × 70%)</b>
	Daily controller therapy		
	ICS		
	MDI		
D	Number of people in “C” who use an ICS MDI ¶	718,583 people (C × 56%)	628,760 people (C × 56%)
<b>E</b>	<b>Number of actuations over a year among people in “D” #</b>	<b>161 act per person per year (2 act/day × 365 days/year × (12% + 10%) adherence)</b>	<b>88 act per person per year (2 act/day × 365 days/year × 12% adherence)</b>
F	Carbon footprint associated with use of controller ICS MDI among people in “D” **	<b>15,176 MT CO<sub>2</sub>e (D × E × 0.1315 kg of CO<sub>2</sub>e/act)</b>	<b>7,243 MT CO<sub>2</sub>e (D × E × 0.1315 kg of CO<sub>2</sub>e/act)</b>
	DPI		
G	Number of people in “C” who use an ICS DPI ¶	564,601 people (C × 44%)	494,026 people (C × 44%)
<b>H</b>	<b>Number of actuations over a year among people in “G” #</b>	<b>161 act per person per year (2 act/day × 365 days/year × (12% + 10%) adherence)</b>	<b>88 act per person per year (2 act/day × 365 days/year × 12% adherence)</b>
I	Carbon footprint associated with use of controller ICS DPI among people in “G” **	<b>816 MT CO<sub>2</sub>e (G × H × 0.009 kg of CO<sub>2</sub>e/act)</b>	<b>389 MT CO<sub>2</sub>e (G × H × 0.009 kg of CO<sub>2</sub>e/act)</b>
	As-needed SABA		
<b>J</b>	<b>Number of people in “B” who overuse SABA §</b>	<b>320,796 people (B × (30% – 10%))</b>	<b>481,194 people (B × 30%)</b>
	Mild overuse: >150 ‡ to 375 uses (doses) of SABA per year		
K	Number of people in “J” who use a SABA >150 to 375 times per year §	224,557 people (J × 70%)	336,836 people (J × 70%)



	<i>MDI</i>		
L	Number of people in “K” who are using a SABA MDI ††	211,084 people (K × 94%)	316,626 people (K × 94%)
M	Number of excess actuations of SABA MDI required for each person in “L” over one year §	225 act per person per year (2 act/dose × 113 excess doses/year)	225 act per person per year (2 act/dose × 113 excess doses/year)
N	Carbon footprint associated with excess SABA MDI use by people in “L” **	<b>6,245 MT CO<sub>2</sub> equivalent</b> (L × M × 0.1315 kg CO <sub>2</sub> e/act)	<b>9,368 MT CO<sub>2</sub>e</b> (L × M × 0.1315 kg CO <sub>2</sub> e/act)
	<i>DPI</i>		
O	Number of people in “K” who are using a SABA DPI ††	13,473 people (K × 6%)	20,210 people (K × 6%)
P	Number of excess actuations of SABA DPI required for each person in “O” over one year §	113 act per person per year (1 act/dose × 113 excess doses/year)	113 act per person per year (1 act/dose × 113 excess doses/year)
Q	Carbon footprint associated with excess SABA DPI use by people in “O” **	<b>14 MT CO<sub>2</sub> equivalent</b> (O × P × 0.009 kg CO <sub>2</sub> e/act)	<b>21 MT CO<sub>2</sub>e</b> (O × P × 0.009 kg CO <sub>2</sub> e/act)
	<b>Moderate overuse: &gt;375 to 750 uses of SABA per year</b>		
R	Number of people in “J” who use a SABA >375 to 750 times per year §	73,783 people (J × 23%)	110,675 people (J × 23%)
	<i>MDI</i>		
S	Number of people in “R” who are using a SABA MDI ††	69,356 people (R × 94%)	104,034 people (R × 94%)
T	Number of excess actuations of SABA MDI required for each person in “S” over one year §	825 act per person per year (2 act/dose × 413 excess doses/year)	825 act per person per year (2 act/dose × 413 excess doses/year)
U	Carbon footprint associated with excess SABA MDI use by people in “S” **	<b>7,524 MT CO<sub>2</sub> equivalent</b> (S × T × 0.263 kg CO <sub>2</sub> e/act)	<b>11,286 MT CO<sub>2</sub>e</b> (S × T × 0.1315 kg CO <sub>2</sub> e/act)
	<i>DPI</i>		
V	Number of people in “R” who are using a SABA DPI ††	4,427 people (R × 6%)	6,640 people (R × 6%)
W	Number of excess actuations of SABA DPI required for each person in “U” over one year §	413 act per person per year (1 act/dose × 413 excess doses/year)	413 act per person per year (1 act/dose × 413 excess doses/year)
X	Carbon footprint associated with excess SABA DPI use by people in “U” **	<b>16 MT CO<sub>2</sub> equivalent</b> (V × W × 0.009 kg CO <sub>2</sub> e/act)	<b>25 MT CO<sub>2</sub>e</b> (V × W × 0.009 kg CO <sub>2</sub> e/act)
	<b>Severe overuse: &gt;750 uses of SABA per year</b>		
Y	Number of people in “J” who use a SABA >750 times per year §	22,456 people (J × 7%)	33,684 people (J × 7%)
	<i>MDI</i>		
Z	Number of people in “Y” who are using a SABA MDI ††	21,108 people (Y × 94%)	31,663 people (Y × 94%)
AA	Number of excess actuations of SABA MDI required for each person in “Z” over one year §	1,200 act per person per year (2 act/dose × 600 excess doses/year)	1,200 act per person per year (2 act/dose × 600 excess doses/year)
AB	Carbon footprint associated with excess SABA MDI use by people in “Z” **	<b>3,331 MT CO<sub>2</sub> equivalent</b> (Z × AA × 0.1315 kg CO <sub>2</sub> e/act)	<b>4,996 MT CO<sub>2</sub>e</b> (Z × AA × 0.1315 kg CO <sub>2</sub> e/act)

	<i>DPI</i>		
AC	Number of people in “Y” who are using a SABA DPI ††	1,347 people ( $Y \times 6\%$ )	2,021 people ( $Y \times 6\%$ )
AD	Number of excess actuations of SABA DPI required for each person in “AC” over one year §	600 act per person per year (1 act/dose $\times$ 600 excess doses/year)	600 act per person per year (1 act/dose $\times$ 600 excess doses/year)
AE	Carbon footprint associated with excess SABA DPI use by people in “AC” **	<b>7 MT CO<sub>2</sub> equivalent</b> ( $AB \times AC \times 0.009 \text{ kg CO}_2\text{e/act}$ )	<b>11 MT CO<sub>2</sub>e</b> ( $AB \times AC \times 0.009 \text{ kg CO}_2\text{e/act}$ )
	<b>Total</b>		
AF	Total carbon footprint	<b>33,130 MT CO<sub>2</sub> equivalent</b> ( $(F + I) + (N + Q + U + X + AB + AE)$ )	<b>33,339 MT CO<sub>2</sub>e</b> ( $(F + I) + (N + Q + U + X + AB + AE)$ )
AG	<b>Anticipated carbon saving</b>	<b>(210) MT CO<sub>2</sub> equivalent</b> ( $AF_{\text{anticipated}} - AF_{\text{current}}$ )	
<p><b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO<sub>2</sub> equivalent; <b>SABA:</b> short-acting beta<sub>2</sub>-agonist</p>			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
<p>* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup>.  † Percentage of people with clinically-diagnosed asthma who do not have objective evidence of disease derived from Aaron, Vandemheen, et al. <sup>2</sup>.  ‡ The distribution of the asthma population across severity stages is derived from Firoozi, Lemiere, et al. <sup>13</sup>. Please note that this analysis does not consider people who have very mild asthma and who are prescribed an as-needed rescue bronchodilator only.  § Overuse is defined as requiring &gt;150 uses (doses) of a short-acting beta<sub>2</sub>-agonist (SABA) over a year. <sup>12</sup> This reflects a conservative definition, given that guidelines define well-controlled asthma as no more than 2 uses (doses) of SABA per week. <sup>4,5</sup> Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).  Percentages of people overusing SABA are derived from Nwaru, Ekstrom, et al. <sup>12</sup>. We calculated the mid-point estimate for mild and moderate SABA overuse categories, and the low-point estimate for the severe overuse category. We did not count the first 150 uses (doses) in any category, as those doses are considered within the acceptable limit for good asthma control.  ¶ Market sales for ICS MDI and DPI inhalers derived from Lavorini, Corrigan, et al. <sup>7</sup>. This analysis does not consider the people who are on an as-needed budesonide/formoterol therapy, as this treatment approach has just been approved.  # This calculation considers a 12% adherence rate. <sup>14</sup>  ** Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup>.  †† Market sales derived from Janson, Henderson, et al. <sup>3</sup>.</p>			

Of note, we did not consider patients with moderate or severe asthma in this last analysis, as they would, by definition, already be on regular controller therapy, whereby optimization would rather occur through dose increases and/or additional therapies such as LTRAs, biologics, etc., and would not contribute to releasing additional GHGs. Accordingly, carbon savings resulting from

addressing excess use of SABA in the moderate to severe asthma would equate ~10,100 metric tons of CO<sub>2</sub> equivalent in this population (e-Table B-3).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **red-coloured font** to help visualize the lines where changes are made between the anticipated and current case. \*

**e-Table B-3. Anticipated carbon savings resulting from improving adherence to controller therapy and reducing excess SABA inhaler use in people with moderate to severe asthma in Canada**

A	Prevalence of clinically-diagnosed asthma <sup>†</sup> (after subtracting people with misdiagnosed asthma – <b>Appendix A, e-Table 1</b> ) <sup>†</sup>	2,546,000 people (3,800,000 – 1,254,000)	
B	Number of people in “A” who have moderate of severe asthma <sup>‡</sup>	942,000 people (A × 37%)	
		Anticipated	Current case
<b>C</b>	<b>Number of people in “B” who are not overusing SABA <sup>§</sup></b>	<b>753,616 people (B × (70% + 10%))</b>	<b>659,414 people (B × 70%)</b>
	<b>As-needed SABA</b>		
<b>D</b>	<b>Number of people in “B” who overuse SABA <sup>§</sup></b>	<b>188,404 people (B × (30% – 10%))</b>	<b>282,606 people (B × 30%)</b>
	<b>Mild overuse: &gt;150 <sup>¶</sup> to 375 uses (doses) of SABA per year</b>		
E	Number of people in “D” who use a SABA >150 to 375 times per year <sup>§</sup>	131,883 people (D × 70%)	197,824 people (D × 70%)
	<b>MDI</b>		
F	Number of people in “K” who are using a SABA MDI <sup>#</sup>	123,970 people (E × 94%)	185,955 people (E × 94%)
G	Number of excess actuations of SABA MDI required for each person in “F” over one year <sup>**</sup>	225 act per person per year (2 act/dose × 113 excess doses/year)	225 act per person per year (2 act/dose × 113 excess doses/year)
H	Carbon footprint associated with excess SABA MDI use by people in “F” <sup>††</sup>	<b>3,668 MT CO<sub>2</sub>e</b> (F × G × 0.1315 kg CO <sub>2</sub> e/act)	<b>5,502 MT CO<sub>2</sub>e</b> (F × G × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>		
I	Number of people in “K” who are using a SABA DPI <sup>#</sup>	7,913 people (E × 6%)	11,869 people (E × 6%)
J	Number of excess actuations of SABA DPI required for each person in “I” over one year <sup>**</sup>	113 act per person per year (1 act/dose × 113 excess doses/year)	113 act per person per year (1 act/dose × 113 excess doses/year)
K	Carbon footprint associated with excess SABA DPI use by people in “I” <sup>††</sup>	<b>8 MT CO<sub>2</sub>e</b> (I × K × 0.009 kg CO <sub>2</sub> e/act)	<b>12 MT CO<sub>2</sub>e</b> (I × K × 0.009 kg CO <sub>2</sub> e/act)
	<b>Moderate overuse: &gt;375 to 750 uses of SABA per year</b>		
L	Number of people in “D” who use a SABA >375 to 750 times per year <sup>§</sup>	43,333 people (D × 23%)	64,999 people (D × 23%)

	<i>MDI</i>		
M	Number of people in “L” who are using a SABA MDI #	40,733 people (L × 94%)	61,099 people (L × 94%)
N	Number of excess actuations of SABA MDI required for each person in “M” over one year **	825 act per person per year (2 act/dose × 413 excess doses/year)	825 act per person per year (2 act/dose × 413 excess doses/year)
O	Carbon footprint associated with excess SABA MDI use by people in “M” ††	<b>4,419 MT CO<sub>2</sub>e</b> (M × N × 0.263 kg CO <sub>2</sub> e/act)	<b>6,629 MT CO<sub>2</sub>e</b> (M × N × 0.1315 kg CO <sub>2</sub> e/act)
	<i>DPI</i>		
P	Number of people in “L” who are using a SABA DPI #	2,600 people (L × 6%)	3,900 people (L × 6%)
Q	Number of excess actuations of SABA DPI required for each person in “P” over one year **	413 act per person per year (1 act/dose × 413 excess doses/year)	413 act per person per year (1 act/dose × 413 excess doses/year)
R	Carbon footprint associated with excess SABA DPI use by people in “P” ††	<b>10 MT CO<sub>2</sub>e</b> (P × Q × 0.009 kg CO <sub>2</sub> e/act)	<b>14 MT CO<sub>2</sub>e</b> (P × Q × 0.009 kg CO <sub>2</sub> e/act)
	<b>Severe overuse: &gt;750 uses of SABA per year</b>		
S	Number of people in “D” who use a SABA >750 times per year §	13,188 people (D × 7%)	19,782 people (D × 7%)
	<i>MDI</i>		
T	Number of people in “S” who are using a SABA MDI #	12,397 people (S × 94%)	18,595 people (S × 94%)
U	Number of excess actuations of SABA MDI required for each person in “T” over one year **	1,200 act per person per year (2 act/dose × 600 excess doses/year)	1,200 act per person per year (2 act/dose × 600 excess doses/year)
V	Carbon footprint associated with excess SABA MDI use by people in “T” ††	<b>1,956 MT CO<sub>2</sub>e</b> (T × U × 0.263 kg CO <sub>2</sub> e/act)	<b>2,934 MT CO<sub>2</sub>e</b> (T × U × 0.1315 kg CO <sub>2</sub> e/act)
	<i>DPI</i>		
W	Number of people in “S” who are using a SABA DPI #	791 people (S × 6%)	1,187 people (S × 6%)
X	Number of excess actuations of SABA DPI required for each person in “W” over one year **	600 act per person per year (1 act/dose × 600 excess doses/year)	600 act per person per year (1 act/dose × 600 excess doses/year)
Y	Carbon footprint associated with excess SABA DPI use by people in “W” ††	<b>4 MT CO<sub>2</sub>e</b> (W × X × 0.009 kg CO <sub>2</sub> e/act)	<b>6 MT CO<sub>2</sub>e</b> (W × X × 0.009 kg CO <sub>2</sub> e/act)
	<b>Total</b>		
Z	Carbon footprint associated with excess SABA MDI use	10,065 MT CO <sub>2</sub> e ((H + K) + (O + R) + (V + Y))	15,098 MT CO <sub>2</sub> e ((H + K) + (O + R) + (V + Y))
AA	<b>Carbon saving from addressing excess use of SABA in moderate to severe asthma in Canada</b>	<b>(5,033) MT CO<sub>2</sub> equivalent (Z<sub>anticipated</sub> – Z<sub>current</sub>)</b>	
<b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent; <b>SABA:</b> short-acting beta <sub>2</sub> -agonist			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup> .			

† Percentage of people with clinically-diagnosed asthma who do not have objective evidence of disease derived from Aaron, Vandemheen, et al. <sup>2</sup>.

‡ The distribution of the asthma population across severity stages is derived from Firoozi, Lemiere, et al. <sup>13</sup>. Please note that this analysis does not consider people who have very mild asthma and who are prescribed an as-needed rescue bronchodilator only. Their carbon footprint is accounted for in **Appendix A, e-Table 1**.

§ Percentages of people overusing SABA are derived from Nwaru, Ekstrom, et al. <sup>12</sup>.

¶ Overuse is defined as requiring >150 uses (doses) of a short-acting beta<sub>2</sub>-agonist (SABA) over a year.<sup>12</sup> This reflects a conservative definition, given that guidelines define well-controlled asthma as no more than 2 uses (doses) of SABA per week.<sup>4,5</sup>

# Market sales for SABA inhalers are derived from Janson, Henderson, et al. <sup>3</sup>.

\*\* We calculated the mid-point estimate for mild and moderate SABA overuse categories, and the low-point estimate for the severe overuse category. We did not count the first 150 uses (doses) in any category, as those doses are considered within the acceptable limit for good asthma control. Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).

†† Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup>.

**e-Table B-4. Carbon footprint associated with excess SABA inhaler use in people with appropriately diagnosed asthma in Canada**

A	Prevalence of clinically-diagnosed asthma * (after subtracting people with misdiagnosed asthma – e-Table A-1) †	2,546,000 people (3,800,000 – 1,254,000)
	<b>SABA overuse</b>	
B	Number of people with clinically-diagnosed asthma who are using a SABA	2,546,000 people (A × 100%)
	<b>Mild overuse: &gt;150 to 375 uses (doses) of SABA per year ‡</b>	
C	Number of people in “B” who use a SABA >150 to 375 times per year §	534,660 people (B × 21%)
	<b>MDI</b>	
D	Number of people in “C” who are using a SABA MDI ¶	502,580 people (C × 94%)
E	Number of excess actuations of SABA MDI required for each person in “D” over one year §	225 act per person per year (2 act/dose × 113 excess doses/year)
F	Carbon footprint associated with excess SABA MDI use by people in “D” #	<b>14,871 MT CO<sub>2</sub> equivalent</b> (D × E × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
G	Number of people in “C” who are using a SABA DPI ¶	32,080 people (C × 6%)
H	Number of excess actuations of SABA DPI required for each person in “G” over one year §	113 act per person per year (1 act/dose × 113 excess doses/year)
I	Carbon footprint associated with excess SABA DPI use by people in “G” #	<b>32 MT CO<sub>2</sub> equivalent</b> (G × H × 0.009 kg CO <sub>2</sub> e/act)
	<b>Moderate overuse: &gt;375 to 750 uses of SABA per year</b>	
J	Number of people in “B” who use a SABA >375 to 750 times per year §	178,200 people (B × 7%)
	<b>MDI</b>	
K	Number of people in “J” who are using a SABA MDI ¶	167,527 people (J × 94%)
L	Number of excess actuations of SABA MDI required for each person in “K” over one year §	825 act per person per year (2 act/dose × 413 excess doses/year)
M	Carbon footprint associated with excess SABA MDI use by people in “K” #	<b>18,175 MT CO<sub>2</sub> equivalent</b> (K × L × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	

N	Number of people in “J” who are using a SABA DPI †	10,693 people (J × 6%)
O	Number of excess actuations of SABA DPI required for each person in “N” over one year §	413 act per person per year (1 act/dose × 413 excess doses/year)
P	Carbon footprint associated with excess SABA DPI use by people in “N” #	<b>40 MT CO<sub>2</sub> equivalent</b> (N × O × 0.009 kg CO <sub>2</sub> e/act)
<b>Severe overuse: &gt;750 uses of SABA per year</b>		
Q	Number of people in “B” who use a SABA >750 times per year §	50,920 people (B × 2%)
<b>MDI</b>		
R	Number of people in “Q” who are using a SABA MDI †	47,865 people (Q × 94%)
S	Number of excess actuations of SABA MDI required for each person in “R” over one year** §	1,200 act per person per year (2 act/dose × 600 excess doses/year)
T	Carbon footprint associated with excess SABA MDI use by people in “R” #	<b>7,553 MT CO<sub>2</sub> equivalent</b> (R × S × 0.1315 kg CO <sub>2</sub> e/act)
<b>DPI</b>		
U	Number of people in “Q” who are using a SABA DPI †	3,055 people (Q × 6%)
V	Number of excess actuations of SABA DPI required for each person in “U” over one year** §	600 act per person per year (1 act/dose × 600 excess doses/year)
W	Carbon footprint associated with excess SABA DPI use by people in “U” #	<b>16 MT CO<sub>2</sub> equivalent</b> (U × V × 0.009 kg CO <sub>2</sub> e/act)
<b>Total</b>		
X	Carbon footprint of SABA MDI overuse	40,598 MT CO <sub>2</sub> e (F + M + T)
Y	Carbon footprint of SABA DPI overuse	89 MT CO <sub>2</sub> e (I + P + W)
Z	<b>Total carbon footprint of SABA inhaler overuse</b>	<b>40,686 MT CO<sub>2</sub>e (X + Y)</b>

**Act:** actuations; **DPI:** dry powder inhaler; **MDI:** metered dose inhaler; **MT CO<sub>2</sub>e:** metric tons of CO<sub>2</sub> equivalent; **SABA:** short-acting beta<sub>2</sub>-agonist

Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.

\* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup>.

† Percentage of people with clinically-diagnosed asthma who do not have objective evidence of disease derived from Aaron, Vandemheen, et al. <sup>2</sup>.

‡ Overuse is defined as requiring >150 uses (doses) of a short-acting beta<sub>2</sub>-agonist (SABA) over a year.<sup>12</sup> This reflects a conservative definition, given that guidelines define well-controlled asthma as no more than 2 uses (doses) of SABA per week.<sup>4,5</sup> Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).

§ Percentages of people overusing SABA are derived from Nwaru, Ekstrom, et al. <sup>12</sup>. We calculated the mid-point estimate for mild and moderate SABA overuse categories, and the low-point estimate for the severe overuse category. We did not count the first 150 uses (doses) in any category, as those doses are considered within the acceptable limit for good asthma control.

¶ Market sales derived from Janson, Henderson, et al. <sup>3</sup>.

# Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup>.

Next, we must account for the GHG emissions that will be caused by increased controller therapy use in patients whose asthma control is optimized. In mild asthma, where addressing ICS underuse (due to under-prescription or non-adherence) would lead to increased ICS-related GHG emissions,

we show that a 10% decrease in the proportion of patients overusing SABAs results in a net reduction of ~800 metric tons of CO<sub>2</sub> equivalent, despite increased use of ICS therapy (**e-Table B-2**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **red-coloured font** to help visualize the lines where changes are made between the anticipated and current case. \*

## COPD

Addressing excess use of rescue therapies could save ~92,000 metric tons of CO<sub>2</sub> equivalent in a single year (**e-Table B-4**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. \*

**e-Table B-5. Carbon footprint associated with excess short-acting bronchodilator use in COPD in Canada**

A	Prevalence of clinically-diagnosed COPD *	2,000,000 people
B	Number of clinically-diagnosed people with COPD who have moderate to severe disease †	1,440,000 people (A × 72%)
	<i>Mild overuse: 4 to 180 days in a year requiring more than 4 uses (doses) of rescue therapy §</i>	
C	Number of people in “B” with mild overuse ‡	406,080 people (B × 28%)
	<b>SABA</b>	
D	Number of people in “C” who use a SABA §	385,776 people (C × 95%)
	<b>MDI</b>	
E	Number of people in “D” who use a SABA MDI §	362,629 people (D × 94%)
F	Estimated number of excess SABA MDI actuations in each patient in “E” over one year ‡	219 act per person per year (0.6 act/day × 365 days/year)
G	Carbon footprint associated with excess SABA MDI use by people in “E” ¶	<b>10,443 MT CO<sub>2</sub>e</b> (E × F × 0.263 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
H	Number of people in “C” who use a SABA DPI §	24,365 people (C × 6%)
I	Estimated number of excess SABA DPI actuations in each patient in “H” over one year ‡	110 act per person per year (0.3 act/day × 365 days/year)
J	Carbon footprint associated with excess SABA DPI use by people in “H” ¶	<b>24 MT CO<sub>2</sub>e</b> (H × I × 0.009 kg CO <sub>2</sub> e/act)
	<b>SAMA</b>	
K	Number of people in “C” who use a SAMA MDI §	20,304 people (C × 5%)
	<b>MDI</b>	
L	Number of people in “K” who use a SAMA MDI §	20,304 people (K × 100%)



M	Estimated number of excess SAMA MDI actuations in each patient in “L” over one year ‡	219 act per person per year (0.6 act/day × 365 days/year)
N	Carbon footprint associated with excess SAMA MDI use by people in “L” †	<b>1,169 MT CO<sub>2</sub>e</b> ( $L \times M \times 0.263 \text{ kg CO}_2\text{e/act}$ )
	<b>Severe overuse: &gt;180 days in a year requiring more than 4 uses (doses) of rescue therapy §</b>	
O	Number of people in “B” with severe SABA overuse ‡	270,720 people (B × 19%)
	<b>SABA</b>	
P	Number of people in “O” who use a SABA §	257,184 people (O × 95%)
	<b>MDI</b>	
Q	Number of people in “P” who use a SABA MDI §	241,753 people (P × 94%)
R	Estimated number of excess SABA MDI actuations in each patient in “Q” over one year ‡	2,117 actuations per person per year (5.8 act/day × 365 days/year)
S	Carbon footprint associated with excess SABA MDI use by people in “Q” †	<b>67,301 MT CO<sub>2</sub>e</b> ( $Q \times R \times 0.1315 \text{ kg CO}_2\text{e/act}$ )
	<b>DPI</b>	
T	Number of people in “P” who use a SABA DPI §	14,505 people (P × 6%)
U	Estimated number of excess SABA DPI actuations in each patient in “T” over one year ‡	1,059 act per person per year (2.9 act/day × 365 days/year)
V	Carbon footprint associated with excess SABA MDI use by people in “T” †	<b>138 MT CO<sub>2</sub>e</b> ( $T \times U \times 0.009 \text{ kg CO}_2\text{e/act}$ )
	<b>SAMA</b>	
W	Number of people in “O” who use a SAMA MDI §	13,536 people (O × 5%)
	<b>MDI</b>	
X	Number of people in “W” who use a SAMA MDI §	13,536 people (W × 100%)
Y	Estimated number of excess SAMA MDI actuations in each patient in “X” over one year ‡	2,117 act per person per year (5.8 act/day × 365 days/year)
Z	Carbon footprint associated with excess SAMA MDI use by people in “X” †	<b>3,768 MT of CO<sub>2</sub>e</b> ( $X \times Y \times 0.1315 \text{ kg CO}_2\text{e/act}$ )
	<b>Total</b>	
AA	Carbon footprint of MDI overuse	82,097 MT CO <sub>2</sub> e (G + K + S + Z)
AB	Carbon footprint of DPI overuse	162 MT CO <sub>2</sub> e (J + V)
AC	<b>Total carbon footprint of inhaler overuse</b>	<b>82,259 MT CO<sub>2</sub>e</b> (AA + AB)
	<b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent; <b>SABA:</b> short-acting beta <sub>2</sub> -agonist	
	Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.	
	* Prevalence of clinically-diagnosed COPD derived from Public Health Agency of Canada <sup>1</sup> . † Severity stages are defined as per CTS guidelines, <sup>15</sup> and corresponds to GOLD groups B and D. <sup>16</sup> The distribution of the COPD population across severity stages is derived from Le, Johannessen, et al. <sup>17</sup> . In this conservative analysis, patients with mild COPD were not considered to overuse rescue therapies. ‡ Overuse is defined as taking >4 uses (doses) of a short-acting reliever in a day. <sup>18</sup> Mild overusers used their rescue therapy for on average ~1 excess dose (use) every 3 days, while severe overusers used their rescue therapy for on average ~3 excess doses (uses) every day. <sup>18</sup> Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation). Please note that SABA/SAMA class was not considered as RESPIMAT® is a propellant-free MDI. § Market sales derived from Janson, Henderson, et al. <sup>3</sup> . ¶ Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup> .	

**e-Table B-6. Carbon footprint associated with excess short-acting bronchodilator use in people with appropriately diagnosed COPD in Canada**

A	Prevalence of clinically-diagnosed COPD * (after subtracting people with misdiagnosed COPD – e-Table A-2) †	1,120,000 people (2,000,000 – 880,000)
B	Number of clinically-diagnosed people with COPD who have moderate to severe disease ‡	806,400 people (A × 72%)
	<i>Mild overuse: 4 to 180 days in a year requiring more than 4 uses (doses) of rescue therapy §</i>	
C	Number of people in “B” with mild overuse §	227,405 people (B × 28%)
	<b>SABA</b>	
D	Number of people in “C” who use a SABA ¶	216,035 people (C × 95%)
	<b>MDI</b>	
E	Number of people in “D” who use a SABA MDI ¶	203,072 people (D × 94%)
F	Estimated number of excess SABA MDI actuations in each patient in “E” over one year §	219 act per person per year (0.6 act/day × 365 days/year)
G	Carbon footprint associated with excess SABA MDI use by people in “E” #	<b>5,848 MT CO<sub>2</sub>e</b> (E × F × 0.263 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
H	Number of people in “C” who use a SABA DPI ¶	13,644 people (C × 6%)
I	Estimated number of excess SABA DPI actuations in each patient in “H” over one year §	110 act per person per year (0.3 act/day × 365 days/year)
J	Carbon footprint associated with excess SABA MDI use by people in “H” #	<b>13 MT CO<sub>2</sub>e</b> (H × I × 0.009 kg CO <sub>2</sub> e/act)
	<b>SAMA</b>	
K	Number of people in “C” who use a SAMA MDI ¶	11,370 people (C × 5%)
	<b>MDI</b>	
L	Number of people in “K” who use a SAMA MDI ¶	11,370 people (K × 100%)
M	Estimated number of excess SAMA MDI actuations in each patient in “L” over one year §	219 act per person per year (0.6 act/day × 365 days/year)
N	Carbon footprint associated with excess SAMA MDI use by people in “L” #	<b>327 MT CO<sub>2</sub>e</b> (L × M × 0.263 kg CO <sub>2</sub> e/act)
	<i>Severe overuse: &gt;180 days in a year requiring more than 4 uses (doses) of rescue therapy §</i>	
O	Number of people in “B” with severe SABA overuse §	151,603 people (B × 19%)
	<b>SABA</b>	
P	Number of people in “O” who use a SABA ¶	144,023 people (O × 95%)
	<b>MDI</b>	
Q	Number of people in “P” who use a SABA MDI ¶	135,382 people (P × 94%)
R	Estimated number of excess SABA MDI actuations in each patient in “Q” over one year §	2,117 actuations per person per year (5.8 act/day × 365 days/year)
S	Carbon footprint associated with excess SABA MDI use by people in “Q” #	<b>37,688 MT CO<sub>2</sub>e</b> (Q × R × 0.263 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
T	Number of people in “P” who use a SABA DPI ¶	8,123 people (P × 6%)
U	Estimated number of excess SABA DPI actuations in each patient in “T” over one year §	1,059 act per person per year (2.9 act/day × 365 days/year)
V	Carbon footprint associated with excess SABA MDI use by people in “T” #	<b>77 MT CO<sub>2</sub>e</b> (T × U × 0.009 kg CO <sub>2</sub> e/act)
	<b>SAMA</b>	

W	Number of people in “O” who use a SAMA MDI <sup>†</sup>	7,580 people (O × 5%)
	<b>MDI</b>	
X	Number of people in “W” who use a SAMA MDI <sup>†</sup>	7,580 people (W × 100%)
Y	Estimated number of excess SAMA MDI actuations in each patient in “X” over one year <sup>§</sup>	2,117 act per person per year (5.8 act/day × 365 days/year)
Z	Carbon footprint associated with excess SAMA MDI use by people in “X” <sup>#</sup>	<b>2110 MT of CO<sub>2</sub>e</b> (X × Y × 0.263 kg CO <sub>2</sub> e/act)
	<b>Total</b>	
AA	Carbon footprint of MDI overuse	45,974 MT CO <sub>2</sub> e (G + K + S + Z)
AB	Carbon footprint of DPI overuse	91 MT CO <sub>2</sub> e (J + V)
AC	<b>Total carbon footprint of inhaler overuse</b>	<b>46,065 MT CO<sub>2</sub>e</b> (AA + AB)
<b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent; <b>SABA:</b> short-acting beta <sub>2</sub> -agonist		
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.		
<p>* Prevalence of clinically-diagnosed COPD derived from Public Health Agency of Canada <sup>1</sup>.  <sup>†</sup> Percentage of people with clinically-diagnosed COPD who do not have objective evidence of disease derived from Hill, Goldstein, et al. <sup>9</sup>.  <sup>‡</sup> Severity stages are defined as per CTS guidelines,<sup>15</sup> and corresponds to GOLD groups B and D.<sup>16</sup> The distribution of the COPD population across severity stages is derived from Le, Johannessen, et al. <sup>17</sup>. In this conservative analysis, patients with mild COPD were not considered to overuse rescue therapies.  <sup>§</sup> Overuse is defined as taking &gt;4 uses (doses) of a short-acting reliever in a day.<sup>18</sup> Mild overusers used their rescue therapy for on average ~1 excess dose (use) every 3 days, while severe overusers used their rescue therapy for on average ~3 excess doses (uses) every day.<sup>18</sup>. Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation). Please note that SABA/SAMA class was not considered as RESPIMAT® is a propellant-free MDI.  <sup>††</sup> Market sales derived from Janson, Henderson, et al. <sup>3</sup>.  <sup>#</sup> Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup>.</p>		

## Appendix C Tables

Carbon savings resulting from switching to therapeutic options with lower global warming potential in asthma and COPD in Canada

## Asthma

### a) Anticipated carbon savings resulting from switching MDI to DPIs (within the same drug class)

In asthma, based on current use of inhaled therapies, switching even 25% of MDI prescriptions to DPIs (within the same drug class) would save ~107,200 MT CO<sub>2</sub> equivalent (rescue inhalers: ~60,100 metric tons of CO<sub>2</sub> equivalent, as shown in **e-Table C-1**; controller inhalers: 47,100 metric tons of CO<sub>2</sub> equivalent, as shown in **e-Table C-2**).

\* In the tables that follow, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **green-coloured font** to help visualize the lines where changes are made between the anticipated and current case. \*

**e-Table C-1. Anticipated carbon saving resulting from switching 25% of rescue MDI prescriptions to DPIs in asthma in Canada**

A	Prevalence of clinically-diagnosed asthma *	3,800,000 people	
		Anticipated	Current case
	<b>No SABA overuse</b>		
B	Number of people in “A” who use a SABA ≤150 times per year †	2,660,000 (A × 70%)	2,660,000 (A × 70%)
	SABA MDI		
<b>C</b>	<b>Number of people in “B” using a SABA MDI as rescue therapy ‡</b>	<b>1,835,400 people (B × (94% – 25%))</b>	<b>2,500,400 people (B × 94%)</b>
D	Number of actuations of SABA MDI over a year in people in “B” (reflecting good control) §	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)	104 act per person per year (2 act/dose × 1 doses/week × 52 weeks/year)
E	Carbon footprint associated with SABA MDI use in people in “B” †	<b>25,101 MT CO<sub>2</sub>e</b> (C × D × 0.1315 kg CO <sub>2</sub> e/act)	<b>34,195 MT CO<sub>2</sub>e</b> (C × D × 0.1315 kg CO <sub>2</sub> e/act)
	SABA DPI		
<b>F</b>	<b>Number of people in “B” using a SABA DPI as rescue therapy ‡</b>	<b>824,600 people (B × (6% + 25%))</b>	<b>159,600 people (B × 6%)</b>
G	Number of actuations of SABA DPI over a year in people in “E” (reflecting good control) §	52 act per person per year (1 act/dose × 1 dose/week × 52 weeks/year)	52 act per person per year (1 act/dose × 1 doses/week × 52 weeks/year)
H	Carbon footprint associated with SABA DPI use in people in “E” †	<b>386 MT CO<sub>2</sub>e</b> (F × G × 0.009 kg CO <sub>2</sub> e/actuation)	<b>75 MT CO<sub>2</sub>e</b> (F × G × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>Mild overuse: &gt;150 to 375 doses of SABA per year</b>		

I	Number of people in “A” who use a SABA >150 to 375 doses of SABA per year †	798,000 (A × 21%)	798,000 (A × 21%)
	SABA MDI		
J	Number of people in “I” using a SABA MDI as rescue therapy ‡	550,620 people (I × (94% – 25%))	750,120 people (I × 94%)
K	Number of actuations of SABA MDI over a year in people in “J”	526 act per person per year (2 act/dose × (150 + 113) dose/year)	526 act per person per year (2 act/doses × (150 + 113) dose/year)
L	Carbon footprint associated with SABA MDI use in people in “J” †	38,086 MT CO <sub>2</sub> e (J × K × 0.1415 kg CO <sub>2</sub> e/act)	52 MT CO <sub>2</sub> e (J × K × 0.1315 kg CO <sub>2</sub> e/act)
	SABA DPI		
M	Number of people in “I” using a SABA DPI as rescue therapy †‡	247,380 people (I × (6% + 25%))	47,880 people (I × 6%)
N	Number of actuations of SABA DPI over a year in people in “M”	263 act per person per year (1 act/dose × (150 + 113) dose/year)	263 act per person per year (1 act/dose × (150 + 113) doses/year)
O	Carbon footprint associated with SABA DPI use in people in “M” †	586 MT CO <sub>2</sub> e (M × N × 0.009 kg CO <sub>2</sub> e/actuation)	113 MT CO <sub>2</sub> e (M × N × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>Moderate overuse: &gt;375 to 750 doses of SABA per year</b>		
P	Number of people in “A” who use a SABA >375 to 750 doses of SABA per year †	266,000 (A × 7%)	266,000 (A × 7%)
	SABA MDI		
Q	Number of people in “P” using a SABA MDI as rescue therapy ‡	183,540 people (P × (94% – 25%))	250,040 people (P × 94%)
R	Number of actuations of SABA MDI over a year in people in “Q”	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)
S	Carbon footprint associated with SABA MDI use in people in “Q” †	27,177 MT CO <sub>2</sub> e (Q × R × 0.1415 kg CO <sub>2</sub> e/act)	37,023 MT CO <sub>2</sub> e (Q × R × 0.1315 kg CO <sub>2</sub> e/act)
	SABA DPI		
T	Number of people in “P” using a SABA DPI as rescue therapy ‡	82,460 people (P × (6% + 25%))	15,960 people (P × 6%)
U	Number of actuations of SABA DPI over a year in people in “T”	563 act per person per year (1 act/dose × (150 + 413) doses/year)	563 act per person per year (1 act/dose × (150 + 413) doses/year)
V	Carbon footprint associated with SABA DPI use in people in “T” †	418 MT CO <sub>2</sub> e (T × U × 0.009 kg CO <sub>2</sub> e/actuation)	81 MT CO <sub>2</sub> e (T × U × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>Severe overuse: &gt;750 doses of SABA per year</b>		
W	Number of people in “A” who use a SABA >750 doses of SABA per year †	76,000 (A × 2%)	76,000 (A × 2%)
	SABA MDI		
X	Number of people in “W” using a SABA MDI as rescue therapy ‡	52,440 people (W × (94% – 25%))	71,440 people (W × 94%)

Y	Number of actuations of SABA MDI over a year in people in “W”	1,500 act per person per year (2 act/dose × (150 + 600) doses/year)	1,500 act per person per year (2 act/dose × (150 + 600) doses/year)
Z	Carbon footprint associated with SABA MDI use in people in “W” <sup>†</sup>	<b>10,344 MT CO<sub>2</sub>e</b> (X × Y × 0.1415 kg CO <sub>2</sub> e/act)	<b>14,092 MT CO<sub>2</sub>e</b> (X × Y × 0.1315 kg CO <sub>2</sub> e/act)
	<b>SABA DPI</b>		
AA	<b>Number of people in “W” using a SABA DPI as rescue therapy<sup>‡</sup></b>	<b>23,560 people</b> (W × (6% + 25%))	<b>4,560 people</b> (W × 6%)
AB	Number of actuations of SABA DPI over a year in people in “AA”	750 act per person per year (1 act/dose × (150 + 600) doses/year)	750 act per person per year (1 act/dose × (150 + 600) doses/year)
AC	Carbon footprint associated with SABA DPI use in people in “A” <sup>†</sup>	<b>159 MT CO<sub>2</sub>e</b> (AA × AB × 0.009 kg CO <sub>2</sub> e/actuation)	<b>31 MT CO<sub>2</sub>e</b> (AA × AB × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>Total</b>		
AD	Total carbon footprint	102,255 MT CO <sub>2</sub> e ((E + H) + (L + O) + (S + V) + (Z + AC))	137,495 MT CO <sub>2</sub> e ((E + H) + (L + O) + (S + V) + (Z + AC))
AE	<b>Anticipated carbon saving</b>	<b>(35,239) MT CO<sub>2</sub>e</b> (H <sub>anticipated</sub> – H <sub>current</sub> )	
<b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent; <b>SABA:</b> short-acting beta <sub>2</sub> -agonist			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup> .			
† Categories of SABA users are derived from Nwaru, Ekstrom, et al. <sup>12</sup> .			
‡ Market sales for SABA inhalers are derived from Janson, Henderson, et al. <sup>3</sup> .			
§ We consider an averaged use of 1 dose of SABA per week. This reflects a conservative definition, given that guidelines define well-controlled asthma as no more than 2 uses (doses) of SABA per week. <sup>4,5</sup> Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation.			
¶ Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup> .			
# We calculated the mid-point estimate for mild and moderate SABA overuse categories, and the low-point estimate for the severe overuse category. For this analysis, we counted the first 150 uses (doses) in any category, even though those doses are considered within the acceptable limit for good asthma control.			

**e-Table C-2. Anticipated carbon saving from switching 25% of controller MDI prescriptions to DPIs in asthma in Canada**

A	Prevalence of clinically-diagnosed asthma <sup>*</sup>	3,800,000 people	
		Anticipated	Current case
	<b>Mild asthma</b>		
B	Number of people in “A” who have mild asthma <sup>†</sup>	2,394,000 people (A × 63%)	2,394,000 people (A × 63%)
	<b>ICS MDI</b>		
C	<b>Number of people in “B” who use an ICS MDI<sup>‡</sup></b>	<b>742,140 people</b> (B × (56% – 25%))	<b>1,340,640 people</b> (B × 56%)

D	Number of actuations over a year among people in “C” §	88 act per person per year (2 act/day × 365 days/year × 12% adherence)	88 act per person per year (2 act/day × 365 days/year × 12% adherence)
E	Carbon footprint associated with use of controller ICS MDI among people in “C” †	8,549 MT CO <sub>2e</sub> (C × D × 0.1315 kg of CO <sub>2e</sub> /act)	15,443 MT CO <sub>2e</sub> (C × D × 0.1315 kg of CO <sub>2e</sub> /act)
	DPI		
F	<b>Number of people in “B” who use an ICS DPI ‡</b>	<b>1,651,860 people (B × (44% + 25%))</b>	<b>1,053,360 people (B × 44%)</b>
G	Number of actuations over a year among people in “F” §	88 act per person per year (2 act/day × 365 days/year × 12% adherence)	88 act per person per year (2 act/day × 365 days/year × 12% adherence)
H	Carbon footprint associated with use of controller ICS DPI among people in “F” †	1,302 MT CO <sub>2e</sub> (F × G × 0.009 kg of CO <sub>2e</sub> /act)	830 MT CO <sub>2e</sub> (F × G × 0.009 kg of CO <sub>2e</sub> /act)
	<b>Moderate and severe asthma</b>		
I	Number of people in “A” who have moderate or severe asthma †	1,406,000 people (A × 37%)	1,406,000 people (A × 37%)
	<b>ICS/LABA</b>		
	MDI		
J	<b>Number of people in “I” who use an ICS/LABA MDI #</b>	<b>309,320 people (I × (47% – 25%))</b>	<b>660,820 people (I × 47%)</b>
	HFC-134a MDI	N	N
K	Number of people in “J” who use an HFC-134a MDI **	272,202 people (J × 88%)	581,522 people (J × 88%)
L	Number of actuations over a year, among people in “K” ††	628 act per person per year (2 act/day × 365 days × 43% adherence)	314 act per person per year (2 act/day × 365 days × 43% adherence)
M	Carbon footprint associated with use of ICS/LABA HFC-134a-containing MDI among people in “K” †	22,472 MT CO <sub>2e</sub> (K × L × 0.263 kg of CO <sub>2e</sub> /act)	48,008 MT CO <sub>2e</sub> (K × L × 0.1315 kg of CO <sub>2e</sub> /act)
	<b>HFC-227ea MDI</b>		
N	Number of people in “J” who use an HFC-227ea-containing MDI **	37,118 people (J × 12%)	79,298 people (J × 12%)
O	Number of actuations over a year, among people in “N” ††	628 act per person per year (2 act/day × 365 days × 43% adherence)	628 act per person per year (2 act/day × 365 days × 43% adherence)
P	Carbon footprint associated with use of ICS/LABA HFC-227ea-containing MDI among people in “N” †	8,121 MT CO <sub>2e</sub> (N × O × 0.697 kg of CO <sub>2e</sub> /act)	17,350 MT CO <sub>2e</sub> (N × O × 0.697 kg of CO <sub>2e</sub> /act)
	DPI		
Q	<b>Number of people in “I” who use an ICS/LABA DPI #</b>	<b>1,096,680 people (I × (53% + 25%))</b>	<b>745,180 people (I × 53%)</b>
R	Number of actuations over a year, among people in “Q” ††	314 act per person per year (2 act/day × 365 days × 43%)	314 act per person per year (2 act/day × 365 days × 43%)
S	Carbon footprint associated with use of ICS/LABA DPI among people in “Q” †	3,098 MT CO <sub>2e</sub> (Q × R × 0.009 kg of CO <sub>2e</sub> /act)	2,105 MT CO <sub>2e</sub> (Q × R × 0.009 kg of CO <sub>2e</sub> /act)
	<b>Total</b>		
T	Total carbon footprint	43,542 MT CO <sub>2e</sub> ((E + H) + (M + P + S))	83,737 MT CO <sub>2e</sub> ((E + H) + (M + P + S))
U	<b>Anticipated carbon saving</b>	<b>(40,194) MT CO<sub>2e</sub> (T<sub>anticipated</sub> – T<sub>current</sub>)</b>	



<b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>ICS:</b> inhaled corticosteroid; <b>LABA:</b> long-acting beta <sub>2</sub> -agonist; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.
* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup> . † The distribution of the asthma population across severity stages is derived from Firoozi, Lemiere, et al. <sup>13</sup> . ‡ Market sales for ICS MDI and DPI inhalers derived from Lavorini, Corrigan, et al. <sup>7</sup> . § This calculation considers a 12% adherence rate. <sup>14</sup> ¶ Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup> . # Market sales for ICS/LABA MDI and DPI inhalers are derived from Janson, Henderson, et al. <sup>3</sup> . ** Market sales for ICS/LABA HFC-134a- and HFC-227ea-containing MDI are derived from a government report. <sup>8</sup> †† This calculation considers a 43% adherence rate. <sup>19</sup>

**b) Anticipated carbon savings resulting from switching patients with mild asthma from an ICS+SABA regimen to as-needed budesonide-formoterol DPI**

Switching 25% of patients with mild asthma from an ICS+SABA regimen to as-needed budesonide-formoterol would further reduce GHGs by ~22,200 MT CO<sub>2</sub>e each year (**e-Table C-3**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **orange-coloured font** to help visualize the lines where changes are made between the anticipated and current case. \*

**e-Table C-3. Anticipated reduction in carbon footprint from switching patients with mild asthma from an ICS+SABA regimen to as-needed budesonide-formoterol DPI in Canada**

		Anticipated	Current case
<b>A</b>	Prevalence of clinically-diagnosed asthma *	3,800,000 people	
	<b>Mild asthma</b>		
<b>B</b>	Number of people in "A" who have mild asthma †	2,394,000 people (A × 63%)	2,394,000 people (A × 63%)
	<b>New treatment paradigm: as-needed Budesonide/Formoterol</b>		
	Budesonide/Formoterol DPI		
<b>C</b>	Number of people in "B" using a Budesonide/Formoterol DPI as controller and rescue therapy ‡	<b>598,500 people (B × 25%)</b>	<b>0 people (B × 0%)</b>

D	Number of actuations of Budesonide/Formoterol DPI over a year in people in “C” <sup>§</sup>	206 act per person per year (113 ug/day × 365 days/year)/(200 ug/dose)	206 act per person per year (113 ug/day × 365 days/year)/(200 ug/dose)
E	Carbon footprint associated with SABA DPI use in people in “C” <sup>†</sup>	1,111 MT CO <sub>2</sub> e (C × D × 0.009 kg CO <sub>2</sub> e/actuation)	0 MT CO <sub>2</sub> e (C × D × 0.009 kg CO <sub>2</sub> e/actuation)
<b>Conventional treatment: daily ICS plus as-needed SABA (in two separate inhalers)</b>			
<b>Daily ICS</b>			
	MDI		
F	Number of people in “B” who use an ICS MDI <sup>#</sup>	1,005,480 people ((B – C) × 56%)	1,340,640 people (B × 56%)
G	Number of actuations over a year among people in “F” <sup>**</sup>	88 act per person per year (2 act/day × 365 days/year × 12% adherence)	88 act per person per year (2 act/day × 365 days/year × 12% adherence)
H	Carbon footprint associated with use of controller ICS MDI among people in “F” <sup>†</sup>	11,583 MT CO <sub>2</sub> e (F × G × 0.1315 kg of CO <sub>2</sub> e/act)	15,443 MT CO <sub>2</sub> e (F × G × 0.1315 kg of CO <sub>2</sub> e/act)
	DPI		
I	Number of people in “B” who use an ICS DPI <sup>#</sup>	790,020 people ((B – C) × 44%)	1,053,360 people (B × 44%)
J	Number of actuations over a year among people in “I” <sup>**</sup>	88 act per person per year (2 act/day × 365 days/year × 12% adherence)	88 act per person per year (2 act/day × 365 days/year × 12% adherence)
K	Carbon footprint associated with use of controller ICS DPI among people in “I” <sup>†</sup>	623 MT CO <sub>2</sub> e (I × J × 0.009 kg of CO <sub>2</sub> e/act)	830 MT CO <sub>2</sub> e (I × J × 0.009 kg of CO <sub>2</sub> e/act)
<b>As-needed SABA</b>			
	MDI		
L	Number of people in “B” using a SABA MDI as rescue therapy <sup>††,‡‡</sup>	1,687,770 people ((B – C) × 94%)	2,250,360 people (B × 94%)
M	Number of actuations of SABA MDI over a year in people in “L” (reflecting good control) <sup>§§</sup>	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)
N	Carbon footprint associated with SABA MDI use in people in “L” <sup>†</sup>	46,164 MT CO <sub>2</sub> e (L × M × 0.263 kg CO <sub>2</sub> e/act)	30,776 MT CO <sub>2</sub> e (L × M × 0.1315 kg CO <sub>2</sub> e/act)
	DPI		
O	Number of people in “B” using a SABA DPI as rescue therapy <sup>††,‡‡</sup>	107,730 people ((B – C) × 6%)	143,640 people (B × 6%)
P	Number of actuations of SABA DPI over a year in people in “O” (reflecting good control) <sup>§§</sup>	52 act per person per year (1 act/dose × 1 dose/week × 52 weeks/year)	52 act per person per year (1 act/dose × 1 dose/week × 52 weeks/year)
Q	Carbon footprint associated with SABA DPI use in people in “O” <sup>†</sup>	50 MT CO <sub>2</sub> e (O × P × 0.009 kg CO <sub>2</sub> e/act)	67 MT CO <sub>2</sub> e (O × P × 0.009 kg CO <sub>2</sub> e/act)
	<b>Total</b>		
R	Total carbon footprint	36,449 MT CO <sub>2</sub> e (E + H + K + N + Q)	47,117 MT CO <sub>2</sub> e (E + H + K + N + Q)
S	Anticipated carbon saving	(10,668) MT CO <sub>2</sub> e (R <sub>anticipated</sub> – R <sub>current</sub> )	
<p><b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>ICS:</b> inhaled corticosteroid; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO<sub>2</sub> equivalent; <b>SABA:</b> short-acting beta<sub>2</sub>-agonist</p>			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
<p>* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada<sup>1</sup>.  <sup>†</sup> The distribution of the asthma population across severity stages is derived from Firoozi, Lemiere, et al.<sup>13</sup>.</p>			

<p>‡ In the anticipated scenario, we use the percentage of asthma patients on conventional ICS+SABA therapy who indicated a preference for an as-needed ICS/LABA therapy.<sup>20</sup></p> <p>§ Number of actuations of Budesonide/Formoterol DPI over a year derived from a pooled analysis of SYGMA, Novel Start, and PRACTICAL randomized controlled trials, as reported in Gagne, Lam Shin Cheung, et al.<sup>21</sup></p> <p>¶ Carbon footprint per actuation derived from Jeswani and Azapagic<sup>6</sup>.</p> <p># Market sales for ICS MDI and DPI inhalers derived from Lavorini, Corrigan, et al.<sup>7</sup></p> <p>** This calculation considers a 12% adherence rate.<sup>14</sup></p> <p>†† Market sales derived from Janson, Henderson, et al.<sup>3</sup></p> <p>‡‡ This analysis does not consider the people who are on a budesonide/formoterol inhaler that is indicated for single maintenance and reliever therapy (SMART). Previous study showed that the SMART dosing is prescribed in 1.2% of patients.<sup>22</sup></p> <p>§§ We define good symptom control as using rescue medication once per week on average. This is consistent with Canadian Asthma Guidelines.<sup>5</sup> Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).</p>
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**c) Anticipated carbon savings resulting from switching patients to a lower carbon footprint MDI (within the same class)**

**i) Selecting MDIs based on type of propellant used**

Switching 25% of patients who happen to be on an HFC-227ea-containing MDI to an HFC-134a-containing MDI could reduce the asthma carbon footprint by ~2,700 metric tons of CO<sub>2</sub> equivalent annually (e-Table C-4).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **yellow-coloured font** to help visualize the lines where changes are made between the anticipated and current case. For simplicity, data shown are limited to drug classes where it is possible to make this switch. \*

**e-Table C-4. Anticipated carbon saving from switching 25% of HFC-227ea-containing MDIs to HFC-134a-containing MDIs in moderate to severe asthma in Canada**

A	Prevalence of clinically-diagnosed asthma *	3,800,000 people	
		Anticipated	Current case
	<b>Moderate and severe asthma</b>		
B	Number of people in "A" who have moderate or severe asthma †	1,406,000 people (A × 37%)	1,406,000 people (A × 37%)
	<b>ICS/LABA</b>		
	MDI		
C	Number of people in "B" who use an ICS/LABA MDI ‡	660,820 people (B × 47%)	660,820 people (B × 47%)
	HFC-134a MDI	N	

<b>D</b>	<b>Number of people in “C” who use an HFC-134a MDI §</b>	<b>601,346 people (C × (88% + (12% × 25%)))</b>	<b>581,522 people (C × 88%)</b>
E	Number of actuations over a year, among people in “D” †	628 act per person per year (2 act/day × 365 days/year × 43% adherence)	628 act per person per year (2 act/day × 365 days/year × 43% adherence)
F	Carbon footprint associated with use of ICS/LABA HFC-134a-containing MDI among people in “D” #	<b>49,645 MT CO<sub>2</sub>e</b> (D × E × 0.1315 kg of CO <sub>2</sub> e/act)	<b>48,008 MT CO<sub>2</sub>e</b> (D × E × 0.1315 kg of CO <sub>2</sub> e/act)
<b>HFC-227ea MDI</b>			
<b>G</b>	<b>Number of people in “C” who use an HFC-227ea-containing MDI §</b>	<b>59,474 people (C × (12% – (12% × 25%)))</b>	<b>79,298 people (C × 12%)</b>
H	Number of act over a year, among people in “G” †	628 act per person per year (2 act/day × 365 days/year × 43% adherence)	628 act per person per year (2 act/day × 365 days/year × 43% adherence)
I	Carbon footprint associated with use of ICS/LABA HFC-227ea-containing MDI among people in “G” #	<b>13,012 MT CO<sub>2</sub>e</b> (G × H × 0.3485 kg of CO <sub>2</sub> e/act)	<b>17,350 MT CO<sub>2</sub>e</b> (G × H × 0.3485 kg of CO <sub>2</sub> e/act)
<b>Total</b>			
J	Total carbon footprint	<b>62,657 MT CO<sub>2</sub>e</b> (F + I)	<b>65,357 MT CO<sub>2</sub>e</b> (F + I)
<b>K</b>	<b>Anticipated carbon saving</b>	<b>(2,701) MT CO<sub>2</sub>e (J<sub>anticipated</sub> – J<sub>current</sub>)</b>	
<p><b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>ICS:</b> inhaled corticosteroid; <b>LABA:</b> long-acting beta<sub>2</sub>-agonist; <b>MDI:</b> pressurized metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO<sub>2</sub> equivalent</p>			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
<p>* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup>.  † The distribution of the asthma population across severity stages is derived from Firoozi, Lemiere, et al. <sup>13</sup>; this conservative analysis was limited to patients with moderate to severe asthma, given that HFC-227ea MDIs are used in ICS/LABA combination inhalers, which are not indicated for patients with mild asthma.  ‡ Market sales for ICS/LABA MDIs are derived from Janson, Henderson, et al. <sup>3</sup>.  § Market sales for ICS/LABA HFC-134a- and HFC-227ea-containing MDI are derived from a government report.<sup>8</sup>  ¶ This calculation considers a 43% adherence rate. Ismaila, Corriveau, et al. <sup>19</sup>.  # Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup>.</p>			

ii) *Selecting MDIs based on amount of propellant used*

Switching 25% of people using a high-volume HFC-containing SABA MDI to a low-volume SABA MDI would result in emission reductions of ~43,800 metric tons of CO<sub>2</sub> equivalent annually (e-Table C-5).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used blue-coloured font to help visualize the lines where changes are made between the anticipated and current case. \*

**e-Table C-5. Anticipated carbon saving resulting from switching 25% of high-volume HFC-134a SABA MDI prescriptions to lowest-volume HFC-134a SABA MDI in asthma in Canada**

A	Prevalence of clinically-diagnosed asthma *	3,800,000 people	
		Anticipated	Current case
	<b>People not overusing SABA</b>		
B	Number of people in "A" who use a SABA ≤150 times per year †	2,660,000 people (A × 70%)	2,660,000 people (A × 70%)
C	Number of people in "B" using a SABA MDI ‡	2,500,400 people (B × 94%)	2,500,400 people (B × 94%)
<b>Low-volume HFC-134a SABA MDI</b>			
D	<b>Number of people in "C" using low-volume HFC-134a SABA MDI §</b>	<b>1,825,292 people (C × (48% – 25%))</b>	<b>1,200,192 people (C × 48%)</b>
E	Number of actuations of SABA MDI over a year in people in "D" ¶	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)
F	Carbon footprint associated with SABA MDI use in people in "D" #	<b>9,017 MT CO<sub>2</sub>e</b> (D × E × 0.095 kg CO <sub>2</sub> e/act)	<b>5,929 MT CO<sub>2</sub>e</b> (D × E × 0.0475 kg CO <sub>2</sub> e/act)
<b>High-volume HFC-134a SABA MDI</b>			
G	<b>Number of people in "C" using a high-volume HFC-134a SABA MDI §</b>	<b>675,108 people ((C × (52% – 25%))</b>	<b>1,300,208 people (C × 52%)</b>
H	Number of actuations of SABA MDI over a year in people in "F" (reflecting good control) ¶	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)
I	Carbon footprint associated with SABA MDI use in people in "F" #	<b>9,233 MT CO<sub>2</sub>e</b> (G × H × 0.263 kg CO <sub>2</sub> e/act)	<b>38,464 MT CO<sub>2</sub>e</b> (G × H × 0.2105 kg CO <sub>2</sub> e/act)
<b>Mild overuse: &gt;150 to 375 doses of SABA per year</b>			
J	Number of people in "A" who use a SABA >150 to 375 times per year	798,000 people (A × 21%)	798,000 people (A × 21%)
K	Number of people in "J" using a SABA MDI ‡	750,120 people (J × 94%)	750,120 people (J × 94%)
<b>Low-volume HFC-134a SABA MDI</b>			
L	<b>Number of people in "K" using low-volume HFC-134a SABA MDI §</b>	<b>547,588 people ((K × (48% + 25%))</b>	<b>360,058 people (K × 48%)</b>
M	Number of actuations of SABA MDI over a year in people in "L" ***	526 act per person per year (2 act/dose × (150 + 113) doses/year)	526 act per person per year (2 act/dose × (150 + 113) doses/year)
N	Carbon footprint associated with SABA MDI use in people in "L" #	<b>13,681 MT CO<sub>2</sub>e</b> (L × M × 0.0475 kg CO <sub>2</sub> e/act)	<b>8,996 MT CO<sub>2</sub>e</b> (L × M × 0.0475 kg CO <sub>2</sub> e/act)
<b>High-volume HFC-134a SABA MDI</b>			
O	<b>Number of people in "C" using a high-volume HFC-134a SABA MDI §</b>	<b>202,532 people ((K × (52% – 25%))</b>	<b>390,062 people (K × 52%)</b>

P	Number of actuations of SABA MDI over a year in people in “O” (reflecting good control) **	526 act per person per year (2 act/dose × (150 + 113) doses/year)	526 act per person per year (2 act/dose × (150 + 113) doses/year)
Q	Carbon footprint associated with SABA MDI use in people in “O” #	22,425 MT CO <sub>2</sub> e (O × P × 0.2105 kg CO <sub>2</sub> e/act)	43,189 MT CO <sub>2</sub> e (O × P × 0.2105 kg CO <sub>2</sub> e/act)
	<b>Moderate overuse: &gt;375 to 750 doses of SABA per year</b>		
R	Number of people in “A” who use a SABA >375 to 750 times per year	266,000 people (A × 7%)	266,000 people (A × 7%)
S	Number of people in “R” using a SABA MDI ‡	250,040 people (R × 94%)	250,040 people (R × 94%)
	<b>Low-volume HFC-134a SABA MDI</b>		
T	<b>Number of people in “S” using low-volume HFC-134a SABA MDI §</b>	<b>182,529 people ((S × (48% + 25%))</b>	<b>120,019 people (S × 48%)</b>
U	Number of actuations of SABA MDI over a year in people in “T” **	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)
V	Carbon footprint associated with SABA MDI use in people in “T” #	9,763 MT CO <sub>2</sub> e (T × U × 0.0475 kg CO <sub>2</sub> e/act)	6,419 MT CO <sub>2</sub> e (T × U × 0.0475 kg CO <sub>2</sub> e/act)
	<b>High-volume HFC-134a SABA MDI</b>		
W	<b>Number of people in “S” using a high-volume HFC-134a SABA MDI §</b>	<b>67,511 people ((S × (52% – 25%))</b>	<b>130,021 people (S × 52%)</b>
X	Number of actuations of SABA MDI over a year in people in “W” (reflecting good control) **	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)
Y	Carbon footprint associated with SABA MDI use in people in “W” #	16,002 MT CO <sub>2</sub> e (W × X × 0.2105 kg CO <sub>2</sub> e/act)	30,818 MT CO <sub>2</sub> e (W × X × 0.2105 kg CO <sub>2</sub> e/act)
	<b>Severe overuse: &gt;750 doses of SABA per year</b>		
Z	Number of people in “A” who use a SABA >750 times per year	76,000 people (A × 2%)	76,000 people (A × 2%)
AA	Number of people in “Z” using a SABA MDI ‡	71,440 people (Z × 94%)	71,440 people (Z × 94%)
	<b>Low-volume HFC-134a SABA MDI</b>		
AB	<b>Number of people in “AA” using low-volume HFC-134a SABA MDI §</b>	<b>52,151 people ((AA × (48% + 25%))</b>	<b>34,291 people (AA × 48%)</b>
AC	Number of actuations of SABA MDI over a year in people in “AB” **	1,500 act per person per year (2 act/dose × (150 + 600) dose/year)	1,500 act per person per year (2 act/dose × (150 + 600) dose/year)
AD	Carbon footprint associated with SABA MDI use in people in “AB” #	3,716 MT CO <sub>2</sub> e (AB × AC × 0.0475 kg CO <sub>2</sub> e/act)	2,443 MT CO <sub>2</sub> e (AB × AC × 0.0475 kg CO <sub>2</sub> e/act)
	<b>High-volume HFC-134a SABA MDI</b>		
AE	<b>Number of people in “AA” using a high-volume HFC-134a SABA MDI §</b>	<b>19,289 people ((AA × (52% – 25%))</b>	<b>37,149 people (AA × 52%)</b>

AF	Number of actuations of SABA MDI over a year in people in “O” (reflecting good control) **	1,500 act per person per year (2 act/dose × (150 + 600) dose/year)	1,500 act per person per year (2 act/dose × (150 + 600) dose/year)
AG	Carbon footprint associated with SABA MDI use in people in “O” #	<b>6,090 MT CO<sub>2</sub>e</b> (AE × AF × 0.2105 kg CO <sub>2</sub> e/act)	<b>11,730 MT CO<sub>2</sub>e</b> (AE × AF × 0.263 kg CO <sub>2</sub> e/act)
	<b>Total</b>		
AH	Total carbon footprint	<b>89,927 MT CO<sub>2</sub>e</b> ((F + I) + (N + Q) + (V + Y) + (AD + AG))	<b>137,988 MT CO<sub>2</sub>e</b> ((F + I) + (N + Q) + (V + Y) + (AD + AG))
AI	<b>Anticipated carbon saving</b>	<b>(48,061) MT CO<sub>2</sub>e</b> (AH <sub>anticipated</sub> – AH <sub>current</sub> )	
<b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent; <b>SABA:</b> short-acting beta <sub>2</sub> -agonist			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup> . † Categories of SABA users are derived from Nwaru, Ekstrom, et al. <sup>12</sup> . ‡ Market sales for SABA inhalers are derived from Janson, Henderson, et al. <sup>3</sup> . § Market share for low- and high-volume HFC-containing SABA MDIs are derived from Badcock, Metcalfe, et al. <sup>23</sup> . We assumed that non-Ventolin sales applied to low-volume HFC-containing SABA MDIs. ¶ We consider an averaged use of 1 dose of SABA per week. This reflects a conservative definition, given that guidelines define well-controlled asthma as no more than 2 uses (doses) of SABA per week. <sup>4,5</sup> Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation. # Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup> . ** We calculated the mid-point estimate for mild and moderate SABA overuse categories, and the low-point estimate for the severe overuse category. For this analysis, we counted the first 150 uses (doses) in any category, even though those doses are considered within the acceptable limit for good asthma control.			

## COPD

### a) Anticipated carbon savings resulting from switching MDI to DPIs (within the same drug class)

In COPD, switching 25% of MDI prescriptions to DPIs (in drug classes where both devices are available) would cut ~193,800 metric tons of CO<sub>2</sub> equivalent: ~178,400 metric tons of CO<sub>2</sub> equivalent in switching rescue inhalers (**e-Table C-6**), and ~15,500 metric tons of CO<sub>2</sub> equivalent in switching controller inhalers (**e-Table C-7**).

\* In the tables that follow, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **green-coloured font** to help visualize the lines where changes are made between the anticipated and current case. For simplicity, data shown are limited to COPD severity stages and drug classes where it is possible to make this switch. \*



**e-Table C-6. Anticipated carbon footprint reduction from switching 25% of rescue MDI prescriptions to DPIs in COPD in Canada**

A	Prevalence of clinically-diagnosed COPD *	2,000,000 people	
		Anticipated	Current case
	<b>Mild COPD</b>		
B	Number of people in “A” who have mild COPD †	560,000 people (A × 28%)	560,000 people (A × 28%)
	<b>No overuse</b>		
C	Number of people in “B” who do not overuse their rescue inhaler †	560,000 people (B × 100%)	560,000 people (B × 100%)
	<b>SABA</b>		
D	Number of people in “C” using a SABA ‡	530,457 people (C × 95%)	530,457 people (C × 95%)
	<b>MDI</b>		
E	<b>Number of people in “D” using a SABA MDI ‡</b>	<b>366,015 people (D × (94% – 25%))</b>	<b>498,629 people (D × 94%)</b>
F	Number of actuations used by each patient in “E” each year §	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
G	Carbon footprint associated with SABA MDI use in people in “E” ¶	<b>10,011 MT CO<sub>2e</sub></b> (E × F × 0.1315 kg CO <sub>2</sub> e/act)	<b>13,639 MT CO<sub>2e</sub></b> (E × F × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>		
H	<b>Number of people in “D” using a SABA DPI ‡</b>	<b>164,442 people (D × (6% + 25%))</b>	<b>31,827 people (D × 6%)</b>
I	Number of actuations used by each patient in “G” each year §	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)
J	Carbon footprint associated with SABA DPI use in people in “G” ¶	<b>154 MT CO<sub>2e</sub></b> (H × I × 0.009 kg CO <sub>2</sub> e/act)	<b>30 MT CO<sub>2e</sub></b> (H × I × 0.009 kg CO <sub>2</sub> e/act)
	<b>Moderate to severe COPD</b>		
K	Number of people in “A” who have moderate or severe COPD †	1,440,000 people (A × 72%)	1,440,000 people (A × 72%)
	<b>No overuse</b>		
L	Number of people in “A” who do not overuse their rescue inhaler †	763,200 people (K × 53%)	763,200 people (K × 53%)
	<b>SABA</b>		
M	Number of people in “L” using a SABA ‡	722,937 people (L × 95%)	722,937 people (L × 95%)
	<b>MDI</b>		
N	<b>Number of people in “M” using a SABA MDI ‡</b>	<b>498,826 people (M × (94% – 25%))</b>	<b>679,561 people (M × 94%)</b>
O	Number of actuations used by each patient in “N” each year §	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
P	Carbon footprint associated with SABA MDI use in people in “N” ¶	<b>13,644 MT CO<sub>2e</sub></b> (N × O × 0.1315 kg CO <sub>2</sub> e/act)	<b>18,587 MT CO<sub>2e</sub></b> (N × O × 0.1315 kg CO <sub>2</sub> e/act)

	DPI		
Q	Number of people in “M” using a SABA DPI ‡	224,110 people ( $M \times (6\% + 25\%)$ )	43,376 people ( $M \times 6\%$ )
R	Number of actuations used by each patient in “Q” each year §	104 act per person per year (1 act/dose $\times$ 2 doses/week $\times$ 52 weeks/year)	104 act per person per year (1 act/dose $\times$ 2 doses/week $\times$ 52 weeks/year)
S	Carbon footprint associated with SABA DPI use in people in “Q” ¶	210 MT CO <sub>2e</sub> ( $Q \times R \times 0.009$ kg CO <sub>2</sub> e/act)	41 MT CO <sub>2e</sub> ( $Q \times R \times 0.009$ kg CO <sub>2</sub> e/act)
	Mild overuse: 4 to 180 days in a year requiring more than 4 uses (doses) of rescue therapy		
T	Number of people in “K” with mild overuse †	406,080 people ( $K \times 28\%$ )	406,080 people ( $K \times 28\%$ )
	SABA		
U	Number of people in “T” using a SABA ‡	384,657 people ( $T \times 95\%$ )	384,657 people ( $T \times 95\%$ )
	MDI		
V	Number of people in “U” using a SABA MDI ‡	265,413 people ( $U \times (94\% - 25\%)$ )	361,577 people ( $U \times 94\%$ )
W	Number of actuations used by each patient in “V” each year #	3,319 act per person per year (8.6 act/day $\times$ 365 days/year)	3,319 act per person per year (8.6 act/day $\times$ 365 days/year)
X	Carbon footprint associated with SABA MDI use in people in “V” ¶	109,557 MT CO <sub>2e</sub> ( $V \times W \times 0.1315$ kg CO <sub>2</sub> e/act)	149,251 MT CO <sub>2e</sub> ( $V \times W \times 0.1315$ kg CO <sub>2</sub> e/act)
	DPI		
Y	Number of people in “U” using a SABA DPI ‡	119,244 people ( $U \times (6\% + 25\%)$ )	23,079 people ( $U \times 6\%$ )
Z	Number of actuations used by each patient in “Y” each year #	1,570 act per person per year (4.3 act/day $\times$ 365 days/year)	1,570 act per person per year (4.3 act/day $\times$ 365 days/year)
AA	Carbon footprint associated with SABA DPI use in people in “Y” ¶	1,684 MT CO <sub>2e</sub> ( $Y \times Z \times 0.009$ kg CO <sub>2</sub> e/act)	326 MT CO <sub>2e</sub> ( $Y \times Z \times 0.009$ kg CO <sub>2</sub> e/act)
	Severe overuse: > 180 days in a year requiring more than 4 uses (doses) of rescue therapy		
AB	Number of people in “K” with severe overuse †	270,720 people ( $K \times 19\%$ )	270,720 people ( $K \times 19\%$ )
	SABA		
AC	Number of people in “AB” using a SABA ‡	256,438 people ( $AB \times 95\%$ )	256,438 people ( $AB \times 95\%$ )
	MDI		
AD	Number of people in “AC” using a SABA MDI ‡	176,942 people ( $AC \times (94\% - 25\%)$ )	241,052 people ( $AC \times 94\%$ )
AE	Number of actuations used by each patient in “AD” each year #	5,037 act per person per year (13.8 act/day $\times$ 365 days/year)	5,037 act per person per year (13.8 act/day $\times$ 365 days/year)
AF	Carbon footprint associated with SABA MDI use in people in “AD” ¶	117,200 MT CO <sub>2e</sub> ( $AD \times AE \times 0.1315$ kg CO <sub>2</sub> e/act)	319,329 MT CO <sub>2e</sub> ( $AD \times AE \times 0.263$ kg CO <sub>2</sub> e/act)
	DPI		
AG	Number of people in “AC” using a SABA DPI ‡	79,496 people ( $AC \times (6\% + 25\%)$ )	15,386 people ( $AC \times 6\%$ )
AH	Number of actuations used by each patient in “AE” each year #	2,519 act per person per year (6.9 act/day $\times$ 365 days/year)	2,519 act per person per year (6.9 act/day $\times$ 365 days/year)

AI	Carbon footprint associated with SABA DPI use in people in “AE” <sup>†</sup>	<b>1,802 MT CO<sub>2</sub>e</b> ( $AB \times AC \times 0.009 \text{ kg CO}_2 \text{ e/act}$ )	<b>349 MT CO<sub>2</sub>e</b> ( $AB \times AC \times 0.009 \text{ kg CO}_2 \text{ e/act}$ )
	<b>TOTAL</b>		
AJ	Total carbon footprint	<b>254,262 MT CO<sub>2</sub>e</b> ( $((G + J) + (P + S) + (X + AA) + (AF + AI))$ )	<b>341,887 MT CO<sub>2</sub>e</b> ( $((G + J) + (P + S) + (X + AA) + (AF + AI))$ )
AL	<b>Anticipated carbon saving</b>	<b>(87,624) MT CO<sub>2</sub>e</b> ( $(A_{\text{anticipated}} - A_{\text{current}})$ )	
<b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent; <b>SABA:</b> short-acting beta <sub>2</sub> -agonist; <b>SAMA:</b> short-acting muscarinic antagonist			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
* Prevalence of clinically-diagnosed COPD derived from Public Health Agency of Canada <sup>1</sup> . <sup>†</sup> Severity stages are defined as per CTS guidelines, <sup>15</sup> and corresponds to GOLD groups B and D. <sup>16</sup> The distribution of the COPD population across severity stages is derived from Le, Johannessen, et al. <sup>17</sup> In this conservative analysis, patients with mild COPD were not considered to overuse rescue therapies. <sup>‡</sup> Market sales derived from Janson, Henderson, et al. <sup>3</sup> . <sup>§</sup> Normal use is defined as taking $\leq 4$ uses (doses) of a short-acting reliever in a week. <sup>10</sup> Here, we assume that patients take their rescue medication twice a week. Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation). <sup>¶</sup> Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup> . <sup>#</sup> Overuse is defined as taking $>4$ uses (doses) of a short-acting reliever in a day. <sup>18</sup> Mild overusers used their rescue therapy for on average $\sim 1$ excess dose (use) every 3 days, while severe overusers used their rescue therapy for on average $\sim 3$ excess doses (uses) every day. <sup>18</sup> Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).			

**e-Table C-7. Anticipated carbon footprint reduction from switching 25% of controller MDI prescriptions to DPIs in COPD in Canada**

A	Prevalence of clinically-diagnosed COPD <sup>*</sup>	2,000,000 people	
		Anticipated	Current
	<b>GOLD A: CAT &lt;10, MRC 1-2 (CTS mild COPD)</b>		
B	Number of people in “A” in GOLD A group <sup>†</sup>	500,000 people ( $A \times 25\%$ )	500,000 people ( $A \times 25\%$ )
	<b>SABA</b>		
C	Number of people in “B” using a SABA <sup>‡</sup>	248,224 people ( $B \times 50\%$ )	248,224 people ( $B \times 50\%$ )
	<b>MDI</b>		
D	<b>Number of people in “C” who are using a SABA MDI<sup>‡</sup></b>	<b>171,274 people (<math>C \times (94\% - 25\%)</math>)</b>	<b>233,330 people (<math>C \times 94\%</math>)</b>
E	Estimated number of SABA MDI actuations used by a single patient in “D” each year <sup>§</sup>	208 act per person per year ( $2 \text{ act/dose} \times 2 \text{ doses/week} \times 52 \text{ weeks/year}$ )	208 act per person per year ( $2 \text{ act/dose} \times 2 \text{ doses/week} \times 52 \text{ weeks/year}$ )

F	Carbon footprint associated with SABA MDI use in people in “D” †	<b>4,685 MT CO<sub>2</sub>e</b> ( $D \times E \times 0.1315 \text{ kg e/act}$ )	<b>6,382 MT CO<sub>2</sub>e</b> ( $D \times E \times 0.1315 \text{ kg e/act}$ )
	DPI		
<b>G</b>	<b>Number of people in “C” who are using a SABA DPI ‡</b>	<b>76,949 people</b> ( $C \times (6\% + 25\%)$ )	<b>14,893 people</b> ( $C \times 6\%$ )
H	Estimated number of SABA DPI actuations used by a single patient in “G” each year §	104 act per person per year ( $1 \text{ act/dose} \times 2 \text{ doses/week} \times 52 \text{ weeks/year}$ )	104 act per person per year ( $1 \text{ act/dose} \times 2 \text{ doses/week} \times 52 \text{ weeks/year}$ )
I	Carbon footprint associated with SABA DPI use in people in “G” †	<b>72 MT CO<sub>2</sub>e</b> ( $G \times H \times 0.009 \text{ kg CO}_2\text{e/act}$ )	<b>14 MT CO<sub>2</sub>e</b> ( $G \times H \times 0.009 \text{ kg CO}_2\text{e/act}$ )
	<b>GOLD B: CAT <math>\geq</math>10, MRC <math>\geq</math>3, and infrequent exacerbations (CTS moderate COPD)</b>		
J	Number of people in “A” in GOLD B group †	1,040,000 people ( $A \times 52\%$ )	1,040,000 people ( $A \times 52\%$ )
	<b>ICS/LABA</b>		
K	Number of people in “J” using an ICS/LABA ‡	416,871 people ( $J \times 40\%$ )	416,871 people ( $J \times 40\%$ )
	MDI		
<b>L</b>	<b>Number of people in “K” who are using an ICS/LABA MDI ‡</b>	<b>91,712 people</b> ( $K \times (47\% - 25\%)$ )	<b>195,929 people</b> ( $K \times 47\%$ )
	<b>HFC-134a-containing MDI</b>		
M	Number of people in “L” who are using an ICS/LABA MDI using HFC-134a as propellant #	80,706 people ( $L \times 88\%$ )	172,418 people ( $L \times 88\%$ )
N	Number of ICS/LABA MDI actuations used by each patient in “M” each year **	270 act per year ( $1 \text{ act/dose} \times 2 \text{ doses/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )	270 act per year ( $1 \text{ act/dose} \times 2 \text{ doses/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )
O	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “M” †	<b>2,867 MT CO<sub>2</sub>e</b> ( $M \times N \times 0.1315 \text{ kg CO}_2\text{e/act}$ )	<b>6,124 MT CO<sub>2</sub>e</b> ( $M \times N \times 0.1315 \text{ kg CO}_2\text{e/act}$ )
	<b>HFC-227ea-containing MDI</b>		
P	Number of people in “L” who are using an ICS/LABA MDI using HFC-227ea as propellant #	11,005 people ( $L \times 12\%$ )	23,512 people ( $L \times 12\%$ )
Q	Number of ICS/LABA MDI actuations used by each patient in “P” each year **	270 act per year ( $1 \text{ act/dose} \times 2 \text{ doses/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )	270 act per year ( $1 \text{ act/dose} \times 2 \text{ doses/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )
R	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “P” †	<b>1,036 MT CO<sub>2</sub>e</b> ( $P \times Q \times 0.3485 \text{ kg CO}_2\text{e/act}$ )	<b>2,213 MT CO<sub>2</sub>e</b> ( $P \times Q \times 0.3485 \text{ kg CO}_2\text{e/act}$ )
	DPI		
<b>S</b>	<b>Number of people in “K” who are using an ICS/LABA DPI ‡</b>	<b>325,159 people</b> ( $K \times (53\% + 25\%)$ )	<b>220,942 people</b> ( $K \times 53\%$ )
T	Number of ICS/LABA DPI actuations used by each patient in “S” each year **	270 act per year ( $1 \text{ act/dose} \times 2 \text{ doses/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )	270 act per year ( $1 \text{ act/dose} \times 2 \text{ doses/day} \times 365 \text{ days/year} \times 37\% \text{ adherence}$ )
U	Carbon footprint associated with ICS/LABA DPI use in people in “S” †	<b>790 MT CO<sub>2</sub>e</b> ( $S \times T \times 0.009 \text{ kg CO}_2\text{e/act}$ )	<b>537 MT CO<sub>2</sub>e</b> ( $S \times T \times 0.009 \text{ kg CO}_2\text{e/act}$ )
	<b>GOLD C: CAT &lt;10, MRC 1-2, and frequent exacerbations</b>		

V	Number of people in “A” in GOLD C group †	60,000 people (A × 3%)	60,000 people (A × 3%)
	<b>GOLD D: CAT ≥10, MRC ≥3, and frequent exacerbations (CTS severe COPD)</b>		
W	Number of people in “A” in GOLD D group †	400,000 people (A × 20%)	400,000 people (A × 20%)
	<b>ICS/LABA</b>		
X	Number of people in “W” using an ICS/LABA ‡	170,176 people (W × 43%)	170,176 people (W × 43%)
	<b>MDI</b>		
Y	<b>Number of people in “X” who are using an ICS/LABA MDI ‡</b>	<b>37,439 people (X × (47% – 25%))</b>	<b>79,983 people (X × 47%)</b>
	<b>HFC-134a-containing MDI</b>		
Z	Number of people in “Y” who are using an ICS/LABA MDI using HFC-134a as propellant #	32,946 people (Y × 88%)	70,385 people (Y × 88%)
AA	Number of ICS/LABA MDI actuations used by each patient in “Z” each year **	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)
AB	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “Z” †	<b>1,170 MT CO<sub>2</sub>e</b> (Z × AA × 0.1315 kg CO <sub>2</sub> e/act)	<b>2,500 MT CO<sub>2</sub>e</b> (Z × AA × 0.1315 kg CO <sub>2</sub> e/act)
	<b>HFC-227ea-containing MDI</b>		
AC	Number of people in “Y” who are using an ICS/LABA MDI using HFC-227ea as propellant #	4,493 people (Y × 12%)	9,598 people (Y × 12%)
AD	Number of ICS/LABA MDI actuations used by each patient in “AC” each year **	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)
AE	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “AC” †	<b>423 MT CO<sub>2</sub>e</b> (AC × AD × 0.1315 kg CO <sub>2</sub> e/act)	<b>1,807 MT CO<sub>2</sub>e</b> (AC × AD × 0.697 kg CO <sub>2</sub> e/act)
	<b>DPI</b>		
AF	<b>Number of people in “X” who are using an ICS/LABA DPI ‡</b>	<b>132,737 people (X × (53% + 25%))</b>	<b>90,193 people (X × 53%)</b>
AG	Number of ICS/LABA DPI actuations used by each patient in “AF” each year **	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)
AH	Carbon footprint associated with ICS/LABA DPI use in people in “AF” †	<b>323 MT CO<sub>2</sub>e</b> (AF × AG × 0.009 kg CO <sub>2</sub> e/act)	<b>219 MT CO<sub>2</sub>e</b> (AF × AG × 0.009 kg CO <sub>2</sub> e/act)
	<b>Total</b>		
	Total carbon footprint	<b>11,365 MT CO<sub>2</sub>e</b> ((F + I) + (O + R + U) + (AB + AE + AH))	<b>18,893 MT CO<sub>2</sub>e</b> ((F + I) + (O + R + U) + (AB + AE + AH))
	<b>Anticipated carbon saving</b>	<b>(7,527) metric tons of CO<sub>2</sub>e</b> (AI <sub>anticipated</sub> – AI <sub>current</sub> )	
<b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>DPI:</b> Dry-powder inhaler; <b>LABA:</b> long-acting beta <sub>2</sub> -agonist; <b>LAMA:</b> long-acting muscarinic antagonist; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent; <b>SAMA:</b> short-acting muscarinic antagonist			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			

\* Prevalence of clinically-diagnosed COPD derived from Public Health Agency of Canada <sup>1</sup>.  
 † Group severity categories are defined as per 2017 GOLD guidelines.<sup>16</sup> Percentages owing to each group are derived from Le, Johannessen, et al. <sup>17</sup>.  
 ‡ Market sales derived from Janson, Henderson, et al. <sup>3</sup>.  
 § Normal use is defined as taking ≤4 uses (doses) of a short-acting reliever in a week.<sup>10</sup> Here, we assume that patients take their rescue medication twice a week. Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).  
 ¶ Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup>.  
 # Market sales for ICS/LABA HFC-134a- and HFC-227ea-containing MDI are derived from a government report.<sup>8</sup>  
 \*\* Percentage of people adherent to their medication is derived from Toy, Beaulieu, et al. <sup>11</sup>.

### b) Using combination inhalers rather than multiple separate inhalers

Switching 25% of LAMA and ICS/LABA prescriptions (in two separate inhalers) to a LAMA/LABA/ICS monotherapy could save ~15,200 metric tons of CO<sub>2</sub> equivalent, even after accounting for increased adherence anticipated with monotherapy (e-Table C-8).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **orange-coloured font** to help visualize the lines where changes are made between the anticipated and current case. For simplicity, data shown are limited to GOLD B and D groups, as this switch applies to these COPD stages only. \*

**e-Table C-8. Anticipated reduction in carbon footprint from switching 25% of people with COPD who are on a LAMA + ICS/LABA (in two separate inhalers) to a LAMA/LABA/ICS monotherapy**

A	Prevalence of clinically-diagnosed COPD *	2,000,000 people	
		Anticipated	Current case
<b>GOLD B: CAT ≥10, MRC ≥3, and infrequent exacerbations (CTS moderate COPD)</b>			
B	Number of people in "A" in GOLD B group †	1,040,000 people (A × 52%)	1,040,000 people (A × 52%)
<b>LAMA/LABA/ICS</b>			
C	Number of people in "B" using a LAMA/LABA/ICS ‡	<b>260,448 people (B × (0.04% + 25%))</b>	<b>448 people (B × 0.04%)</b>
<b>DPI</b>			
D	Number of people in "C" who are using a LAMA/LABA/ICS DPI ‡	260,448 people (C × 100%)	448 people (C × 100%)
E	Number of LAMA/LABA/ICS DPI actuations used by each patient in "D" each year §	157 act per year (1 act/dose × 1 time/day × 365 days/year × 43% adherence)	157 act per year (1 act/dose × 1 time/day × 365 days/year × 43% adherence)
F	Carbon footprint associated with LAMA/LABA/ICS DPI use in people in "D" ¶	<b>368 MT CO<sub>2</sub>e (D × E × 0.009 kg CO<sub>2</sub>e/act)</b>	<b>0.6 MT CO<sub>2</sub>e (D × E × 0.009 kg CO<sub>2</sub>e/act)</b>

<b>LAMA or LAMA/LABA</b>			
<b>G</b>	<b>Number of people in “B” using a LAMA or a LAMA/LABA ‡</b>	<b>302,541 people ((B × 54%) – (B × 25%))</b>	<b>562,541 people (B × 54%)</b>
	DPI		
H	Number of people in “G” who are using a LAMA DPI or a LAMA/LABA DPI ‡	302,541 people (G × 100%)	562,541 people (G × 100%)
I	Estimated number of a LAMA DPI or a LAMA/LABA DPI actuations used by a single patient in “H” each year §	270 act per year (1 act/dose × 2 times/day × 365 days/year × 37% adherence)	270 act per year (1 act/dose × 2 times/day × 365 days/year × 37% adherence)
J	Carbon footprint associated with a LAMA DPI or a LAMA/LABA DPI use in people in “H” ¶	<b>735 MT CO<sub>2</sub>e</b> (H × I × 0.009 kg CO <sub>2</sub> e/act)	<b>1,367 MT CO<sub>2</sub>e</b> (H × I × 0.009 kg CO <sub>2</sub> e/act)
<b>ICS/LABA</b>			
<b>K</b>	<b>Number of people in “B” using an ICS/LABA ‡</b>	<b>156,871 people ((B × 40%) – (B × 25%))</b>	<b>416,871 people (B × 40%)</b>
	MDI		
L	Number of people in “K” who are using an ICS/LABA MDI ‡	73,729 people (K × 47%)	195,929 people (K × 47%)
	HFC-134a-containing MDI		
M	Number of people in “L” who are using an ICS/LABA MDI using HFC-134a as propellant #	64,882 people (L × 88%)	172,418 people (L × 88%)
N	Number of ICS/LABA MDI actuations used by each patient in “M” each year §	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
O	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “M” ¶	<b>2,304 MT CO<sub>2</sub>e</b> (M × N × 0.1315 kg CO <sub>2</sub> e/act)	<b>6,124 MT CO<sub>2</sub>e</b> (M × N × 0.1315 kg CO <sub>2</sub> e/act)
	HFC-227ea-containing MDI		
P	Number of people in “L” who are using an ICS/LABA MDI using HFC-227ea as propellant #	8,848 people (L × 12%)	23,512 people (L × 12%)
Q	Number of ICS/LABA MDI actuations used by each patient in “P” each year §	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
R	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “P” ¶	<b>833 MT CO<sub>2</sub>e</b> (P × Q × 0.03485 kg CO <sub>2</sub> e/act)	<b>2,213 MT CO<sub>2</sub>e</b> (P × Q × 0.697 kg CO <sub>2</sub> e/act)
	DPI		
S	Number of people in “K” who are using an ICS/LABA DPI ‡	83,142 people (K × 53%)	220,942 people (K × 53%)
T	Number of ICS/LABA DPI actuations used by each patient in “S” each year §	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
U	Carbon footprint associated with ICS/LABA DPI use in people in “S” ¶	<b>202 MT CO<sub>2</sub>e</b> (S × T × 0.009 kg CO <sub>2</sub> e/act)	<b>537 MT CO<sub>2</sub>e</b> (S × T × 0.3485 kg CO <sub>2</sub> e/act)
<b>GOLD D: CAT ≥10, MRC ≥3, and frequent exacerbations (CTS severe COPD)</b>			
V	Number of people in “A” in GOLD D group †	400,000 people (A × 28%)	400,000 people (A × 28%)



	<b>LAMA/LABA/ICS</b>		
<b>W</b>	<b>Number of people in “V” who are using a LAMA/LABA/ICS ‡</b>	<b>100,183 people (V × (0.05% + 25%))</b>	<b>183 people (V × 0.05%)</b>
	DPI		
X	Number of people in “W” who are using a LAMA/LABA/ICS DPI ‡	100,183 people (W × 100%)	183 people (W × 100%)
Y	Number of LAMA/LABA/ICS DPI actuations used by each patient in “X” each year §	157 act per year (1 act/dose × 1 time/day × 365 days/year × 43% adherence)	157 act per year (1 act/dose × 1 time/day × 365 days/year × 43% adherence)
Z	Carbon footprint associated with LAMA/LABA/ICS DPI use in in people in “X” †	<b>142 MT CO<sub>2</sub>e</b> (X × Y × 0.009 kg CO <sub>2</sub> e/act)	<b>0.3 MT CO<sub>2</sub>e</b> (X × Y × 0.009 kg CO <sub>2</sub> e/act)
	<b>LAMA or LAMA/LABA</b>		
<b>AA</b>	<b>Number of people in “V” using a LAMA or a LAMA/LABA ‡</b>	<b>129,641 people ((V × 57%) – (V × 25%))</b>	<b>229,641 people (V × 57%)</b>
	DPI		
AB	Number of people in “AA” who are using a LAMA DPI or a LAMA/LABA DPI ‡	129,641 people (AA × 100%)	229,641 people (AA × 100%)
AC	Estimated number of a LAMA DPI or a LAMA/LABA DPI actuations used by a single patient in “AB” each year §	270 act per year (1 act/dose × 2 times/day × 365 days/year × 37% adherence)	270 act per year (1 act/dose × 2 times/day × 365 days/year × 37% adherence)
AD	Carbon footprint associated with a LAMA DPI or a LAMA/LABA DPI use in people in “AB” †	<b>315 MT CO<sub>2</sub>e</b> (AB × AC × 0.009 kg CO <sub>2</sub> e/act)	<b>558 MT CO<sub>2</sub>e</b> (AB × AC × 0.009 kg CO <sub>2</sub> e/act)
	<b>ICS/LABA</b>		
<b>AE</b>	<b>Number of people in “V” using an ICS/LABA ‡</b>	<b>70,176 people ((V × 43%) – (V × 25%))</b>	<b>170,176 people (V × 43%)</b>
	MDI		
AF	Number of people in “AE” who are using an ICS/LABA MDI ‡	32,983 people (AE × 47%)	79,983 people (AE × 47%)
	HFC-134a-containing MDI		
AG	Number of people in “AF” who are using an ICS/LABA MDI using HFC-134a as propellant #	29,025 people (AF × 88%)	70,385 people (AF × 88%)
AH	Number of ICS/LABA MDI actuations used by each patient in “AG” each year §	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
AI	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “AG” †	<b>1,031 MT CO<sub>2</sub>e</b> (AG × AH × 0.1315 kg CO <sub>2</sub> e/act)	<b>2,500 MT CO<sub>2</sub>e</b> (AG × AH × 0.1315 kg CO <sub>2</sub> e/act)
	HFC-227ea-containing MDI		
AJ	Number of people in “AF” who are using an ICS/LABA MDI using HFC-227ea as propellant #	3,958 people (AF × 12%)	9,598 people (AF × 12%)
AK	Number of ICS/LABA MDI actuations used by each patient in “AJ” each year §	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)

AL	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “AJ” <sup>†</sup>	<b>373 MT CO<sub>2</sub>e</b> (AJ × AK × 0.3485 kg CO <sub>2</sub> e/act)	<b>903 MT CO<sub>2</sub>e</b> (AJ × AK × 0.3485 kg CO <sub>2</sub> e/act)
	DPI		
AM	Number of people in “AD” who are using an ICS/LABA DPI <sup>‡</sup>	37,193 people (AD × 53%)	90,193 people (AD × 53%)
AN	Number of ICS/LABA DPI actuations used by each patient in “AM” each year <sup>§</sup>	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
AO	Carbon footprint associated with ICS/LABA DPI use in people in “AM” <sup>†</sup>	<b>90 MT CO<sub>2</sub>e</b> (AM × AN × 0.009 kg CO <sub>2</sub> e/act)	<b>219 MT CO<sub>2</sub>e</b> (AM × AN × 0.009 kg CO <sub>2</sub> e/act)
	<b>Total</b>		
AP	Total carbon footprint	<b>6,393 MT CO<sub>2</sub>e</b> ((O + R) + (AI + AL))	<b>14,423 MT CO<sub>2</sub>e</b> ((F + J + O + R + U) + (Z + AD + AI + AL + AP))
<b>AQ</b>	<b>Anticipated carbon saving</b>	<b>(8,030) MT CO<sub>2</sub>e</b> ( <i>AP<sub>anticipated</sub></i> – <i>AP<sub>current</sub></i> )	
<p><b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>DPI:</b> Dry-powder inhaler; <b>LABA:</b> long-acting beta<sub>2</sub>-agonist; <b>LAMA:</b> long-acting muscarinic antagonist; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO<sub>2</sub> equivalent; <b>SABA:</b> short-acting beta<sub>2</sub>-agonist; <b>SAMA:</b> short-acting muscarinic antagonist</p>			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
<p>* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada<sup>1</sup>.  <sup>†</sup> Group severity categories are defined as per 2017 GOLD guidelines.<sup>16</sup> Percentages owing to each group are derived from Le, Johannessen, et al.<sup>17</sup>.  <sup>‡</sup> Market sales derived from Janson, Henderson, et al.<sup>3</sup>.  <sup>§</sup> Percentage of people adherent to their medication is derived from Toy, Beaulieu, et al.<sup>11</sup>.  <sup>†</sup> Carbon footprint per actuation derived from Jeswani and Azapagic<sup>6</sup>.  <sup>#</sup> Market sales for ICS/LABA HFC-134a- and HFC-227ea-containing MDI are derived from a government report.<sup>8</sup></p>			

### c) Selecting MDIs with lower global warming potential

#### i) Selecting MDIs based on propellant used

Switching 25% of COPD patients on an HFC-227ea-containing MDI (found in some ICS/LABA combination inhalers) to a lower GHG-emitting MDI within the same class would save ~970 metric tons of CO<sub>2</sub> equivalent (**e-Table C-9**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **yellow-coloured font** to help visualize the lines where changes are made between the anticipated and current case. For simplicity, data shown are limited to drug classes where it is possible to make this switch. \*

**e-Table C-9. Anticipated carbon footprint reduction from switching 25% of HFC-227ea-containing MDI prescriptions to HFC-134a-containing MDIs in COPD in Canada**

	Prevalence of clinically-diagnosed COPD *	2,000,000 people	
		Anticipated	Current case
	<b>GOLD B: CAT <math>\geq</math>10, MRC <math>\geq</math>3, and infrequent exacerbations (CTS moderate COPD)</b>		
B	Number of people in "A" in GOLD B group <sup>†</sup>	1,040,000 people (A $\times$ 52%)	1,040,000 people (A $\times$ 52%)
	<b>ICS/LABA</b>		
C	Number of people in "B" using an ICS/LABA <sup>‡</sup>	416,871 people (B $\times$ 40%)	416,871 people (B $\times$ 40%)
	<b>MDI</b>		
D	Number of people in "C" who are using an ICS/LABA MDI <sup>‡</sup>	195,929 people (C $\times$ 47%)	195,929 people (C $\times$ 47%)
	<b>HFC-134a-containing MDI</b>		
E	<b>Number of people in "D" who are using an ICS/LABA MDI using HFC-134a as propellant <sup>§</sup></b>	<b>178,296 people (D <math>\times</math> (88% + (12% <math>\times</math> 25%)))</b>	<b>172,418 people (D <math>\times</math> 88%)</b>
F	Number of ICS/LABA MDI actuations used by each patient in "E" each year <sup>¶</sup>	270 act per year (1 act/dose $\times$ 2 doses/day $\times$ 365 days/year $\times$ 37% adherence)	270 act per year (1 act/dose $\times$ 2 doses/day $\times$ 365 days/year $\times$ 37% adherence)
G	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in "E" <sup>#</sup>	<b>6,333 MT CO<sub>2</sub>e (E <math>\times</math> F <math>\times</math> 0.1315 kg CO<sub>2</sub>e/act)</b>	<b>6,124 MT CO<sub>2</sub>e (E <math>\times</math> F <math>\times</math> 0.1315 kg CO<sub>2</sub>e/act)</b>
	<b>HFC-227ea-containing MDI</b>		
H	<b>Number of people in "D" who are using an ICS/LABA MDI using HFC-227ea as propellant <sup>§</sup></b>	<b>17,634 people (D <math>\times</math> (12% - (12% <math>\times</math> 25%)))</b>	<b>23,512 people (D <math>\times</math> 12%)</b>
I	Number of ICS/LABA MDI actuations used by each patient in "H" each year <sup>¶</sup>	270 act per year (1 act/dose $\times$ 2 doses/day $\times$ 365 days/year $\times$ 37% adherence)	270 act per year (1 act/dose $\times$ 2 doses/day $\times$ 365 days/year $\times$ 37% adherence)
J	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in "H" <sup>#</sup>	<b>1,660 MT CO<sub>2</sub>e (H <math>\times</math> I <math>\times</math> 0.3485 kg CO<sub>2</sub>e/act)</b>	<b>2,213 MT CO<sub>2</sub>e (H <math>\times</math> I <math>\times</math> 0.3485 kg CO<sub>2</sub>e/act)</b>
	<b>GOLD D: CAT <math>\geq</math>10, MRC <math>\geq</math>3, and frequent exacerbations (CTS severe COPD)</b>		
K	Number of people in "A" in GOLD D group <sup>†</sup>	400,000 people (A $\times$ 20%)	400,000 people (A $\times$ 20%)
	<b>ICS/LABA</b>		
L	Number of people in "K" using an ICS/LABA <sup>‡</sup>	170,176 people (K $\times$ 43%)	170,176 people (K $\times$ 43%)
	<b>MDI</b>		
M	Number of people in "L" who are using an ICS/LABA MDI <sup>‡</sup>	79,983 people (L $\times$ 47%)	79,983 people (L $\times$ 47%)
	<b>HFC-134a-containing MDI</b>		
N	<b>Number of people in "M" who are using an ICS/LABA MDI using HFC-134a as propellant <sup>§</sup></b>	<b>72,784 people (M <math>\times</math> (88% + (12% <math>\times</math> 25%)))</b>	<b>70,385 people (M <math>\times</math> 88%)</b>

O	Number of ICS/LABA MDI actuations used by each patient in “N” each year <sup>†</sup>	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)
P	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “N” <sup>#</sup>	<b>2,585 MT CO<sub>2</sub>e</b> (N × O × 0.1315 kg CO <sub>2</sub> e/act)	<b>2,500 MT CO<sub>2</sub>e</b> (N × O × 0.1315 kg CO <sub>2</sub> e/act)
	<b>HFC-227ea-containing MDI</b>		
Q	<b>Number of people in “M” who are using an ICS/LABA MDI using HFC-227ea as propellant <sup>§</sup></b>	<b>7,198 people</b> (M × (12% – (12% × 25%)))	<b>9,598 people</b> (P × 12%)
R	Number of ICS/LABA MDI actuations used by each patient in “Q” each year <sup>†</sup>	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)
S	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “Q” <sup>#</sup>	<b>678 MT CO<sub>2</sub>e</b> (Q × R × 0.3485 kg CO <sub>2</sub> e/act)	<b>903 MT CO<sub>2</sub>e</b> (Q × R × 0.3485 kg CO <sub>2</sub> e/act)
	<b>Total</b>		
T	Total carbon footprint	11,255 MT CO <sub>2</sub> e ((G + J) + (P + S))	11,740 MT CO <sub>2</sub> e ((G + J) + (P + S))
U	<b>Anticipated carbon saving</b>	<b>(485) MT CO<sub>2</sub>e</b> (T <sub>anticipated</sub> – T <sub>current</sub> )	
<b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>ICS:</b> inhaled corticosteroid; <b>LABA:</b> long-acting beta <sub>2</sub> -agonist; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
* Prevalence of clinically-diagnosed COPD derived from Public Health Agency of Canada <sup>1</sup> . <sup>†</sup> Group severity categories are defined as per 2017 GOLD guidelines. <sup>16</sup> Percentages owing to each group are derived from Le, Johannessen, et al. <sup>17</sup> . <sup>‡</sup> Market sales derived from Janson, Henderson, et al. <sup>3</sup> . <sup>§</sup> Market sales for ICS/LABA HFC-134a- and HFC-227ea-containing MDI are derived from a government report. <sup>8</sup> <sup>††</sup> Percentage of people adherent to their medication is derived from Toy, Beaulieu, et al. <sup>11</sup> . <sup>#</sup> Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup> .			

ii) *Selecting MDIs based on amount of propellant used*

Finally, switching 25% of high-volume SABA MDIs to low-volume MDIs would eliminate ~109,000 metric tons of CO<sub>2</sub> equivalent (**e-Table C-10**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **blue-coloured font** to help visualize the lines where changes are made between the anticipated and current case. For simplicity, data shown are limited to drug classes where it is possible to make this switch. \*

**e-Table C-10. Anticipated saving from switching 25% of high-volume HFC-134a SABA MDI prescriptions to lowest-volume HFC-134a SABA MDI in COPD in Canada**

A	Prevalence of clinically-diagnosed COPD *	2,000,000 people	
		Anticipated	Current
	<b>Mild COPD</b>		
B	Number of people in “A” who have mild disease †	560,000 people (A × 28%)	560,000 people (A × 28%)
	<b>No overuse</b>		
C	Number of people in “B” who do not overuse SABA ‡	560,000 people (B × 100%)	560,000 people (B × 100%)
	<b>SABA</b>		
D	Number of people in “C” using a SABA §	530,457 people (C × 95%)	530,457 people (C × 95%)
	<b>MDI</b>		
E	Number of people in “D” who are using a SABA MDI §	498,629 people (D × 94%)	498,629 people (D × 94%)
	<b>Low-volume HFC-134a SABA MDI</b>		
F	Number of people in “E” using low-volume HFC-134a SABA MDI ¶	363,999 people ((E × (48% + 25%))	239,342 people (E × 48%)
G	Number of actuations of SABA MDI over a year in people in “F” (reflecting good control) ‡	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
H	Carbon footprint associated with SABA MDI use in people in “F” #	3,596 MT CO <sub>2</sub> e (F × G × 0.095 kg CO <sub>2</sub> e/act)	2,365 MT CO <sub>2</sub> e (F × G × 0.0475 kg CO <sub>2</sub> e/act)
	<b>High-volume HFC-134a SABA MDI</b>		
I	Number of people in “E” using a high-volume HFC-134a SABA MDI ¶	134,630 people ((E × (52% – 25%))	259,287 people (E × 52%)
J	Number of actuations of SABA MDI over a year in people in “I” (reflecting good control) ‡	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
K	Carbon footprint associated with SABA MDI use in people in “I” #	5,895 MT CO <sub>2</sub> e (I × J × 0.2105 kg CO <sub>2</sub> e/act)	11,353 MT CO <sub>2</sub> e (I × J × 0.2105 kg CO <sub>2</sub> e/act)
	<b>Moderate COPD</b>		
L	Number of people in “A” who have moderate or severe disease †	1,440,000 people (A × 72%)	1,440,000 people (A × 72%)
	<b>No overuse</b>		
M	Number of people in “L” who do not overuse SABA ‡	763,200 people (B × 53%)	763,200 people (B × 53%)
	<b>SABA</b>		
N	Number of people in “M” using a SABA §	722,937 people (M × 95%)	722,937 people (M × 95%)
	<b>MDI</b>		
O	Number of people in “N” who are using a SABA MDI §	679,561 people (N × 94%)	679,561 people (N × 94%)
	<b>Low-volume HFC-134a SABA MDI</b>		

P	Number of people in “O” using low-volume HFC-134a SABA MDI <sup>¶</sup>	496,079 people ((O × (48% + 25%))	326,189 people (O × 48%)
Q	Number of actuations of SABA MDI over a year in people in “P” (reflecting good control) <sup>‡</sup>	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
R	Carbon footprint associated with SABA MDI use in people in “p” <sup>#</sup>	4,901 MT CO <sub>2</sub> e (P × Q × 0.0475 kg CO <sub>2</sub> e/act)	3,223 MT CO <sub>2</sub> e (P × Q × 0.0475 kg CO <sub>2</sub> e/act)
<b>High-volume HFC-134a SABA MDI</b>			
S	Number of people in “O” using a high-volume HFC-134a SABA MDI <sup>¶</sup>	183,481 people ((O × (52% – 25%))	353,371 people (O × 52%)
T	Number of actuations of SABA MDI over a year in people in “S” (reflecting good control) <sup>‡</sup>	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
U	Carbon footprint associated with SABA MDI use in people in “S” <sup>#</sup>	8,034 MT CO <sub>2</sub> e (S × T × 0.2105 kg CO <sub>2</sub> e/act)	15,472 MT CO <sub>2</sub> e (S × T × 0.2105 kg CO <sub>2</sub> e/act)
<b>Mild overuse: 4 to 180 days in a year requiring more than 4 uses (doses) of rescue therapy</b>			
V	Number of people in “L” with mild overuse <sup>**</sup>	406,080 people (L × 28%)	406,080 people (L × 28%)
<b>SABA</b>			
W	Number of people in “V” using a SABA <sup>§</sup>	384,657 people (V × 95%)	384,657 people (V × 95%)
<b>MDI</b>			
X	Number of people in “W” who are using a SABA MDI <sup>§</sup>	361,577 people (W × 94%)	361,577 people (W × 94%)
<b>Low-volume HFC-134a SABA MDI</b>			
Y	Number of people in “X” using low-volume HFC-134a SABA MDI <sup>¶</sup>	263,952 people ((X × (48% + 25%))	173,557 people (X × 48%)
Z	Number of actuations of SABA MDI over a year in people in “P” (reflecting good control) <sup>**</sup>	3,139 act per person per year (8.6 act/daye × 365 days/year)	3,139 act per person per year (8.6 act/daye × 365 days/year)
AA	Carbon footprint associated with SABA MDI use in people in “p” <sup>#</sup>	39,356 MT CO <sub>2</sub> e (Y × Z × 0.2105 kg CO <sub>2</sub> e/act)	25,878 MT CO <sub>2</sub> e (Y × Z × 0.095 kg CO <sub>2</sub> e/act)
<b>High-volume HFC-134a SABA MDI</b>			
AB	Number of people in “X” using a high-volume HFC-134a SABA MDI <sup>¶</sup>	97,626 people ((X × (52% – 25%))	188,020 people (X × 52%)
AC	Number of actuations of SABA MDI over a year in people in “AB” (reflecting good control) <sup>**</sup>	3,139 act per person per year (8.6 act/daye × 365 days/year)	3,139 act per person per year (8.6 act/daye × 365 days/year)
AD	Carbon footprint associated with SABA MDI use in people in “AB” <sup>#</sup>	64,507 MT CO <sub>2</sub> e (AB × AC × 0.2105 kg CO <sub>2</sub> e/act)	124,236 MT CO <sub>2</sub> e (AB × AC × 0.263 kg CO <sub>2</sub> e/act)
<b>Severe overuse: &gt; 180 days in a year requiring more than 4 uses (doses) of rescue therapy</b>			
AE	Number of people in “L” with severe overuse <sup>**</sup>	270,720 people (L × 19%)	270,720 people (L × 19%)
<b>SABA</b>			
AF	Number of people in “AE” using a SABA <sup>§</sup>	256,438 people (AE × 95%)	256,438 people (AE × 95%)
<b>MDI</b>			

AG	Number of people in “AF” who are using a SABA MDI §	241,052 people (AF × 94%)	241,052 people (AF × 94%)
<b>Low-volume HFC-134a SABA MDI</b>			
AH	Number of people in “AG” using low-volume HFC-134a SABA MDI †	175,968 people ((AG × (48% + 25%))	115,705 people (AG × 48%)
AI	Number of actuations of SABA MDI over a year in people in “P” (reflecting good control) **	5,037 act per person per year (13.8 act/daye × 365 days/year)	5,037 act per person per year (13.8 act/daye × 365 days/year)
AJ	Carbon footprint associated with SABA MDI use in people in “p” #	42,102 MT CO <sub>2</sub> e (P × Q × 0.0475 kg CO <sub>2</sub> e/act)	27,683 MT CO <sub>2</sub> e (P × Q × 0.0475 kg CO <sub>2</sub> e/act)
<b>High-volume HFC-134a SABA MDI</b>			
AK	Number of people in “AG” using a high-volume HFC-134a SABA MDI †	65,084 people ((AG × (52% – 25%))	125,347 people (AG × 52%)
AL	Number of actuations of SABA MDI over a year in people in “S” (reflecting good control) **	5,037 act per person per year (13.8 act/daye × 365 days/year)	5,037 act per person per year (13.8 act/daye × 365 days/year)
AM	Carbon footprint associated with SABA MDI use in people in “S” #	69,008 MT CO <sub>2</sub> e (S × T × 0.2105 kg CO <sub>2</sub> e/act)	132904 MT CO <sub>2</sub> e (S × T × 0.2105 kg CO <sub>2</sub> e/act)
<b>Total</b>			
AN	Total carbon footprint	237,398 MT CO <sub>2</sub> e (H + K) + (R + U) + (AA + AD) + (AJ + AM)	343,113 MT CO <sub>2</sub> e (H + K) + (R + U) + (AA + AD) + (AJ + AM)
AO	Anticipated carbon saving	(105,715) MT CO <sub>2</sub> e ( $AN_{anticipated} - AN_{current}$ )	
<p><b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>DPI:</b> Dry-powder inhaler; <b>HFC:</b> hydrofluorocarbon; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO<sub>2</sub> equivalent; <b>SABA:</b> short-acting beta<sub>2</sub>-agonist</p>			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			
<p>* Prevalence of clinically-diagnosed COPD derived from Public Health Agency of Canada <sup>1</sup>.  † Severity stages are defined as per CTS guidelines,<sup>15</sup> and corresponds to GOLD groups B and D.<sup>16</sup> The distribution of the COPD population across severity stages is derived from Le, Johannessen, et al. <sup>17</sup>.  ‡ In this conservative analysis, patients with mild COPD were not considered to overuse rescue therapies. Normal use is defined as taking ≤4 uses (doses) of a short-acting reliever in a week.<sup>10</sup> Here, we assume that patients take their rescue medication twice a week. Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).  § Market sales derived from Janson, Henderson, et al. <sup>3</sup>.  ¶ Market share for low- and high-volume HFC-containing SABA MDIs are derived from Badcock, Metcalfe, et al. <sup>23</sup>. We assumed that non-Ventolin sales applied to low-volume HFC-containing SABA MDIs.  # Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup>.  ** Overuse is defined as taking &gt;4 uses (doses) of a short-acting reliever in a day.<sup>18</sup> Mild overusers used their rescue therapy for on average ~1 excess dose (use) every 3 days, while severe overusers used their rescue therapy for on average ~3 excess doses (uses) every day.<sup>18</sup> Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).</p>			



## Appendix D Tables

### Asthma

In estimating the combined carbon savings from switching inhalers to lower global warming potential options (after accounting for overlapping carbon savings from the 3 outlined strategies), the total impact would be an emission reduction by ~227,200 metric tons of CO<sub>2</sub> equivalent for asthma (**e-Table D-1**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **green-, orange-, yellow-, and blue-coloured fonts** to help visualize the lines where changes are made between the anticipated and current case. \*

*e-Table D-1. Anticipated carbon saving resulting from switching inhalers to lower global warming potential options, after accounting for overlapping carbon savings from (i) switching MDI prescriptions to DPIs, (ii) switching separate inhalers to combination inhalers, and (iii) switching MDIs with highest global warming potential to MDIs with lower global warming potential, in asthma in Canada*

A	Prevalence of clinically-diagnosed asthma *	3,800,000 people	
		Anticipated	Current case
	Rescue medications		
	No SABA overuse		
B	Number of people in "A" who use a SABA ≤150 times per year †	2,061,500 ((A × 70%) – AW)	2,660,000 (A × 70%)
	SABA MDI		
C	Number of people in "B" using a SABA MDI as rescue therapy ‡	1,422,435 people (B × (94% – 25%))	2,500,400 people (B × 94%)
	Low-volume SAMA MDIs		
D	Number of people in "C" using a low-volume SABA MDI §	1,038,378 people (C × (48% + 25%))	1,200,192 people (C × 48%)
E	Number of actuations of SABA MDI over a year in people in "D" (reflecting good control) ¶	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)
F	Carbon footprint associated with SABA MDI use in people in "D" #	5,130 MT CO <sub>2</sub> e (D × E × 0.0475 kg CO <sub>2</sub> e/act)	5,929 MT CO <sub>2</sub> e (D × E × 0.0475 kg CO <sub>2</sub> e/act)
	High-volume SABA MDIs		
G	Number of people in "C" using a low-volume SABA MDI §	384,057 people (C × (52% – 25%))	1,308,208 people (C × 52%)

H	Number of actuations of SABA MDI over a year in people in “G” (reflecting good control) <sup>¶</sup>	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)
I	Carbon footprint associated with SABA MDI use in people in “G” <sup>#</sup>	<b>8,408 MT CO<sub>2</sub>e</b> (G × H × 0.2105 kg CO <sub>2</sub> e/act)	<b>28,464 MT CO<sub>2</sub>e</b> (D × E × 0.2105 kg CO <sub>2</sub> e/act)
	SABA DPI		
<b>J</b>	<b>Number of people in “B” using a SABA DPI as rescue therapy <sup>‡</sup></b>	<b>639,065 people (B × (6% + 25%))</b>	<b>159,600 people (B × 6%)</b>
K	Number of actuations of SABA DPI over a year in people in “E” (reflecting good control) <sup>¶</sup>	52 act per person per year (1 act/dose × 1 dose/week × 52 weeks/year)	52 act per person per year (1 act/dose × 1 doses/week × 52 weeks/year)
L	Carbon footprint associated with SABA DPI use in people in “E” <sup>#</sup>	<b>299 MT CO<sub>2</sub>e</b> (J × K × 0.009 kg CO <sub>2</sub> e/actuation)	<b>75 MT CO<sub>2</sub>e</b> (J × K × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>Mild overuse: &gt;150 to 375 doses of SABA per year</b>		
M	Number of people in “A” who use a SABA >150 to 375 doses of SABA per year <sup>†</sup>	798,000 (A × 21%)	798,000 (A × 21%)
	SABA MDI		
<b>N</b>	<b>Number of people in “M” using a SABA MDI as rescue therapy <sup>‡</sup></b>	<b>550,620 people (M × (94% – 25%))</b>	<b>750,120 people (M × 94%)</b>
	Low-volume SAMA MDIs		
<b>O</b>	<b>Number of people in “N” using a low-volume SABA MDI <sup>§</sup></b>	<b>401,953 people (N × (48% + 25%))</b>	<b>360,058 people (N × 48%)</b>
P	Number of actuations of SABA MDI over a year in people in “O” <sup>**</sup>	526 act per person per year (2 act/dose × (150 + 113) doses/year)	526 act per person per year (2 act/dose × (150 + 113) doses/year)
Q	Carbon footprint associated with SABA MDI use in people in “O” <sup>#</sup>	<b>13,757 MT CO<sub>2</sub>e</b> (O × P × 0.0475 kg CO <sub>2</sub> e/act)	<b>8,996 MT CO<sub>2</sub>e</b> (O × P × 0.0475 kg CO <sub>2</sub> e/act)
	High-volume SABA MDIs		
<b>R</b>	<b>Number of people in “N” using a low-volume SABA MDI <sup>§</sup></b>	<b>148,667 people (N × (52% – 25%))</b>	<b>390,062 people (N × 52%)</b>
S	Number of actuations of SABA MDI over a year in people in “R” <sup>**</sup>	526 act per person per year (2 act/dose × (150 + 113) doses/year)	526 act per person per year (2 act/dose × (150 + 113) doses/year)
T	Carbon footprint associated with SABA MDI use in people in “R” <sup>#</sup>	<b>14,461 MT CO<sub>2</sub>e</b> (R × S × 0.2105 kg CO <sub>2</sub> e/act)	<b>43,189 MT CO<sub>2</sub>e</b> (R × S × 0.263 kg CO <sub>2</sub> e/act)
	SABA DPI		
<b>U</b>	<b>Number of people in “M” using a SABA DPI as rescue therapy <sup>‡</sup></b>	<b>247,380 people (M × (6% + 25%))</b>	<b>47,880 people (M × 6%)</b>
V	Number of actuations of SABA DPI over a year in people in “U” <sup>**</sup>	263 act per person per year (1 act/dose × (150 + 113) doses/year)	263 act per person per year (1 act/dose × (150 + 113) doses/year)
W	Carbon footprint associated with SABA DPI use in people in “U” <sup>#</sup>	<b>586 MT CO<sub>2</sub>e</b> (U × V × 0.009 kg CO <sub>2</sub> e/actuation)	<b>113 MT CO<sub>2</sub>e</b> (U × V × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>Moderate overuse: &gt;375 to 750 doses of SABA per year</b>		
X	Number of people in “A” who use a SABA >375 to 750 doses of SABA per year <sup>†</sup>	266,000 (A × 7%)	266,000 (A × 7%)
	SABA MDI		
<b>Y</b>	<b>Number of people in “X” using a SABA MDI as rescue therapy <sup>‡</sup></b>	<b>183,540 people (X × (94% – 25%))</b>	<b>250,040 people (X × 94%)</b>
	Low-volume SAMA MDIs		

<b>Z</b>	<b>Number of people in “Y” using a low-volume SABA MDI §</b>	<b>133,984 people (Y × (48% + 25%))</b>	<b>120,019 people (Y × 48%)</b>
AA	Number of actuations of SABA MDI over a year in people in “Z” **	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)
AB	Carbon footprint associated with SABA MDI use in people in “Z” #	<b>7,166 MT CO<sub>2</sub>e</b> (Z × AA × 0.0475 kg CO <sub>2</sub> e/act)	<b>6,419 MT CO<sub>2</sub>e</b> (Z × AA × 0.0475 kg CO <sub>2</sub> e/act)
	High-volume SABA MDIs		
<b>AC</b>	<b>Number of people in “Y” using a low-volume SABA MDI §</b>	<b>49,556 people (Y × (52% – 25%))</b>	<b>130,021 people (Y × 52%)</b>
AD	Number of actuations of SABA MDI over a year in people in “AC” **	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)	1,126 act per person per year (2 act/dose × (150 + 413) doses/year)
AE	Carbon footprint associated with SABA MDI use in people in “AC” #	<b>11,746 MT CO<sub>2</sub>e</b> (AC × AD × 0.2105 kg CO <sub>2</sub> e/act)	<b>30,818 MT CO<sub>2</sub>e</b> (AC × AD × 0.2105 kg CO <sub>2</sub> e/act)
	SABA DPI		
AF	Number of people in “X” using a SABA DPI as rescue therapy ‡	82,460 people (X × (6% + 25%))	15,960 people (X × 6%)
AG	Number of actuations of SABA DPI over a year in people in “AF” **	563 act per person per year (1 act/dose × (150 + 413) doses/year)	563 act per person per year (1 act/dose × (150 + 413) doses/year)
AH	Carbon footprint associated with SABA DPI use in people in “AF” #	<b>418 MT CO<sub>2</sub>e</b> (AF × AG × 0.009 kg CO <sub>2</sub> e/act)	<b>81 MT CO<sub>2</sub>e</b> (AF × AG × 0.009 kg CO <sub>2</sub> e/act)
	<b>Severe overuse: &gt;750 doses of SABA per year</b>		
AI	Number of people in “A” who use a SABA >750 doses of SABA per year †	76,000 (A × 2%)	76,000 (A × 2%)
	SABA MDI		
<b>AJ</b>	<b>Number of people in “AI” using a SABA MDI as rescue therapy ‡</b>	<b>52,440 people (AI × (94% – 25%))</b>	<b>71,440 people (AI × 94%)</b>
	Low-volume SAMA MDIs		
<b>AK</b>	<b>Number of people in “AJ” using a low-volume SABA MDI §</b>	<b>38,281 people (AJ × (48% + 25%))</b>	<b>34,291 people (AJ × 48%)</b>
AL	Number of actuations of SABA MDI over a year in people in “AK” **	1,500 act per person per year (2 act/dose × (150 + 600) doses/year)	1,500 act per person per year (2 act/dose × (150 + 600) doses/year)
AM	Carbon footprint associated with SABA MDI use in people in “AK” #	<b>2,728 MT CO<sub>2</sub>e</b> (AK × AL × 0.0475 kg CO <sub>2</sub> e/act)	<b>2,443 MT CO<sub>2</sub>e</b> (AK × AL × 0.0475 kg CO <sub>2</sub> e/act)
	High-volume SABA MDIs		
<b>AN</b>	<b>Number of people in “AJ” using a low-volume SABA MDI §</b>	<b>14,159 people (AJ × (52% – 25%))</b>	<b>37,149 people (AJ × 52%)</b>
AO	Number of actuations of SABA MDI over a year in people in “AN” **	1,500 act per person per year (2 act/dose × (150 + 600) doses/year)	1,500 act per person per year (2 act/dose × (150 + 600) doses/year)
AP	Carbon footprint associated with SABA MDI use in people in “AN” #	<b>4,471 MT CO<sub>2</sub>e</b> (AN × AO × 0.2105 kg CO <sub>2</sub> e/act)	<b>11,730 MT CO<sub>2</sub>e</b> (AN × AO × 0.2105 kg CO <sub>2</sub> e/act)
	SABA DPI		
<b>AQ</b>	<b>Number of people in “” using a SABA DPI as rescue therapy ‡</b>	<b>3,641 people (AI × (6% + 25%))</b>	<b>4,560 people (AI × 6%)</b>
AR	Number of actuations of SABA DPI over a year in people in “AQ” **	750 act per person per year (1 act/dose × (150 + 600) doses/year)	750 act per person per year (1 act/dose × (150 + 600) doses/year)

AS	Carbon footprint associated with SABA DPI use in people in “AQ” #	<b>25 MT CO<sub>2</sub>e</b> ( $AQ \times AR \times 0.009 \text{ kg CO}_2\text{e/actuation}$ )	<b>31 MT CO<sub>2</sub>e</b> ( $AQ \times AR \times 0.009 \text{ kg CO}_2\text{e/actuation}$ )
	<b>Sub-total, rescue medications</b>		
AT	Total carbon footprint, rescue inhalers	71,193 MT CO <sub>2</sub> e ((F + I + L) + (Q + T + W) + (AB + AE + AH) + (AM + AP + AS))	138,288 MT CO <sub>2</sub> e ((F + I + L) + (Q + T + W) + (AB + AE + AH) + (AM + AP + AS))
AU	<b>Anticipated carbon saving, rescue inhalers</b>	<b>(67,095) metric tons of CO<sub>2</sub>e</b> ( $AT_{\text{anticipated}} - AT_{\text{current}}$ )	
	<b>Controller medications</b>		
	<b>Mild asthma</b>		
AV	Number of people in “A” who have mild asthma ††	2,394,000 ( $A \times 63\%$ )	2,394,000 ( $A \times 63\%$ )
	<b>New treatment paradigm: as-needed Budesonide/Formoterol</b>		
	Budesonide/Formoterol DPI		
<b>AW</b>	<b>Number of people in “AV” who use a Budesonide/Formoterol DPI ††</b>	<b>598,500 people</b> ( $AV \times 25\%$ )	<b>0 people</b> ( $AV \times 0\%$ )
AX	Number of actuations of Budesonide/Formoterol DPI over a year in people in “AW” §§	206 act per person per year ( $113 \text{ ug/day} \times 365 \text{ days/year} / (200 \text{ ug/dose})$ )	206 act per person per year ( $113 \text{ ug/day} \times 365 \text{ days/year} / (200 \text{ ug/dose})$ )
AY	Carbon footprint associated with Budesonide/Formoterol DPI use in people in “AW” #	<b>1,111 MT CO<sub>2</sub>e</b> ( $AW \times AY \times 0.009 \text{ kg CO}_2\text{e/actuation}$ )	<b>0 MT CO<sub>2</sub>e</b> ( $AW \times AY \times 0.009 \text{ kg CO}_2\text{e/actuation}$ )
	<b>Conventional treatment: daily ICS (plus an as-needed SABA in a separate inhaler)</b>		
	<b>ICS</b>		
	<b>MDI</b>		
<b>AZ</b>	<b>Number of people in “AV” using an ICS MDI ††</b>	<b>556,605 people</b> ( $(AV - AW) \times (56\% - 25\%)$ )	<b>1,340,640 people</b> ( $AV \times 56\%$ )
BA	Number of actuations of ICS MDI over a year in people in “AZ” ###	88 act per person per year ( $2 \text{ act/day} \times 365 \text{ days/year} \times 12\% \text{ adherence}$ )	88 act per person per year ( $2 \text{ act/day} \times 365 \text{ days/year} \times 12\% \text{ adherence}$ )
BB	Carbon footprint associated with ICS MDI use in people in “AZ” #	<b>6,412 MT CO<sub>2</sub>e</b> ( $AZ \times BA \times 0.1315 \text{ kg CO}_2\text{e/actuation}$ )	<b>15,443 MT CO<sub>2</sub>e</b> ( $AZ \times BA \times 0.1315 \text{ kg CO}_2\text{e/actuation}$ )
	<b>DPI</b>		
<b>BC</b>	<b>Number of people in “AV” using an ICS DPI ††</b>	<b>1,238,895 people</b> ( $(AV - AW) \times (44\% + 25\%)$ )	<b>1,053,360 people</b> ( $AV \times 44\%$ )
BD	Number of actuations of ICS DPI over a year in people in “BC” ###	88 act per person per year ( $2 \text{ act/day} \times 365 \text{ days/year} \times 12\% \text{ adherence}$ )	88 act per person per year ( $2 \text{ act/day} \times 365 \text{ days/year} \times 12\% \text{ adherence}$ )
BE	Carbon footprint associated with ICS DPI use in people in “BC” #	<b>977 MT CO<sub>2</sub>e</b> ( $AZ \times BA \times 0.009 \text{ kg CO}_2\text{e/actuation}$ )	<b>830 MT CO<sub>2</sub>e</b> ( $AZ \times BA \times 0.009 \text{ kg CO}_2\text{e/actuation}$ )
	<b>Moderate or severe asthma</b>		
BF	Number of people in “A” who have moderate or severe asthma ††	1,406,000 people ( $A \times 37\%$ )	1,406,000 people ( $A \times 37\%$ )
	<b>ICS/LABA</b>		
	<b>MDI</b>		
<b>BG</b>	<b>Number of people in “BF” who use an ICS/LABA MDI †</b>	<b>309,320 people</b> ( $BF \times (47\% - 25\%)$ )	<b>660,820 people</b> ( $BF \times 47\%$ )
	<b>HFC-134a MDI</b>	<b>N</b>	
<b>BH</b>	<b>Number of people in “BG” who use a HFC-134a MDI ***</b>	<b>281,481 people</b> ( $BG \times (88\% + (12\% \times 25\%))$ )	<b>581,522 people</b> ( $BG \times 88\%$ )
BI	Number of actuations over a year, among people in “BH” †††	314 act per person per year ( $2 \text{ act/day} \times 365 \text{ days/year} \times 43\% \text{ adherence}$ )	314 act per person per year ( $2 \text{ act/day} \times 365 \text{ days/year} \times 43\% \text{ adherence}$ )

BJ	Carbon footprint associated with use of ICS/LABA HFC-134a-containing MDI among people in “BH” #	<b>11,619 MT CO<sub>2</sub>e</b> (BH × BI × 0.1315 kg of CO <sub>2</sub> e/act)	<b>24,004 MT CO<sub>2</sub>e</b> (BH × BI × 0.1315 kg of CO <sub>2</sub> e/act)
	HFC-227ea MDI		
BK	<b>Number of people in “BG” who use a HFC-227ea-containing MDI ***</b>	<b>27,839 people</b> (BG × (12% – (12% × 25%)))	<b>79,298 people</b> (BG × 12%)
BL	Number of actuations over a year, among people in “BK” †††	314 act per person per year (2 act/day × 365 days/year × 43% adherence)	314 act per person per year (2 act/day × 365 days/year × 43% adherence)
BM	Carbon footprint associated with use of ICS/LABA HFC-227ea-containing MDI among people in “BK” #	<b>3,045 MT CO<sub>2</sub>e</b> (BK × BL × 0.3485 kg of CO <sub>2</sub> e/act)	<b>8,675 T CO<sub>2</sub>e</b> (BK × BL × 0.3485 kg of CO <sub>2</sub> e/act)
	DPI		
BN	<b>Number of people in “BF” who use an ICS/LABA DPI ‡</b>	<b>1,096,680 people</b> (BF × (53% + 25%))	<b>745,180 people</b> (BF × 53%)
BO	Number of actuations over a year, among people in “BN” †††	314 act per person per year (2 act/day × 365 days/year × 43% adherence)	314 act per person per year (2 act/day × 365 days/year × 43% adherence)
BP	Carbon footprint associated with use of ICS/LABA DPI among people in “BN” #	<b>3,098 MT CO<sub>2</sub>e</b> (BN × BO × 0.009 kg of CO <sub>2</sub> e/act)	<b>2,105 MT CO<sub>2</sub>e</b> (BN × BO × 0.009 kg of CO <sub>2</sub> e/act)
	<b>Sub-total, controller medications</b>		
BQ	Total carbon footprint, controller inhalers	26,262 MT CO <sub>2</sub> e ((AY + BB + BE) + (BJ + BM + BP))	51,058 MT CO <sub>2</sub> e ((AY + BB + BE) + (BJ + BM + BP))
BR	<b>Anticipated carbon saving, rescue inhalers</b>	<b>(24,796) metric tons of CO<sub>2</sub>e</b> (BQ <sub>anticipated</sub> – BQ <sub>current</sub> )	
	<b>Total, rescue and controller medications</b>		
BS	<b>Anticipated carbon saving</b>	<b>(91,891) metric tons of CO<sub>2</sub>e</b> (AU + BR)	

**Act:** actuations; **MT CO<sub>2</sub>e:** metric tons of CO<sub>2</sub> equivalent; **DPI:** dry powder inhaler; **ICS:** inhaled corticosteroid; **LABA:** long-acting beta<sub>2</sub>-agonist; **MDI:** metered-dose inhaler; **SABA:** short-acting beta<sub>2</sub>-agonist

Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.

\* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup>.  
 † Categories of SABA users are derived from Nwaru, Ekstrom, et al. <sup>12</sup>.  
 ‡ Market sales of SABA and ICS/LABA MDI and DPI inhalers are derived from Janson, Henderson, et al. <sup>3</sup>.  
 § Market share for low- and high-volume HFC-containing SABA MDIs are derived from Badcock, Metcalfe, et al. <sup>23</sup>. We assumed that non-Ventolin sales applied to low-volume HFC-containing SABA MDIs.  
 ¶ We consider an averaged use of 1 dose of SABA per week. This reflects a conservative definition, given that guidelines define well-controlled asthma as no more than 2 uses (doses) of SABA per week. <sup>4,5</sup> Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation.  
 # Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup>.  
 \*\* We calculated the mid-point estimate for mild and moderate SABA overuse categories, and the low-point estimate for the severe overuse category. For this analysis, we counted the first 150 uses (doses) in any category, even though those doses are considered within the acceptable limit for good asthma control.  
 †† The distribution of the asthma population across severity stages is derived from Firoozi, Lemiere, et al. <sup>13</sup>.  
 ‡‡ This analysis does not consider the people who are on a budesonide/formoterol inhaler that is indicated for single maintenance and reliever therapy (SMART). Previous study showed that the SMART dosing is prescribed in 1.2% of patients. <sup>22</sup>  
 §§ Number of actuations of Budesonide/Formoterol DPI over a year derived from a pooled analysis of SYGMA, Novel Start, and PRACTICAL randomized controlled trials, as reported in Gagne, Lam Shin Cheung, et al. <sup>21</sup>.  
 ¶¶ Market sales for ICS MDI and DPI inhalers derived from Lavorini, Corrigan, et al. <sup>7</sup>.  
 ### This calculation considers a 12% adherence rate. <sup>14</sup>

\*\*\* Market sales for ICS/LABA HFC-134a- and HFC-227ea-containing MDI are derived from a government report.<sup>8</sup>

††† This calculation considers a 43% adherence rate. Ismaila, Corriveau, et al. <sup>19</sup>.

## COPD

Similarly, in estimating the combined carbon savings from switching inhalers to lower global warming potential options (after accounting for overlapping carbon savings from the 3 outlined strategies) in COPD, the total impact would be an emission reduction by ~333,100 metric tons of CO<sub>2</sub> equivalent for COPD (**e-Table D-2**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. We also used **green-, orange-, yellow-, and blue-coloured fonts** to help visualize the lines where changes are made between the anticipated and current case. \*

*e-Table D-2. Anticipated carbon saving resulting from switching inhalers to lower global warming potential options, after accounting for overlapping carbon savings from (i) switching MDI prescriptions to DPIs, (ii) switching separate inhalers to combination inhalers, and (iii) switching MDIs with highest global warming potential to MDIs with lower global warming potential, in COPD in Canada*

A	Prevalence of clinically-diagnosed COPD *	2,000,000 people	
		Anticipated	Current case
	Rescue medications		
	Mild COPD		
B	Number of people in “A” who have mild disease †	560,000 (A × 28%)	560,000 (A × 28%)
	No overuse		
	SABA		
C	Number of people in “B” who are using a SABA as rescue therapy ‡	530,457 people (B × 95%)	530,457 people (B × 95%)
	MDI		
D	Number of people in “C” using a SABA MDI ‡	366,015 people (C × (94% – 25%))	498,629 people (C × 94%)
	Low-volume SABA MDIs		
E	Number of people in “D” using a low-volume SABA MDI §	267,191 people (D × (48% + 25%))	239,342 people (D × 48%)



F	Number of actuations of SABA MDI over a year in people in “E” (reflecting good control) <sup>†</sup>	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
G	Carbon footprint associated with SABA MDI use in people in “E” <sup>#</sup>	<b>2,640 MT CO<sub>2</sub>e</b> (E × F × 0.0475 kg CO <sub>2</sub> e/act)	<b>2,365 MT CO<sub>2</sub>e</b> (E × F × 0.0475 kg CO <sub>2</sub> e/act)
	<b>High-volume SABA MDIs</b>		
H	<b>Number of people in “D” using a high-volume SABA MDI <sup>§</sup></b>	<b>98,824 people (D × (52% – 25%))</b>	<b>259,287 people (D × 52%)</b>
I	Number of actuations of SABA MDI over a year in people in “G” (reflecting good control) <sup>†</sup>	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
J	Carbon footprint associated with SABA MDI use in people in “G” <sup>#</sup>	<b>4,327 MT CO<sub>2</sub>e</b> (H × I × 0.2105 kg CO <sub>2</sub> e/act)	<b>11,353 MT CO<sub>2</sub>e</b> (H × I × 0.2105 kg CO <sub>2</sub> e/act)
	<b>SABA DPI</b>		
K	<b>Number of people in “C” using a SABA DPI as rescue therapy <sup>‡</sup></b>	<b>164,442 people (C × (6% + 25%))</b>	<b>31,827 people (C × 6%)</b>
L	Number of actuations of SABA DPI over a year in people in “K” (reflecting good control) <sup>†</sup>	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)
M	Carbon footprint associated with SABA DPI use in people in “K” <sup>#</sup>	<b>154 MT CO<sub>2</sub>e</b> (K × L × 0.009 kg CO <sub>2</sub> e/actuation)	<b>30 MT CO<sub>2</sub>e</b> (K × L × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>SAMA</b>		
N	Number of people in “B” who are using a SAMA as rescue therapy <sup>‡</sup>	29,543 people (B × 5%)	29,543 people (B × 5%)
	<b>MDI</b>		
O	Number of people in “N” using a SAMA MDI <sup>‡</sup>	29,543 people (N × 100%)	29,543 people (N × 100%)
P	Number of actuations of SAMA MDI over a year in people in “O” (reflecting good control) <sup>†</sup>	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
Q	Carbon footprint associated with SAMA MDI use in people in “O” <sup>#</sup>	<b>808 MT CO<sub>2</sub>e</b> (O × P × 0.1315 kg CO <sub>2</sub> e/act)	<b>808 MT CO<sub>2</sub>e</b> (O × P × 0.1315 kg CO <sub>2</sub> e/act)
	<b>Moderate or severe COPD</b>		
R	Number of people in “A” who have moderate or severe disease <sup>†</sup>	1,440,000 (A × 72%)	1,440,000 (A × 72%)
	<b>No overuse</b>		
S	Number of people in “R” who do not overuse their rescue therapy <sup>**</sup>	763,200 people (R × 53%)	763,200 people (R × 53%)
	<b>SABA</b>		
T	Number of people in “S” who are using a SABA as rescue therapy <sup>‡</sup>	722,937 people (S × 95%)	722,937 people (S × 95%)
	<b>MDI</b>		



U	Number of people in “T” using a SABA MDI ‡	498,826 people (T × (94% – 25%))	679,561 people (T × 94%)
	Low-volume SABA MDIs		
V	Number of people in “U” using a low-volume SABA MDI §	364,143 people (U × (48% + 25%))	326,189 people (U × 48%)
W	Number of actuations of SABA MDI over a year in people in “V” (reflecting good control) ¶	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
X	Carbon footprint associated with SABA MDI use in people in “V” #	3,598 MT CO <sub>2</sub> e (V × W × 0.0475 kg CO <sub>2</sub> e/act)	15,472 MT CO <sub>2</sub> e (V × W × 0.0475 kg CO <sub>2</sub> e/act)
	High-volume SABA MDIs		
Y	Number of people in “U” using a high-volume SABA MDI §	134,683 people (U × (52% – 25%))	353,371 people (U × 52%)
Z	Number of actuations of SABA MDI over a year in people in “Y” (reflecting good control) ¶	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
AA	Carbon footprint associated with SABA MDI use in people in “Y” #	5,897 MT CO <sub>2</sub> e (Y × Z × 0.2105 kg CO <sub>2</sub> e/act)	15,472 MT CO <sub>2</sub> e (Y × Z × 0.2105 kg CO <sub>2</sub> e/act)
	SABA DPI		
AB	Number of people in “T” using a SABA DPI as rescue therapy ‡	224,110 people (T × (6% + 25%))	43,376 people (T × 6%)
AC	Number of actuations of SABA DPI over a year in people in “AB” (reflecting good control) ¶	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)
AD	Carbon footprint associated with SABA DPI use in people in “AB” #	210 MT CO <sub>2</sub> e (AB × AC × 0.009 kg CO <sub>2</sub> e/actuation)	41 MT CO <sub>2</sub> e (AB × AC × 0.009 kg CO <sub>2</sub> e/actuation)
	SAMA		
AE	Number of people in “S” who are using a SAMA as rescue therapy ‡	40,263 people (S × 5%)	40,263 people (S × 5%)
	MDI		
AF	Number of people in “AE” using a SAMA MDI ‡	40,263 people (AE × 100%)	40,263 people (AE × 100%)
AG	Number of actuations of SAMA MDI over a year in people in “AF” (reflecting good control) ¶	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
AH	Carbon footprint associated with SAMA MDI use in people in “AF” #	1,101 MT CO <sub>2</sub> e (AF × AG × 0.1315 kg CO <sub>2</sub> e/act)	1,103 MT CO <sub>2</sub> e (AF × AG × 0.1315 kg CO <sub>2</sub> e/act)
	Mild overuse: 4 to 180 days in a year requiring more than 4 uses (doses) of rescue therapy		
AI	Number of people in “R” with mild overuse **	406,080 (R × 28%)	406,080 (R × 28%)
	SABA		
AJ	Number of people in “AI” who are using a SABA as rescue therapy ‡	384,657 people (AI × 95%)	384,657 people (AI × 95%)
	MDI		

<b>AK</b>	<b>Number of people in “AJ” using a SABA MDI as rescue therapy ‡</b>	<b>265,413 people (AJ × (94% – 25%))</b>	<b>361,577 people (AJ × 94%)</b>
	Low-volume SAMA MDIs		
<b>AL</b>	<b>Number of people in “AK” using a low-volume SABA MDI §</b>	<b>193,752 people (AK × (48% + 25%))</b>	<b>173,557 people (AK × 48%)</b>
AM	Number of actuations of SABA MDI over a year in people in “AL” **	3,139 act per person per year ((8 + 0.6) act/day × 365 days/year)	3,139 act per person per year ((8 + 0.6) act/day × 365 days/year)
AN	Carbon footprint associated with SABA MDI use in people in “AL” #	<b>28,889 MT CO<sub>2</sub>e</b> (AL × AM × 0.0475 kg CO <sub>2</sub> e/act)	<b>25,878 MT CO<sub>2</sub>e</b> (AL × AM × 0.0475 kg CO <sub>2</sub> e/act)
	High-volume SABA MDIs		
<b>AO</b>	<b>Number of people in “AK” using a low-volume SABA MDI §</b>	<b>71,662 people (AK × (52% – 25%))</b>	<b>188,020 people (AK × 52%)</b>
AP	Number of actuations of SABA MDI over a year in people in “AO” **	3,139 act per person per year ((8 + 0.6) act/day × 365 days/year)	3,139 act per person per year ((8 + 0.6) act/day × 365 days/year)
AQ	Carbon footprint associated with SABA MDI use in people in “AO” #	<b>47,351 MT CO<sub>2</sub>e</b> (AO × AP × 0.2105 kg CO <sub>2</sub> e/act)	<b>124,236 MT CO<sub>2</sub>e</b> (AO × AP × 0.263 kg CO <sub>2</sub> e/act)
	DPI		
<b>AR</b>	<b>Number of people in “AJ” using a SABA DPI as rescue therapy ‡</b>	<b>119,244 people (AJ × (6% + 25%))</b>	<b>23,079 people (AJ × 6%)</b>
AS	Number of actuations of SABA DPI over a year in people in “AR” **	1,570 act per person per year ((4 + 0.3) act/day × 365 days/year)	1,570 act per person per year ((4 + 0.3) act/day × 365 days/year)
AT	Carbon footprint associated with SABA DPI use in people in “AR” #	<b>1,684 MT CO<sub>2</sub>e</b> (AR × AS × 0.009 kg CO <sub>2</sub> e/actuation)	<b>326 MT CO<sub>2</sub>e</b> (AR × AS × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>SAMA</b>		
AU	Number of people in “AI” who are using a SAMA as rescue therapy ‡	21,423 people (AI × 5%)	21,423 people (AI × 5%)
	MDI		
AV	Number of people in “AU” using a SAMA MDI ‡	21,423 people (AU × 100%)	21,423 people (AU × 100%)
AW	Number of actuations of SAMA MDI over a year in people in “AV” **	3,139 act per person per year ((8 + 0.6) act/day × 365 days/year)	3,139 act per person per year ((8 + 0.6) act/day × 365 days/year)
AX	Carbon footprint associated with SAMA MDI use in people in “AV” #	<b>8,842 MT CO<sub>2</sub>e</b> (AV × AW × 0.1315 kg CO <sub>2</sub> e/act)	<b>8,843 MT CO<sub>2</sub>e</b> (AV × AW × 0.2105 kg CO <sub>2</sub> e/act)
	<b>Severe overuse: &gt;180 days in a year requiring more than 4 uses (doses) of rescue therapy</b>		
AY	Number of people in “R” with severe overuse **	270,720 (R × 19%)	270,720 (R × 19%)
	<b>SABA</b>		
AZ	Number of people in “AY” who are using a SABA as rescue therapy ‡	256,438 people (AY × 95%)	256,438 people (AY × 95%)
	SABA MDI		

<b>BA</b>	<b>Number of people in “AZ” using a SABA MDI as rescue therapy ‡</b>	<b>176,942 people (AZ × (94% – 25%))</b>	<b>241,052 people (AZ × 94%)</b>
	Low-volume SABA MDIs		
<b>BB</b>	<b>Number of people in “BA” using a low-volume SABA MDI §</b>	<b>129,168 people (BA × (48% + 25%))</b>	<b>115,705 people (BA × 48%)</b>
BC	Number of actuations of SABA MDI over a year in people in “BB” **	5,037 act per person per year ((8 + 5.8) act/day × 365 days/year)	5,037 act per person per year ((8 + 5.8) act/day × 365 days/year)
BD	Carbon footprint associated with SABA MDI use in people in “BB” #	<b>30,904 MT CO<sub>2</sub>e (BB × BC × 0.0475 kg CO<sub>2</sub>e/act)</b>	<b>27,683 MT CO<sub>2</sub>e (BB × BC × 0.0475 kg CO<sub>2</sub>e/act)</b>
	High-volume SABA MDIs		
<b>BE</b>	<b>Number of people in “BA” using a low-volume SABA MDI §</b>	<b>47,774 people (BA × (52% – 25%))</b>	<b>125,347 people (BA × 52%)</b>
BF	Number of actuations of SABA MDI over a year in people in “BE” **	5,037 act per person per year ((8 + 5.8) act/day × 365 days/year)	5,037 act per person per year ((8 + 5.8) act/day × 365 days/year)
BG	Carbon footprint associated with SABA MDI use in people in “BE” #	<b>50,655 MT CO<sub>2</sub>e (BE × BF × 0.2105 kg CO<sub>2</sub>e/act)</b>	<b>132,904 MT CO<sub>2</sub>e (BE × BF × 0.2105 kg CO<sub>2</sub>e/act)</b>
	SABA DPI		
<b>BH</b>	<b>Number of people in “AZ” using a SABA DPI as rescue therapy ‡</b>	<b>79,496 people (AZ × (6% + 25%))</b>	<b>15,386 people (AZ × 6%)</b>
BI	Number of actuations of SABA DPI over a year in people in “BH” **	2,519 act per person per year ((4 + 2.9) act/day × 365 days/year)	2,519 act per person per year ((4 + 2.9) act/day × 365 days/year)
BJ	Carbon footprint associated with SABA DPI use in people in “BH” #	<b>1,802 MT CO<sub>2</sub>e (BH × BI × 0.009 kg CO<sub>2</sub>e/actuation)</b>	<b>349 MT CO<sub>2</sub>e (BH × BI × 0.009 kg CO<sub>2</sub>e/actuation)</b>
	<b>SAMA</b>		
BK	Number of people in “AY” who are using a SAMA as rescue therapy ‡	14,282 people (AY × 5%)	14,282 people (AY × 5%)
	MDI		
BL	Number of people in “BK” using a SAMA MDI ‡	14,282 people (BK × 100%)	14,282 people (BK × 100%)
BM	Number of actuations of SAMA MDI over a year in people in “BL” **	5,037 act per person per year ((8 + 5.8) act/day × 365 days/year)	5,037 act per person per year ((8 + 5.8) act/day × 365 days/year)
BN	Carbon footprint associated with SAMA MDI use in people in “BL” #	<b>9,460 MT CO<sub>2</sub>e (BL × BM × 0.1315 kg CO<sub>2</sub>e/act)</b>	<b>9,460 MT CO<sub>2</sub>e (BL × BM × 0.1315 kg CO<sub>2</sub>e/act)</b>
	<b>Sub-total, rescue medications</b>		
BO	Total carbon footprint, rescue inhalers	187,517 MT CO <sub>2</sub> e ((G + J + M + Q) + (X + AA + AD + AH) + (N + Q + T + X) + (BD + BG + BJ + BN))	344,234 MT CO <sub>2</sub> e ((G + J + M + Q) + (X + AA + AD + AH) + (N + Q + T + X) + (BD + BG + BJ + BN))
BP	<b>Anticipated carbon saving, rescue inhalers</b>	<b>(156,717) MT CO<sub>2</sub>e (BO<sub>anticipated</sub> – BO<sub>current</sub>)</b>	
	<b>Controller medications</b>		
	<b>GOLD A: CAT &lt;10, MRC 1-2 (CTS mild COPD)</b>		

BQ	Number of people in “A” in GOLD A group †	500,000 (A × 25%)	500,000 (A × 25%)
	<b>SABA</b>		
BR	Number of people in “BQ” who are using a SABA ‡	248,224 people (BQ × 50%)	248,224 people (BQ × 50%)
	MDI		
<b>BS</b>	<b>Number of people in “BR” using a SABA MDI ‡</b>	<b>171,274 people (BR × (94% – 25%))</b>	<b>233,330 people (BR × 94%)</b>
	Low-volume SABA MDIs		
<b>BT</b>	<b>Number of people in “BS” using a low-volume SABA MDI §</b>	<b>125,030 people (BS × (48% + 25%))</b>	<b>111,998 people (BS × 48%)</b>
BU	Number of actuations of SABA MDI over a year in people in “BT” ¶	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
BV	Carbon footprint associated with SABA MDI use in people in “BT” #	<b>2,025 MT CO<sub>2</sub>e</b> (BT × BU × 0.2105 kg CO <sub>2</sub> e/act)	<b>1,107 MT CO<sub>2</sub>e</b> (BT × BU × 0.0475 kg CO <sub>2</sub> e/act)
	High-volume SABA MDIs		
<b>BW</b>	<b>Number of people in BS” using a high-volume SABA MDI §</b>	<b>46,244 people (BS × (52% – 25%))</b>	<b>121,332 people (BS × 52%)</b>
BX	Number of actuations of SABA MDI over a year in people in “BW” ¶	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
BY	Carbon footprint associated with SABA MDI use in people in “BW” #	<b>2,025 MT CO<sub>2</sub>e</b> (BW × BX × 0.2105 kg CO <sub>2</sub> e/act)	<b>5,312 MT CO<sub>2</sub>e</b> (BW × BX × 0.2105 kg CO <sub>2</sub> e/act)
	DPI		
<b>BZ</b>	<b>Number of people in “BR” using a SABA DPI ‡</b>	<b>76,949 people (BR × (6% + 25%))</b>	<b>14,893 people (BR × 6%)</b>
CA	Number of actuations of SABA DPI over a year in people in “BZ” ¶	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)
CB	Carbon footprint associated with SABA DPI use in people in “BZ” #	<b>72 MT CO<sub>2</sub>e</b> (BZ × CA × 0.009 kg CO <sub>2</sub> e/actuation)	<b>14 MT CO<sub>2</sub>e</b> (BZ × CA × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>SAMA</b>		
CC	Number of people in “BQ” who are using a SAMA ‡	13,825 people (BQ × 3%)	13,825 people (BQ × 3%)
	MDI		
CD	Number of people in “CC” using a SAMA MDI ‡	13,825 people (CC × 100%)	13,825 people (CC × 100%)
CE	Number of actuations of SAMA MDI over a year in people in “CD” ¶	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
CF	Carbon footprint associated with SAMA MDI use in people in “CD” #	<b>378 MT CO<sub>2</sub>e</b> (CD × CE × 0.1315 kg CO <sub>2</sub> e/act)	<b>378 MT CO<sub>2</sub>e</b> (CD × CE × 0.1315 kg CO <sub>2</sub> e/act)
	<b>LAMA</b>		
CG	Number of people in “BQ” who are using a LAMA ‡	214,970 people (BQ × 43%)	214,970 people (BQ × 43%)
	DPI		

CH	Number of people in “CG” using a LAMA DPI ‡	214,970 people (CG × 100%)	214,970 people (CG × 100%)
CI	Number of actuations of LAMA DPI over a year in people in “CH” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
CJ	Carbon footprint associated with LAMA DPI use in people in “CH” #	<b>523 MT CO<sub>2</sub>e</b> (CH × CI × 0.009 kg CO <sub>2</sub> e/actuation)	<b>523 MT CO<sub>2</sub>e</b> (CH × CI × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>LABA</b>		
CK	Number of people in “BQ” who are using a LABA ‡	22,982 people (BQ × 5%)	22,982 people (BQ × 5%)
	DPI		
CL	Number of people in “CK” using a LABA DPI ‡	22,982 people (CK × 100%)	22,982 people (CK × 100%)
CM	Number of actuations of LABA DPI over a year in people in “CL” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
CN	Carbon footprint associated with LABA DPI use in people in “CL” #	<b>56 MT CO<sub>2</sub>e</b> (CL × CM × 0.009 kg CO <sub>2</sub> e/actuation)	<b>56 MT CO<sub>2</sub>e</b> (CL × CM × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>GOLD B: CAT ≥10, MRC ≥3, and infrequent exacerbations (CTS moderate COPD)</b>		
CO	Number of people in “A” in GOLD B group †	1,040,000 (A × 52%)	1,040,000 (A × 52%)
	<b>LABA or LABA/LABA</b>		
<b>CP</b>	<b>Number of people in “CO” who are using a LABA or a LABA/LABA ‡</b>	<b>302,541 people ((CO × 54%) – (CO × 25%))</b>	<b>562,541 people (CO × 54%)</b>
	DPI		
CQ	Number of people in “CG” using a LABA or a LABA/LABA DPI ‡	302,541 people (CP × 100%)	562,541 people (CG × 100%)
CR	Number of actuations of LABA or a LABA/LABA DPI over a year in people in “CQ” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
CS	Carbon footprint associated with LABA or a LABA/LABA DPI use in people in “CQ” #	<b>735 MT CO<sub>2</sub>e</b> (CQ × CR × 0.009 kg CO <sub>2</sub> e/actuation)	<b>1,367 MT CO<sub>2</sub>e</b> (CQ × CR × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>LABA</b>		
CT	Number of people in “CO” who are using a LABA ‡	60,141 people (CO × 6%)	60,141 people (CO × 6%)
	DPI		
CU	Number of people in “CT” using a LABA DPI ‡	60,141 people (CT × 100%)	60,141 people (CT × 100%)
CV	Number of actuations of LABA DPI over a year in people in “CU” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
CW	Carbon footprint associated with LABA DPI use in people in “CU” #	<b>146 MT CO<sub>2</sub>e</b> (CU × CV × 0.009 kg CO <sub>2</sub> e/actuation)	<b>146 MT CO<sub>2</sub>e</b> (CU × CV × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>ICS/LABA</b>		

<b>CX</b>	<b>Number of people in “CO” who are using an ICS/LABA ‡</b>	<b>156,871 people ((CO × 40%) – (CO × 25%))</b>	<b>416,871 people (CO × 40%)</b>
	MDI		
<b>CY</b>	<b>Number of people in “CX” who use an ICS/LABA MDI ‡</b>	<b>34,512 people (CX × (47% – 25%))</b>	<b>195,929 people (CX × 47%)</b>
	HFC-134a MDI	N	
<b>CZ</b>	<b>Number of people in “CY” who use a HFC-134a MDI ‡‡</b>	<b>31,406 people (CY × (88% + (12% × 25%))</b>	<b>172,418 people (CY × 88%)</b>
DA	Number of actuations over a year, among people in “CZ” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
DB	Carbon footprint associated with use of ICS/LABA HFC-134a-containing MDI among people in “CZ” #	<b>1,115 MT CO<sub>2</sub>e</b> (CZ × DA × 0.1315 kg of CO <sub>2</sub> e/act)	<b>6,124 MT CO<sub>2</sub>e</b> (CZ × DA × 0.1315 kg of CO <sub>2</sub> e/act)
	HFC-227ea MDI		
<b>DC</b>	<b>Number of people in “CY” who use a HFC-227ea-containing MDI ‡‡</b>	<b>3,106 people (CY × (12% – (12% × 25%)))</b>	<b>23,512 people (CY × 12%)</b>
DD	Number of actuations over a year, among people in “DC” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
DE	Carbon footprint associated with use of ICS/LABA HFC-227ea-containing MDI among people in “DC” #	<b>292 MT CO<sub>2</sub>e</b> (DC × DD × 0.3485 kg of CO <sub>2</sub> e/act)	<b>2,213 MT CO<sub>2</sub>e</b> (DC × DD × 0.3485 kg of CO <sub>2</sub> e/act)
	DPI		
<b>DF</b>	<b>Number of people in “CX” who use an ICS/LABA DPI ‡</b>	<b>122,359 people (CX × (53% + 25%))</b>	<b>220,942 people (CX × 53%)</b>
DG	Number of actuations over a year, among people in “DF” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
DH	Carbon footprint associated with use of ICS/LABA DPI among people in “BN” #	<b>297 MT CO<sub>2</sub>e</b> (DF × DG × 0.009 kg of CO <sub>2</sub> e/act)	<b>537 MT CO<sub>2</sub>e</b> (DF × DG × 0.009 kg of CO <sub>2</sub> e/act)
	<b>LAMA/LABA/ICS</b>		
<b>DI</b>	<b>Number of people in “CO” who are using a LAMA/LABA/ICS ‡</b>	<b>260,448 people (CO × (0.04% + 25%))</b>	<b>448 people (CO × 0.04%)</b>
	DPI		
DJ	Number of people in “DI” using a LAMA/LABA/ICS DPI ‡	60,141 people (DI × 100%)	448 people (DI × 100%)
DK	Number of actuations of LAMA/LABA/ICS DPI over a year in people in “DJ” ††	157 act per person per year (1 act/dose × 1 dose/day × 365 days/year × 43% adherence)	157 act per person per year (1 act/dose × 1 dose/day × 365 days/year × 43% adherence)
DL	Carbon footprint associated with LAMA/LABA/ICS DPI use in people in “DJ” #	<b>368 MT CO<sub>2</sub>e</b> (DJ × DK × 0.009 kg CO <sub>2</sub> e/actuation)	<b>0.6 MT CO<sub>2</sub>e</b> (DJ × DK × 0.009 kg CO <sub>2</sub> e/actuation)
<b>GOLD C: GOLD C: CAT &lt;10, MRC 1-2, and frequent exacerbations</b>			

DM	Number of people in “A” in GOLD C group †	60,000 (A × 3%)	60,000 (A × 3%)
	<b>LAMA</b>		
DN	Number of people in “DM” who are using a LAMA ‡	60,000 people (DM × 100%)	60,000 people (DM × 100%)
	DPI		
DO	Number of people in “DN” using a LAMA DPI ‡	60,000 people (DN × 100%)	60,000 people (DN × 100%)
DP	Number of actuations of LAMA DPI over a year in people in “DO” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
DQ	Carbon footprint associated with LAMA DPI use in people in “DO” #	<b>146 MT CO<sub>2</sub>e</b> (DO × DP × 0.009 kg CO <sub>2</sub> e/actuation)	<b>146 MT CO<sub>2</sub>e</b> (DO × DP × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>GOLD D: CAT ≥10, MRC ≥3, and frequent exacerbations (CTS severe COPD)</b>		
DR	Number of people in “A” in GOLD D group †	400,000 (A × 20%)	400,000 (A × 20%)
	<b>LAMA or LAMA/LABA</b>		
<b>DS</b>	<b>Number of people in “DR” who are using a LAMA or a LAMA/LABA ‡</b>	<b>129,641 people ((DR × 57%) – (DR × 25%))</b>	<b>229,641 people (DR × 57%)</b>
	DPI		
DT	Number of people in “DS” using a LAMA or a LAMA/LABA DPI ‡	129,641 people (DS × 100%)	229,641 people (DS × 100%)
DU	Number of actuations of LAMA or a LAMA/LABA DPI over a year in people in “DT” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
DV	Carbon footprint associated with LAMA or a LAMA/LABA DPI use in people in “DT” #	<b>315 MT CO<sub>2</sub>e</b> (DT × DU × 0.009 kg CO <sub>2</sub> e/actuation)	<b>558 MT CO<sub>2</sub>e</b> (DT × DU × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>ICS/LABA</b>		
<b>DW</b>	<b>Number of people in “DR” who are using an ICS/LABA ‡</b>	<b>70,176 people ((DR × 43%) – (DR × 25%))</b>	<b>170,176 people (DR × 43%)</b>
	MDI		
<b>DX</b>	<b>Number of people in “DW” who use an ICS/LABA MDI ‡</b>	<b>15,439 people (DW × (47% – 25%))</b>	<b>79,983 people (DW × 47%)</b>
	HFC-134a MDI	N	
<b>DY</b>	<b>Number of people in “DX” who use an HFC-134a MDI ††</b>	<b>14,049 people (DX × (88% + (12% × 25%))</b>	<b>70,385 people (DX × 88%)</b>
DZ	Number of actuations over a year, among people in “DY” ††	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
EA	Carbon footprint associated with use of ICS/LABA HFC-134a-containing MDI among people in “DY” #	<b>499 MT CO<sub>2</sub>e</b> (DY × DZ × 0.1315 kg of CO <sub>2</sub> e/act)	<b>2,499 MT CO<sub>2</sub>e</b> (DY × DZ × 0.1315 kg of CO <sub>2</sub> e/act)
	HFC-227ea MDI		



<b>EB</b>	<b>Number of people in “DX” who use an HFC-227ea-containing MDI <sup>††</sup></b>	<b>1,389 people (DX × (12% – (12% × 25%)))</b>	<b>9,598 people (DX × 12%)</b>
EC	Number of actuations over a year, among people in “EB” <sup>††</sup>	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
ED	Carbon footprint associated with use of ICS/LABA HFC-227ea-containing MDI among people in “EB” <sup>#</sup>	<b>131 MT CO<sub>2</sub>e</b> (EB × EC × 0.009 kg of CO <sub>2</sub> e/act)	<b>1,807 MT CO<sub>2</sub>e</b> (EB × EC × 0.697 kg of CO <sub>2</sub> e/act)
	DPI		
<b>EE</b>	<b>Number of people in “DW” who use an ICS/LABA DPI <sup>‡</sup></b>	<b>54,737 people (DW × (53% + 25%))</b>	<b>90,193 people (DW × 53%)</b>
EF	Number of actuations over a year, among people in “EE” <sup>††</sup>	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)	270 act per person per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
EG	Carbon footprint associated with use of ICS/LABA DPI among people in “EE” <sup>#</sup>	<b>133 MT CO<sub>2</sub>e</b> (EE × EF × 0.009 kg of CO <sub>2</sub> e/act)	<b>219 MT CO<sub>2</sub>e</b> (EE × EF × 0.009 kg of CO <sub>2</sub> e/act)
	<b>LAMA/LABA/ICS</b>		
<b>EH</b>	<b>Number of people in “CO” who are using a LAMA/LABA/ICS <sup>‡</sup></b>	<b>100,183 people (CO × (0.04% + 25%))</b>	<b>183 people (CO × 0.04%)</b>
	DPI		
EI	Number of people in “EH” using a LAMA/LABA/ICS DPI	100,183 people (EH × 100%)	183 people (EH × 100%)
EJ	Number of actuations of LAMA/LABA/ICS DPI over a year in people in “EI” <sup>††</sup>	157 act per person per year (1 act/dose × 1 dose/day × 365 days/year × 43% adherence)	157 act per person per year (1 act/dose × 1 dose/day × 365 days/year × 43% adherence)
EK	Carbon footprint associated with LAMA/LABA/ICS DPI use in people in “EI” <sup>#</sup>	<b>142 MT CO<sub>2</sub>e</b> (EI × EJ × 0.009 kg CO <sub>2</sub> e/actuation)	<b>0.3 MT CO<sub>2</sub>e</b> (DJ × DK × 0.009 kg CO <sub>2</sub> e/actuation)
	<b>Sub-total, controller medications</b>		
EL	Total carbon footprint, controller inhalers	<b>8,609 MT CO<sub>2</sub>e</b> ((BV + BY + CB + CF + CJ + CN) + (CS + CW + DB + DE + DH + DL) + (DQ) + (DV + EA + ED + EG + EK))	<b>22,105 MT CO<sub>2</sub>e</b> ((BV + BY + CB + CF + CJ + CN) + (CS + CW + DB + DE + DH + DL) + (DQ) + (DV + EA + ED + EG + EK))
EM	<b>Anticipated carbon saving, controller inhalers</b>	<b>(13,496) metric tons of CO<sub>2</sub>e</b> (EL <sub>anticipated</sub> – EL <sub>current</sub> )	
	<b>Total, rescue and controller medications</b>		
EN	<b>Anticipated carbon saving</b>	<b>(366,339) metric tons of CO<sub>2</sub>e</b> (BP + EM)	
<p><b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>DPI:</b> dry powder inhaler; <b>ICS:</b> inhaled corticosteroid; <b>LABA:</b> long-acting beta<sub>2</sub>-agonist; <b>LAMA:</b> long-acting muscarinic antagonist; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO<sub>2</sub> equivalent; <b>SABA:</b> short-acting beta<sub>2</sub>-agonist; <b>SAMA:</b> short-acting muscarinic antagonist</p>			
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.			

\* Prevalence of clinically-diagnosed COPD derived from Public Health Agency of Canada <sup>1</sup>.  
 † Group severity categories are defined as per 2017 GOLD guidelines.<sup>16</sup> Percentages owing to each group are derived from Le, Johannessen, et al. <sup>17</sup>.  
 ‡ Market sales of SABA, SAMA, LAMA, LAMA/LABA, LABA, ICS/LABA, and LAMA/LABA/ICS devices are derived from Janson, Henderson, et al. <sup>3</sup>.  
 § Market share for low- and high-volume HFC-containing SABA MDIs are derived from Badcock, Metcalfe, et al. <sup>23</sup>. We assumed that non-Ventolin sales applied to low-volume HFC-containing SABA MDIs.  
 ¶ In this conservative analysis, patients with mild COPD were not considered to overuse rescue therapies. Normal use is defined as taking  $\leq 4$  uses (doses) of a short-acting reliever in a week<sup>10</sup>. Here, we assume that patients take their rescue medication twice a week. Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).  
 # Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup>.  
 \*\* Overuse is defined as taking  $>4$  uses (doses) of a short-acting reliever in a day.<sup>18</sup> Mild overusers used their rescue therapy for on average  $\sim 1$  excess dose (use) every 3 days, while severe overusers used their rescue therapy for on average  $\sim 3$  excess doses (uses) every day.<sup>18</sup>. Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).  
 †† Percentage of people adherent to their medication is derived from Toy, Beaulieu, et al. <sup>11</sup>.  
 ‡‡ Market sales for ICS/LABA HFC-134a- and HFC-227ea-containing MDI are derived from a government report.<sup>8</sup>

## Appendix E Tables

Carbon footprint of inhalers among Canadians with adequately diagnosed and optimally controlled asthma and COPD

### Asthma

Based on the current market share, the carbon footprint of rescue inhalers among Canadians with appropriately diagnosed and optimally controlled asthma is estimated at  $\sim 65,600$  metric tons of CO<sub>2</sub> equivalent (**e-Table E-1**), while that of controller inhalers is estimated at  $\sim 66,500$  metric tons of CO<sub>2</sub> equivalent (**e-Table E-2**).

\* In the table that follows, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. \*

**e-Table E-1. Carbon footprint of rescue inhalers in people with appropriately diagnosed and optimally controlled asthma in Canada**

A	Prevalence of clinically-diagnosed asthma * (after subtracting people with overdiagnosed asthma – <b>Appendix A, e-Table 1</b> ) <sup>†</sup>	2,546,000 people (3,800,000 – 1,254,000)
	MDI	

B	Number of people in “A” using a SABA MDI as rescue therapy ‡	2,393,240 people (A × 94%)
C	Number of actuations of SABA MDI over a year in people in “B” (reflecting good control) §	104 act per person per year (2 act/dose × 1 dose/week × 52 weeks/year)
D	Carbon footprint associated with SABA MDI use in people in “B” ¶	32,730 metric tons of CO <sub>2</sub> e (B × C × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
E	Number of people in “A” using a SABA DPI as rescue therapy ‡	152,760 people (A × 6%)
F	Number of actuations of SABA DPI over a year in people in “F” (reflecting good control) §	52 act per person per year (1 act/dose × 1 dose/week × 52 weeks/year)
G	Carbon footprint associated with SABA DPI use in people in “F” ¶	71 MT CO <sub>2</sub> e (E × F × 0.009 kg CO <sub>2</sub> e/act)
	<b>Total</b>	
H	<b>Total carbon footprint</b>	<b>32,801 MT CO<sub>2</sub>e (D + G)</b>
<b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent; <b>SABA:</b> short-acting beta <sub>2</sub> -agonist		
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.		
* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada <sup>1</sup> .		
† Percentage of people with clinically-diagnosed asthma who do not have objective evidence of disease derived from Aaron, Vandemheen, et al. <sup>2</sup> .		
‡ Market sales for SABA MDI and DPI devices derived from Janson, Henderson, et al. <sup>3</sup> . This analysis does not consider the people who are on budesonide/formoterol maintenance and reliever therapy (SMART). This represents 1.2% of patients. <sup>22</sup>		
§ We consider an average use of 1 dose of SABA per week. This reflects a conservative definition, given that guidelines define well-controlled asthma as no more than 2 uses (doses) of SABA per week. <sup>4,5</sup> Note that a typical use (dose) of a SABA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation.		
¶ Carbon footprint per actuation is derived from Jeswani and Azapagic <sup>6</sup> .		

***e-Table E-2. Carbon footprint of inhaled controller therapy in people with appropriately diagnosed and optimally controlled asthma in Canada***

A	Prevalence of clinically-diagnosed asthma * (after subtracting people with over-diagnosed asthma – <b>Appendix A, e-Table 1</b> ) †	2,546,000 people (3,800,000 – 1,254,000)
	<b>Mild asthma</b>	
B	Number of people in “A” who have mild asthma ‡	1,603,980 people (A × 63%)
	<b>ICS</b>	
	<b>MDI</b>	
C	Number of people in “B” who use an ICS MDI §	898,229 people (B × 56%)
D	Number of actuations over a year among people in “C” ¶	88 act per person per year (2 act/day × 365 days/year × 12% adherence)
E	Carbon footprint associated with use of controller ICS MDI among people in “C” #	10,347 MT CO <sub>2</sub> e (C × D × 0.1315 kg of CO <sub>2</sub> e/act)
	<b>DPI</b>	
F	Number of people in “B” who use an ICS DPI §	705,751 people (B × 44%)
G	Number of actuations over a year among people in “F” ¶	88 act per person per year (2 act/day × 365 days/year × 12% adherence)

H	Carbon footprint associated with use of controller ICS DPI among people in “F” <sup>#</sup>	556 MT CO <sub>2</sub> e (F × G × 0.009 kg of CO <sub>2</sub> e/act)
	<b>Moderate and severe asthma</b>	
I	Number of people in “A” who have moderate or severe asthma <sup>‡</sup>	942,020 people (A × 37%)
	<b>ICS/LABA MDI</b>	
J	Number of people in “I” who use an ICS/LABA MDI <sup>**</sup>	442,749 people (I × 47%)
	<b>HFC-134a MDI</b>	N
K	Number of people in “J” who use a HFC-134a MDI <sup>††</sup>	389,619 people (J × 88%)
L	Number of actuations over a year, among people in “K” <sup>‡‡</sup>	314 act per person per year (2 act/day × 365 days × 43% adherence)
M	Carbon footprint associated with use of ICS/LABA HFC-134a-containing MDI among people in “K” <sup>#</sup>	16,083 MT CO <sub>2</sub> e (K × L × 0.1315 kg of CO <sub>2</sub> e/act)
	<b>HFC-227ea MDI</b>	
N	Number of people in “J” who use a HFC-227ea-containing MDI <sup>††</sup>	53,130 people (J × 12%)
O	Number of actuations over a year, among people in “N” <sup>‡‡</sup>	314 act per person per year (2 act/day × 365 days × 43% adherence)
P	Carbon footprint associated with use of ICS/LABA HFC-227ea-containing MDI among people in “N” <sup>#</sup>	5,812 MT CO <sub>2</sub> e (N × O × 0.3485 kg of CO <sub>2</sub> e/act)
	<b>DPI</b>	
Q	Number of people in “I” who use an ICS/LABA DPI <sup>**</sup>	499,271 people (I × 53%)
R	Number of actuations over a year, among people in “Q” <sup>‡‡</sup>	314 act per person per year (2 act/day × 365 days × 43%)
S	Carbon footprint associated with use of ICS/LABA DPI among people in “Q” <sup>#</sup>	1,410 MT CO <sub>2</sub> e (Q × R × 0.009 kg of CO <sub>2</sub> e/act)
	<b>Total</b>	
T	Carbon footprint of controller MDIs	32,242 MT CO <sub>2</sub> e (E + M + P)
U	Carbon footprint of controller DPIs	1,967 MT CO <sub>2</sub> e (H + S)
V	<b>Total carbon footprint</b>	<b>34,209 MT CO<sub>2</sub>e (T + U)</b>
<b>Act:</b> actuations; <b>DPI:</b> dry powder inhaler; <b>ICS:</b> inhaled corticosteroid; <b>LABA:</b> long-acting beta <sub>2</sub> -agonist; <b>MDI:</b> pressurized metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO <sub>2</sub> equivalent		
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.		
<p>* Prevalence of clinically-diagnosed asthma derived from Public Health Agency of Canada<sup>1</sup>.</p> <p>† Percentage of people with clinically-diagnosed asthma who do not have objective evidence of disease derived from Aaron, Vandemheen, et al.<sup>2</sup>.</p> <p>‡ The distribution of the asthma population across severity stages is derived from Firoozi, Lemiere, et al.<sup>13</sup>. Please note that this analysis does not consider people who have very mild asthma and who are prescribed an as-needed rescue bronchodilator only. Their carbon footprint is accounted for in <b>Appendix E, e-Table 1</b>.</p> <p>§ Market sales for ICS MDI and DPI inhalers derived from Lavorini, Corrigan, et al.<sup>7</sup>. This analysis does not consider the people who are on an as-needed budesonide/formoterol therapy, as this treatment approach has just been approved.</p> <p>¶ This calculation considers a 12% adherence rate.<sup>14</sup></p> <p># Carbon footprint per actuation is derived from Jeswani and Azapagic<sup>6</sup>;</p> <p>** Market sales for ICS/LABA MDI and DPI inhalers are derived from Janson, Henderson, et al.<sup>3</sup>.</p> <p>†† Market sales for ICS/LABA HFC-134a- and HFC-227ea-containing MDI are derived from a government report.<sup>8</sup></p> <p>‡‡ This calculation considers a 43% adherence rate.<sup>19</sup>.</p>		

## COPD

Based on the current market share, the carbon footprint of rescue inhalers is estimated at ~57,800 metric tons of CO<sub>2</sub> equivalent in Canadians with appropriately diagnosed and optimally controlled COPD (e-Table E-3), while that of controller inhalers is estimated at ~22,400 metric tons of CO<sub>2</sub> equivalent (e-Table E-4).

\* In the tables that follow, please note that, for simplicity, numbers and percentages presented are rounded to the nearest unit. \*

**e-Table E-3. Carbon footprint of rescue inhalers in people with appropriately diagnosed and optimally diagnosed COPD in Canada**

A	Prevalence of clinically-diagnosed COPD* (after subtracting people with over-diagnosed COPD – Appendix A, e-Table 2)†	1,120,000 people (2,000,000 – 880,000)
	<b>SABA</b>	
B	Number of people in “A” using a SABA‡	1,060,913 people (A × 95%)
	MDI	
C	Number of people in “B” who are using a SABA MDI‡	997,259 people (B × 94%)
D	Estimated number of SABA MDI actuations used by a single patient in “C” each year§	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
E	Carbon footprint associated with SABA MDI use in people in “C”¶	<b>27,277 metric tons of CO<sub>2</sub>e</b> (C × D × 0.1315 kg CO <sub>2</sub> e/act)
	DPI	
F	Number of people in “B” who are using a SABA DPI‡	63,655 people (B × 6%)
G	Estimated number of SABA DPI actuations used by a single patient in “F” each year§	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)
H	Carbon footprint associated with SABA DPI use in people in “F”¶	<b>60 metric tons of CO<sub>2</sub>e</b> (F × G × 0.009 kg CO <sub>2</sub> e/act)
	<b>SAMA</b>	
I	Number of people in “B” using a SAMA‡	59,087 people (A × 5%)
	MDI	
J	Number of people in “I” who are using a SAMA MDI‡	59,087 people (I × 100%)
K	Estimated number of SAMA MDI actuations used by a single patient in “J” each year§	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
L	Carbon footprint associated with SAMA MDI use in people in “J”¶	<b>1,616 metric tons of CO<sub>2</sub>e</b> (J × K × 0.263 kg CO <sub>2</sub> e/act)
	<b>Total</b>	
M	<b>Total carbon footprint</b>	<b>28,953 metric tons of CO<sub>2</sub> equivalent</b> (E + H + L)

**Act:** actuations; **COPD:** chronic obstructive pulmonary disease; **DPI:** Dry-powder inhaler; **MDI:** metered dose inhaler; **MT CO<sub>2</sub>e:** metric tons of CO<sub>2</sub> equivalent; **SABA:** short-acting beta<sub>2</sub>-agonist; **SAMA:** short-acting muscarinic antagonist

Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.

* Prevalence of clinically-diagnosed COPD derived from Public Health Agency of Canada <sup>1</sup> .
† Percentage of people with clinically-diagnosed COPD who do not have objective evidence of disease derived from Hill, Goldstein, et al. <sup>9</sup> .
‡ Market sales derived from Janson, Henderson, et al. <sup>3</sup>
§ Here, we assume that patients take their rescue medication twice a week, based on the fact that, in mild COPD, normal use is defined as taking $\leq 4$ uses (doses) of a short-acting reliever in a week. <sup>10</sup> Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).
¶ Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup> .

***e-Table E-4. Carbon footprint of controller inhalers in people with appropriately diagnosed and optimally diagnosed COPD in Canada***

A	Prevalence of clinically-diagnosed COPD * (after subtracting people with over-diagnosed COPD – Appendix A, e-Table 2) †	1,120,000 people (2,000,000 – 880,000)
	<b>GOLD A: CAT &lt;10, MRC 1-2 (CTS mild COPD)</b>	
B	Number of people in “A” in GOLD A group ‡	280,000 people (A × 25%)
	<b>SABA</b>	
C	Number of people in “B” using a SABA §	139,005 people (B × 50%)
	<b>MDI</b>	
D	Number of people in “C” who are using a SABA MDI §	130,665 people (C × 94%)
E	Estimated number of SABA MDI actuations used by a single patient in “D” each year ¶	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
F	Carbon footprint associated with SABA MDI use in people in “D” #	<b>3,574 MT CO<sub>2</sub>e</b> (D × E × 0.1315 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
G	Number of people in “C” who are using a SABA DPI §	8,340 people (C × 6%)
H	Estimated number of SABA DPI actuations used by a single patient in “G” each year ¶	104 act per person per year (1 act/dose × 2 doses/week × 52 weeks/year)
I	Carbon footprint associated with SABA DPI use in people in “G” #	<b>8 MT CO<sub>2</sub>e</b> (G × H × 0.009 kg CO <sub>2</sub> e/act)
	<b>SAMA</b>	
J	Number of people in “B” using a SAMA §	7,742 people (B × 3%)
	<b>MDI</b>	
K	Number of people in “J” who are using a SAMA MDI §	7,742 people (J × 100%)
L	Estimated number of SAMA MDI actuations used by a single patient in “K” each year ¶	208 act per person per year (2 act/dose × 2 doses/week × 52 weeks/year)
M	Carbon footprint associated with SAMA MDI use in people in “K” #	<b>212 MT CO<sub>2</sub>e</b> (K × L × 0.1315 kg CO <sub>2</sub> e/act)
	<b>LAMA</b>	
N	Number of people in “B” using a LAMA §	120,383 people (B × 43%)
	<b>DPI</b>	
O	Number of people in “N” who are using a LAMA DPI §	120,383 people (N × 100%)
P	Estimated number of LABA DPI actuations used by a single patient in “O” each year **	270 act per person per year (1 act/dose × 2 times/day × 365 days/year × 37% adherence)
Q	Carbon footprint associated with a LAMA DPI in people in “O” #	<b>293 MT CO<sub>2</sub>e</b> (O × P × 0.009 kg CO <sub>2</sub> e/act)
	<b>LABA</b>	

R	Number of people in “B” using a LABA § DPI	12,870 people (B × 5%)
S	Number of people in “R” who are using a LABA DPI §	12,870 people (R × 100%)
T	Estimated number of LABA DPI actuations used by a single patient in “S” each year **	270 act per person per year (1 act/dose × 2 times/day × 365 days/year × 37% adherence)
U	Carbon footprint associated with LABA DPI use in people in “S” # <b>GOLD B: CAT ≥10, MRC ≥3, and infrequent exacerbations (CTS moderate COPD)</b>	<b>31 MT CO<sub>2</sub>e</b> (S × T × 0.009 kg CO <sub>2</sub> e/act)
V	Number of people in “A” in GOLD B group ‡ <b>LAMA or LAMA/LABA</b>	582,400 people (A × 52%)
W	Number of people in “V” using a LAMA or a LAMA/LABA § DPI	315,023 people (V × 54%)
X	Number of people in “W” who are using a LAMA DPI or a LAMA/LABA DPI §	315,023 people (W × 100%)
Y	Estimated number of a LAMA DPI or a LAMA/LABA DPI actuations used by a single patient in “X” each year **	270 act per person per year (1 act/dose × 2 times/day × 365 days/year × 37% adherence)
Z	Carbon footprint associated with a LAMA DPI or a LAMA/LABA DPI use in people in “X” # <b>LABA</b>	<b>766 MT CO<sub>2</sub>e</b> (X × Y × 0.009 kg CO <sub>2</sub> e/act)
AA	Number of people in “V” using a LABA § DPI	33,679 people (V × 6%)
AB	Number of people in “AA” who are using a LABA DPI §	33,679 people (AA × 100%)
AC	Estimated number of LABA DPI actuations used by a single patient in “AB” each year **	270 act per person per year (1 act/dose × 2 times/day × 365 days/year × 37% adherence)
AD	Carbon footprint associated with LABA DPI use in people in “AB” # <b>ICS/LABA</b>	<b>82 MT CO<sub>2</sub>e</b> (AB × AC × 0.009 kg CO <sub>2</sub> e/act)
AE	Number of people in “V” using an ICS/LABA ‡ MDI	233,448 people (V × 40%)
AF	Number of people in “AF” who are using an ICS/LABA MDI § <b>HFC-134a-containing MDI</b>	109,720 people (AE × 47%)
AG	Number of people in “AF” who are using an ICS/LABA MDI using HFC-134a as propellant ††	96,554 people (AF × 88%)
AH	Number of ICS/LABA MDI actuations used by each patient in “AG” each year **	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
AI	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “AG” † <b>HFC-227ea-containing MDI</b>	<b>3,429 MT CO<sub>2</sub>e</b> (AG × AH × 0.1315 kg CO <sub>2</sub> e/act)
AJ	Number of people in “AF” who are using an ICS/LABA MDI using HFC-227ea as propellant ††	13,166 people (AF × 12%)
AK	Number of ICS/LABA MDI actuations used by each patient in “AJ” each year **	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
AL	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “AJ” † DPI	<b>1,239 MT CO<sub>2</sub>e</b> (AJ × AK × 0.697 kg CO <sub>2</sub> e/act)
AM	Number of people in “AE” who are using an ICS/LABA DPI §	123,727 people (AE × 53%)



AN	Number of ICS/LABA DPI actuations used by each patient in “AM” each year **	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)
AO	Carbon footprint associated with ICS/LABA DPI use in people in “AM” †	<b>301 MT CO<sub>2</sub>e</b> (AM × AN × 0.009 kg CO <sub>2</sub> e/act)
	<b>LAMA/LABA/ICS</b>	
AP	Number of people in “V” who are using a LAMA/LABA/ICS §	251 people (V × 0.04%)
	DPI	
AQ	Number of people in “AP” who are using a LAMA/LABA/ICS DPI §	251 people (AP × 100%)
AR	Number of LAMA/LABA/ICS DPI actuations used by each patient in “AQ” each year **	157 act per person per year (1 <i>act/dose</i> × 1 <i>time/day</i> × 365 days/year × 43% adherence)
AS	Carbon footprint associated with LAMA/LABA/ICS DPI use in people in “AQ” #	<b>0.4 MT CO<sub>2</sub>e</b> (AQ × AR × 0.009 kg CO <sub>2</sub> e/act)
	<b>GOLD C: CAT &lt;10, MRC 1-2, and frequent exacerbations (CTS ??? COPD)</b>	
AT	Number of people in “A” in GOLD C group ‡	33,600 people (A × 3%)
	<b>LAMA</b>	
AU	Number of people in “AT” using a LAMA §	33,600 people (AT × 100%)
	DPI	
AV	Number of people in “AU” who are using a LAMA DPI §	33,600 people (AU × 100%)
AW	Estimated number of a LAMA DPI actuations used by a single patient in “AV” each year **	270 act per person per year (1 <i>act/dose</i> × 2 <i>times/day</i> × 365 days/year × 37% adherence)
AX	Carbon footprint associated with a LAMA DPI use in people in “AV” #	<b>82 MT CO<sub>2</sub>e</b> (AV × AW × 0.009 kg CO <sub>2</sub> e/act)
	<b>GOLD D: CAT ≥10, MRC ≥3, and frequent exacerbations (CTS severe COPD)</b>	
AY	Number of people in “A” in GOLD D group ‡	224,000 people (A × 20%)
	<b>LAMA/LABA</b>	
AZ	Number of people in “AY” using a LAMA/LABA §	128,599 people (AY × 57%)
	DPI	
BA	Number of people in “AZ” who are using a LAMA/LABA DPI §	128,599 people (AZ × 100%)
BB	Estimated number of a LAMA/LABA DPI actuations used by a single patient in “BA” each year **	270 actuations per person per year (1 <i>act/dose</i> × 2 <i>times/day</i> × 365 days/year × 37% adherence)
BC	Carbon footprint associated with a LAMA/LABA DPI use in people in “BA” #	<b>313 MT CO<sub>2</sub>e</b> (BA × BB × 0.009 kg CO <sub>2</sub> e/act)
	<b>ICS/LABA</b>	
BD	Number of people in “AY” using an ICS/LABA §	95,298 people (AY × 43%)
	MDI	
BE	Number of people in “BD” who are using an ICS/LABA MDI §	44,790 people (BD × 47%)
	HFC-134a-containing MDI	
BF	Number of people in “BE” who are using an ICS/LABA MDI using HFC-134a as propellant ††	39,415 people (BE × 88%)
BG	Number of ICS/LABA MDI actuations used by each patient in “BF” each year **	270 act per year (1 <i>act/dose</i> × 2 doses/day × 365 days/year × 37% adherence)
BH	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “BF” †	<b>1,400 MT CO<sub>2</sub>e</b> (BF × BH × 0.1315 kg CO <sub>2</sub> e/act)
	HFC-227ea-containing MDI	

BI	Number of people in “BE” who are using an ICS/LABA MDI using HFC-227ea as propellant ††	5,375 people (BE × 12%)
BJ	Number of ICS/LABA MDI actuations used by each patient in “BI” each year **	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
BK	Carbon footprint associated with ICS/LABA MDI (HFC-134a) use in people in “BI” †	<b>506 MT CO<sub>2</sub>e</b> (BI × BK × 0.3485 kg CO <sub>2</sub> e/act)
	<b>DPI</b>	
BL	Number of people in “BD” who are using an ICS/LABA DPI §	50,508 people (BD × 53%)
BM	Number of ICS/LABA DPI actuations used by each patient in “BL” each year **	270 act per year (1 act/dose × 2 doses/day × 365 days/year × 37% adherence)
BN	Carbon footprint associated with ICS/LABA DPI use in people in “BL” †	<b>123 MT CO<sub>2</sub>e</b> (BL × BM × 0.009 kg CO <sub>2</sub> e/act)
	<b>LAMA/LABA/ICS</b>	
BO	Number of people in “AY” who are using a LAMA/LABA/ICS ‡	102 people (AY × 0.05%)
	<b>DPI</b>	
BP	Number of people in “BO” who are using a LAMA/LABA/ICS DPI §	102 people (BO × 100%)
BQ	Estimated number of LAMA/LABA/ICS DPI actuations used by a single patient in “BP” each year **	157 act per person per year (1 act/dose × 1 time/day × 365 days/year × 43% adherence)
BR	Carbon footprint associated with LAMA/LABA/ICS DPI use in people in “BP” †	<b>0.1 MT CO<sub>2</sub>e</b> (BP × BQ × 0.009 kg CO <sub>2</sub> e/act)
	<b>Total</b>	
BS	Carbon footprint of MDIs	20,721 MT CO <sub>2</sub> e ((F + M) + (AI + AL) + (BH + BK))
BT	Carbon footprint of DPIs	1,720 MT CO <sub>2</sub> e ((I + Q + U) + (Z + AD + AO + AS) + (AX) + (BC + BN + BR))
BU	<b>Total carbon footprint</b>	<b>12,358 MT CO<sub>2</sub>e</b> (BS + BT)
<p><b>Act:</b> actuations; <b>COPD:</b> chronic obstructive pulmonary disease; <b>DPI:</b> Dry-powder inhaler; <b>ICS:</b> inhaled corticosteroid; <b>LABA:</b> long-acting beta<sub>2</sub>-agonist; <b>LAMA:</b> long-acting muscarinic antagonist; <b>MDI:</b> metered dose inhaler; <b>MT CO<sub>2</sub>e:</b> metric tons of CO<sub>2</sub> equivalent; <b>SABA:</b> short-acting beta<sub>2</sub>-agonist; <b>SAMA:</b> short-acting muscarinic antagonist</p>		
Please note that, for simplicity, numbers and percentages presented here are rounded to the nearest unit.		
<p>* Prevalence of clinically-diagnosed COPD derived from Public Health Agency of Canada <sup>1</sup>.  † Percentage of people with clinically-diagnosed COPD who do not have objective evidence of disease derived from Hill, Goldstein, et al. <sup>9</sup>.  ‡ Severity stages are defined as per CTS guidelines,<sup>15</sup> and corresponds to GOLD groups A, B, C, and D.<sup>16</sup> The distribution of the COPD population across severity stages is derived from Le, Johannessen, et al. <sup>17</sup>.  § Market sales derived from Janson, Henderson, et al. <sup>3</sup>.  ¶ In mild COPD, normal use is defined as taking ≤4 uses (doses) of a short-acting reliever in a week.<sup>10</sup> Here, we assume that patients take their rescue medication twice a week. Note that a typical use (dose) of a SABA or SAMA MDI consists of 2 medication actuations, and of a SABA DPI consists of 1 medication actuation).  # Carbon footprint per actuation derived from Jeswani and Azapagic <sup>6</sup>.  ** Percentage of people adherent to their medication is derived from Toy, Beaulieu, et al. <sup>11</sup>.  †† Market sales for ICS/LABA HFC-134a- and HFC-227ea-containing MDI are derived from a government report.<sup>8</sup></p>		

## References

1. Public Health Agency of Canada. Report from the Canadian Chronic Disease Surveillance System: asthma and chronic obstructive pulmonary disease (COPD) in Canada, 2018. Ottawa: Health Canada; 2018.
2. Aaron SD, Vandemheen KL, FitzGerald JM, Ainslie M, Gupta S, Lemiere C, Field SK, et al. Reevaluation of Diagnosis in Adults With Physician-Diagnosed Asthma. *JAMA* 2017;317:269-79.
3. Janson C, Henderson R, Löfdahl M, Hedberg M, Sharma R, Wilkinson AJK. Carbon footprint impact of the choice of inhalers for asthma and COPD. *Thorax* 2020;75:82.
4. GINA. Global strategy for asthma management and prevention. Available from: [www.ginasthma.org](http://www.ginasthma.org) (accessed: 2021 July 26).
5. Yang CL, Hicks EA, Mitchell P, Reisman J, Podgers D, Hayward KM, Waite M, et al. 2021 Canadian Thoracic Society Guideline – A focused update on the management of very mild and mild asthma. *Canadian Journal of Respiratory, Critical Care, and Sleep Medicine* 2021;5:205-45.
6. Jeswani HK, Azapagic A. Life cycle environmental impacts of inhalers. *Journal of Cleaner Production* 2019;237:117733.
7. Lavorini F, Corrigan CJ, Barnes PJ, Dekhuijzen PR, Levy ML, Pedersen S, Roche N, et al. Retail sales of inhalation devices in European countries: so much for a global policy. *Respir Med* 2011;105:1099-103.
8. PMPRB. Market Intelligence Report: Combination Inhalers for Asthma, 2018. Ottawa, ON: Patented Medicine Prices Review Board; 2020.

9. Hill K, Goldstein RS, Guyatt GH, Blouin M, Tan WC, Davis LL, Heels-Ansdell DM, et al. Prevalence and underdiagnosis of chronic obstructive pulmonary disease among patients at risk in primary care. *Cmaj* 2010;182:673-8.
10. Soler-Cataluna JJ, Marzo M, Catalan P, Miralles C, Alcazar B, Miravittles M. Validation of clinical control in COPD as a new tool for optimizing treatment. *Int J Chron Obstruct Pulmon Dis* 2018;13:3719-31.
11. Toy EL, Beaulieu NU, McHale JM, Welland TR, Plauschinat CA, Swensen A, Duh MS. Treatment of COPD: relationships between daily dosing frequency, adherence, resource use, and costs. *Respir Med* 2011;105:435-41.
12. Nwaru BI, Ekstrom M, Hasvold P, Wiklund F, Telg G, Janson C. Overuse of short-acting beta2-agonists in asthma is associated with increased risk of exacerbation and mortality: a nationwide cohort study of the global SABINA programme. *Eur Respir J* 2020;55:1901872.
13. Firoozi F, Lemiere C, Beaulieu MF, Forget A, Blais L. Development and validation of database indexes of asthma severity and control. *Thorax* 2007;62:581-7.
14. Jobin MS, Moisan J, Bolduc Y, Dorval E, Boulet LP, Gregoire JP. Factors associated with the appropriate use of asthma drugs. *Can Respir J* 2011;18:97-104.
15. Bourbeau J, Bhutani M, Hernandez P, Marciniuk DD, Aaron SD, Balter M, Beaulieu M-F, et al. CTS position statement: pharmacotherapy in patients with COPD—an update. *Canadian Journal of Respiratory, Critical Care, and Sleep Medicine* 2017;1:222-41.
16. Singh D, Agusti A, Anzueto A, Barnes PJ, Bourbeau J, Celli BR, Criner GJ, et al. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Lung

- Disease: The GOLD Science Committee Report 2019. *Eur Respir J* 2019. 10.1183/13993003.00164-2019.
17. Le LAK, Johannessen A, Hardie JA, Johansen OE, Gulsvik A, Vikse BE, Bakke P. Prevalence and prognostic ability of the GOLD 2017 classification compared to the GOLD 2011 classification in a Norwegian COPD cohort. *Int J Chron Obstruct Pulmon Dis* 2019;14:1639-55.
  18. Fan VS, Gyls-Colwell I, Locke E, Sumino K, Nguyen HQ, Thomas RM, Magzamen S. Overuse of short-acting beta-agonist bronchodilators in COPD during periods of clinical stability. *Respiratory Medicine* 2016;116:100-6.
  19. Ismaila A, Corriveau D, Vaillancourt J, Parsons D, Stanford R, Su Z, Sampalis JS. Impact of adherence to treatment with fluticasone propionate/salmeterol in asthma patients. *Current Medical Research & Opinion* 2014;30:1417-25.
  20. Baggott C, Hansen P, Hancox RJ, Hardy JK, Sparks J, Holliday M, Weatherall M, et al. What matters most to patients when choosing treatment for mild-moderate asthma? Results from a discrete choice experiment. *Thorax* 2020;75:842-8.
  21. Gagne M, Lam Shin Cheung J, Kouri A, FitzGerald JM, O'Byrne PM, Boulet LP, Grill A, et al. A patient decision aid for mild asthma: navigating a new asthma treatment paradigm. *Respir Med* 2021. 10.1016/j.rmed.2021.106568:106568.
  22. Disantostefano RL, Boudiaf N, Stempel DA, Barnes NC, Greening AP. The frequency of, and adherence to, single maintenance and reliever therapy instructions in asthma: A descriptive analysis. *NPJ Prim Care Respir Med* 2016;26.

23. Badcock O, Metcalfe S, Wyeth J. Variation in the incidence of branded Ventolin dispensing for asthma by socioeconomic deprivation. Wellington, NZ: University of Otago; 2017.