EnviroWinBlog 02. Success of environmental action against the problem of the hole in the ozone layer.

Introduction

This EnviroWinBlog 02 is part of a set of three EnviroWinBlogs describing the success of large-scale environmental actions. EnviroWinBlog 01 describes the success against the problem of acid rain, whilst EnviroWinBlog 02 describes success against the problem of the hole in the ozone layer, and EnviroWinBlog 03 describes successful progress against the Crown-of-Thorns starfish. Promotion of the successes of these three environmental wins is detailed in EnviroWinBlog 04.

Citation references, Paragraph and Section references are those contained in the PhD Thesis "Values and science in contemporary education: The study and impact of student orientation". The Thesis document is available in the University of Newcastle repository, here: http://hdl.handle.net/1959.13/1501410 (and then by clicking on Attachment01).

3.1.2 Win No. 2. Success of environmental action against the problem of the hole in the ozone layer.

Ozone depletion and the hole in the ozone layer.

The ozone layer prevents biologically damaging solar ultraviolet (UV) radiation from reaching the Earth's surface. Ozone is a molecule comprised of three oxygen atoms and has the chemical formula O_3. Since the 1970's, serious concern regarding ozone depletion have been raised by scientists world-wide, such that depletion of the stratospheric ozone layer has been one of the most prominent environmental issues over the last forty years. Depletion occurs when human-made compounds such as chlorofluorocarbons (CFCs) release chlorine atoms, which can destroy ozone. CFCs were produced from the 1950s to early 1990s for use in refrigerators, aerosols and air conditioners. In 1985, researchers discovered a large and unexpected depletion of ozone over Antarctica in the southern spring. This phenomenon was labelled the "hole in the ozone layer" in the popular press (Chipperfield, 2017).

Action to reduce the hole in the ozone layer

The Montreal Protocol and its amendments and adjustments were very successful in reducing the atmospheric abundance of ozone-depleting substances (ODSs). Consequently, the forecast posited by Hegglin, Fahey, McFarland, Montzka, and Nash (2015) was that, assuming the nations of the world continue to comply with the provisions of the Montreal Protocol, the decrease of ODSs would continue throughout the 21st century. The status reports of Hegglin et al. (2015), Reiny (2018) and Strahan and Douglass (2018) were evidence that the hole in the ozone layer was indeed diminishing and was on track for resolution during this century. These developments are in support of Schrope (2000) who had confirmed that the international efforts to halt ozone depletion have been successful and had forecast that the polar ozone holes zones should permanently close by about 50 years hence.

1987 Montreal Protocol & 2016 Amendment.

The Montreal Protocol and its amendments and adjustments were very successful in reducing the atmospheric abundance of ODSs. As a result of the Montreal Protocol, the overall abundance of ODSs in the atmosphere has been decreasing since the mid-2000s (Hegglin et al., 2015). The Montreal Protocol consists of a multi-phased plan involving the use of hydrochlorofluorocarbons (HCFCs), which are not as damaging to the environment as are chlorofluorocarbons (CFCs), and are substituted for CFCs. HCFCs could be used in the same equipment as CFCs, since their chemical structure was very similar. Globally, only four companies produced CFCs, so transitioning away from CFCs to HCFCs was relatively easy to implement. However, HCFCs also contribute to ozone layer destruction, but at a lower rate than CFCs. Accordingly, in later phases of the Montreal Protocol, the use of HCFCs was also being gradually phased out to more eco-friendly refrigerants (Buis, 2019). The use of eco-friendly refrigerants such as hydrocarbons, hydrofluoro olefin, R744 which is refrigerant-grade carbon dioxide (CO_2), and environmentally safe nanorefrigerants, reduce ozone depletion potential and global warming potential (GWP) (Kasaeian et al., 2018). Consequently, production and consumption of all principal ODSs are planned to be almost completely phased out before the year 2050 (Hegglin et al., 2015).

Status of ozone depletion and of the hole in the ozone layer

The forecast posited by Hegglin et al. (2015) was that, assuming the nations of the world continue to comply with the provisions of the Montreal Protocol, the decrease of ozone-depleting substances (ODSs) would continue throughout the 21st century. However, only after mid-century would the level of ODSs fall to values that were present before the Antarctic ozone hole was first observed in the early 1980s (Hegglin et al., 2015).

Reiny (2018) reported that there was less chlorine now than 9 years ago, and that chlorine has decreased on average about 25 parts per trillion/year (0.8%/year). Additionally, chlorine was decreasing in the Antarctic stratosphere and the ozone destruction was decreasing proportionally. Reiny (2018) summarises that the Antarctic ozone hole was healing slowly because levels of the human-made chemicals causing the hole have long lifetimes.

Strahan and Douglass (2018) determined that all of the reactive chlorine variants are decreasing in the Antarctic stratosphere, with a measured decline in chlorofluorocarbons (CFCs) of 20% since 2005. Due to the long lifetimes of the CFCs, the Antarctic ozone hole was healing slowly, with the expectation of elimination in the period 2060 to 2080. These developments have aligned with the position endorsed by Schrope (2000), who had confirmed that the international efforts to halt ozone depletion have been successful and had forecast that the polar ozone holes zones should permanently close by about 50 years hence.

Summary of the hole in the ozone layer problem and conclusion

The status reports of Hegglin et al. (2015), Reiny (2018), Strahan and Douglass (2018) and (Schrope, 2000) are evidence that the hole in the ozone layer was indeed diminishing and was on track for resolution during this century. That is, the Montreal Protocol was working effectively.

Additional successes are described in EnviroWinBlog 01 regarding the problem of acid rain, and in EnviroWinBlog 03 regarding progress against the Crown-of-Thorns starfish. Promotion of the successes of these three environmental wins is detailed in EnviroWinBlog 04.

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