

Are All Inhaled Drugs Climate Friendly?

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It is broadly known that human activity has a direct and/or indirect influence on the Environment and ultimately the Global Climate. Several industrial activities such as the manufacturing of refrigerants, aerosols, fire suppression agents or solvents, are being restructured in order to find the best "climate friendly" replacement for the most commonly and generically used agents. Inhaled drugs, on the other hand, still require greater commitment to develop more environmentally-compatible medications. This should be a priority.

However, the issue is, what are the environmental impacts that we expect from an inhaled drug? A response is not easy; however, some light may be shed when we consider the three main environmental hazards: the ozone layer depletion, the photochemical smog and the global warming.

The role of Cl and Br atoms in ozone layer depletion was discovered. Halogenated hydrocarbons (CFCs, HCFCs, and HFCs) are the main species that may be the feature to control and minimize this impact.

The Montreal Protocol and its continuous updates on Substances that Deplete the Ozone Layer (CFCs, HCFCs, and HFCs) are the main regulatory framework. The protocol aims to phase out the production and consumption of these substances. The protocol has been successful in reducing the levels of these substances in the atmosphere. The protocol has also led to the development of alternative technologies and products that do not deplete the ozone layer.

134a (CH₂FCF₃) and HFA-227ea (CF₃CHFCF₃), are 1430 and 3220, respectively, whereas the GWP for the CFC that replace, CFC-11 (CCl₃F), is just a little bit lower (4750) [5]. Therefore, the propellants that are being used are not completely environmentally- benign.

The inhaled anesthetic overview is similar to the asthma propellants. Only in 2006 in the United States, general anesthetics were administered to at least 50 million patients. Besides, anesthetic gases are widely used in dentist offices, veterinary clinics and research laboratories. N₂O is the most popular anesthetic gas, and according to some estimates, the emissions of N₂O during 2006 were approximately 3.5x10⁴ tons used for anesthetic purposes for 70 million patients, that is 3% of total N₂O emissions in the United States during 2006 [11]. It is worth noting that N₂O contributes to both global warming (GWP₁₀₀ = 298) and ozone layer depletion [5,12]. Aside from N₂O, all volatile anesthetic currently used are halogenated gases. Efforts were carried out to replace anesthetic containing Cl and/or Br atoms with some novel ones – mainly hydrofluoroethers (HFE) – that do not contribute to the ozone layer. For example, desflurane (CHF₂OCHF₂) and sevoflurane ((CF₃)₂CHOCH₂F) are currently two of the most common volatile anesthetic agents, and have replaced others such as isoflurane (CF₃CHClOCHCF₂), halothane (CF₃CHClBr) or enflurane (CHF₂O-CF₂CHFCl) [4]. Nevertheless, as happened with the HFA propellants, they all have again relatively large GWPs – for instance desflurane and sevoflurane show GWP₁₀₀ values of 1620 and 210, respectively [13]. This suggests that both HFAs and HFEs are useful alternatives to combat the ozone layer depletion but still contribute to the global warming issue.

In conclusion, some inhaled drugs contribute to the global warming and ozone depletion. Nowadays, it is possible to predict by com-

predict a(t)-OL6 BDC 5.247 0 0(wa)9(r)13r i24717(t2454t)6(e)-47(t)6(o)-47(t)-6drf .C 5.247177(dr)-1-47(wa)9(oo)-d6(o)-9177(-47(wa)9(r)-647(t)A)2B (p)12onhe2up3comdesy opir mhe 11(u7(t)-6(e)-99(42p)7(let)-5(io43(m)-6(h)4rt)-kh)418(ys, (e)-(p3).(io43(S4714)-47(dr)-10(ug(N)25)3(s)I)0.28