



## A long way to go: minimizing the carbon footprint from anesthetic gases

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Greenhouse gases (GHGs) are important contributors to global warming because they absorb and trap infrared radiation within the atmosphere. Anesthesiologists use potent GHGs – i.e., hydrofluorocarbons (sevoflurane and desflurane), chlorofluorocarbons (isoflurane), and nitrous oxide. Following their anesthetic use, these gases are scavenged from the anesthetic circuit and expelled into the atmosphere, where they can remain for decades. The global warming potential (GWP<sub>100</sub>) compares the energy absorbed by 1 ton of a GHG relative to the energy absorbed by 1 ton of CO<sub>2</sub> over a 100-year period, with a higher absorbance indicating a worse effect.<sup>1</sup> With a GWP<sub>100</sub> of 2540, desflurane absorbs far more energy than a comparable amount of CO<sub>2</sub>.<sup>2</sup> Conversely, the GWP<sub>100</sub> values for isoflurane, nitrous oxide, and sevoflurane are only 510, 289, and 130, respectively.<sup>2</sup>

To illustrate the impact of anesthetic gases on the environment, we used calculations from Ryan and Nielsen to convert the GWP<sub>100</sub> of each anesthetic gas (at 1 minimum alveolar concentration-hour and fresh gas flow rate of 1 L·min<sup>-1</sup>) to the grams of CO<sub>2</sub> emitted per hour (CO<sub>2</sub> equivalent [CDE]).<sup>3</sup> The CDE was then converted to the distance (in kilometers) travelled assuming the average

car emits 200 g of CO<sub>2</sub> per kilometer. The distances displayed in the Figure document an imaginary road trip from Ottawa to Montreal, where:

One hour of 2% *sevoflurane* emits a CDE similar to that driving 6.5 km;

One hour of 1.2% *isoflurane* emits a CDE similar to that driving 14 km;

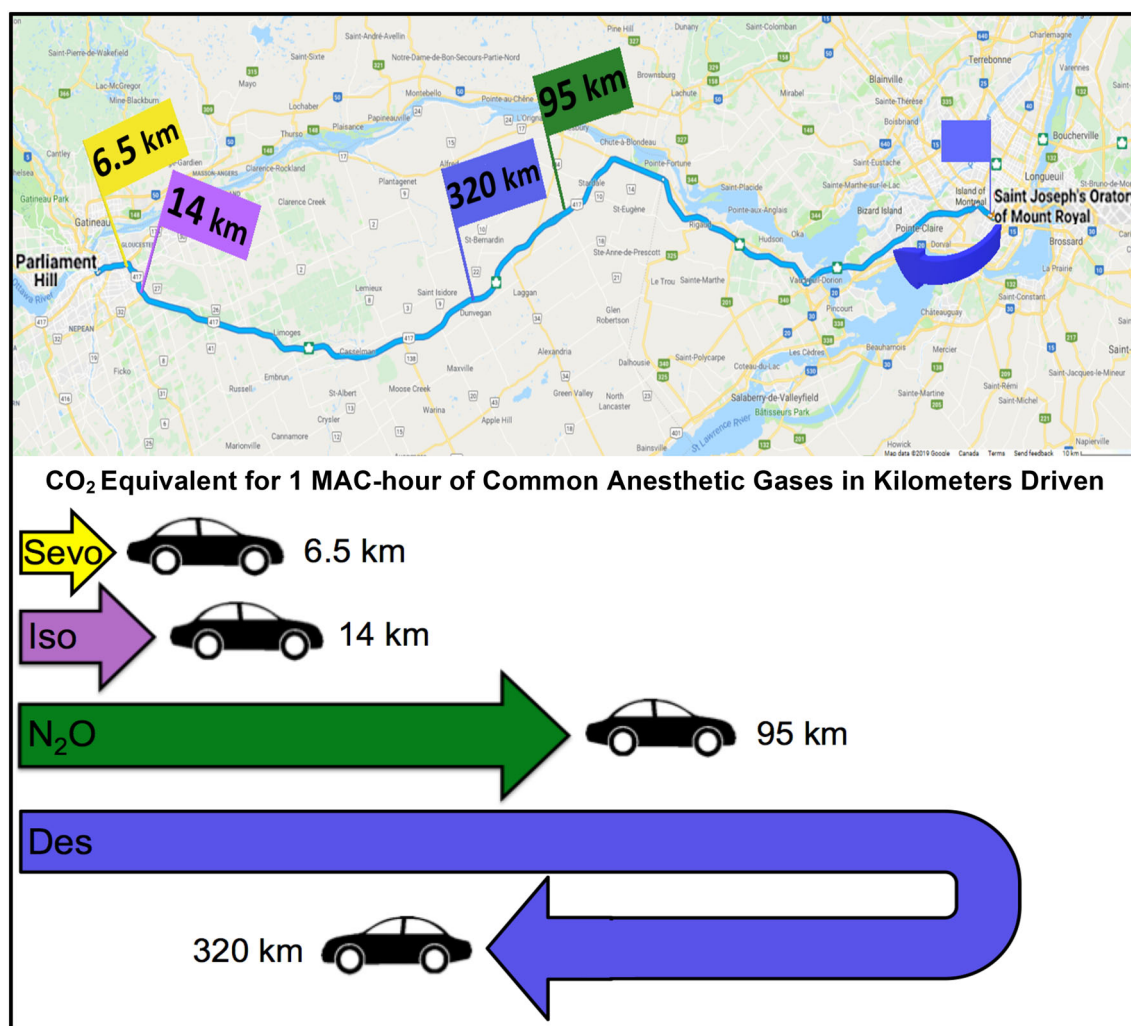
One hour of 60% *nitrous oxide* emits a CDE similar to that driving 95 km;

One hour of 6% *desflurane* emits a CDE similar to that driving 320 km (a distance equivalent to driving to Montreal and half way back to Ottawa).

Desflurane's CDE is thus 50 times higher than that of sevoflurane. Anesthesiologists should consider the GWP<sub>100</sub> in addition to the clinical and pharmacoeconomic factors when planning an anesthetic. As global citizens, it is our responsibility to find environmentally friendlier and more sustainable ways to practice anesthesia.

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**Figure** Visual map of the CO<sub>2</sub> equivalent for 1 MAC-hour of common anesthetic gases in kilometers driven. A route from Parliament Hill (111 Wellington St, Ottawa, ON, Canada) to Saint Joseph's Oratory of Mount Royal (3800 Queen Mary Road, Montreal, QC, Canada) was plotted using Google Maps. The total distance is 192 km. The CO<sub>2</sub> equivalent of travelling a distance (in kilometers) is

calculated by assuming that a car emits 200 g of CO<sub>2</sub> per kilometer. Desflurane's emission is equivalent to the distance driven to Montreal (small blue flag) and half way back to Ottawa (large blue flag). Desflurane (Des) = blue; isoflurane (Iso) = purple; nitrous oxide (N<sub>2</sub>O) = green; sevoflurane (Sevo) = yellow; MAC-hour = 1 minimum alveolar concentration-hour

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