

CHEMICAL ECONOMICS

MONTREAL AND KYOTO - A PERSONAL VIEW OF TWO PROTOCOLS

The Montreal and Kyoto Protocols concern limiting and phase out of certain gases which impact the climate on a global basis. To be effective they require all countries to be involved.

Both the Montreal and the Kyoto Protocols have had and continue to have a profound impact on the chemical industry. The Montreal Protocol, agreed in 1987 places limits to ozone depleting gases (particularly chloro-fluoro compounds, is seen largely as successful and to be emulated in the control of other gases of concern. The Kyoto Protocol (agreed 1997) seeks to limit the emission of greenhouse gases (particularly carbon dioxide) has struggled to achieve its objectives. The poor outcome of the Kyoto Protocol is often compared with the relative success of the Montreal Protocol. But the two are quite different.

The origins of the Montreal Protocol lie in the discovery of the existence of holes in the protective ozone layer in the upper atmosphere. These holes are located above the polar regions. The invention of the electron capture detector for gas chromatographs, which could detect chlorine in extremely low concentrations suggested that ozone was being destroyed by chlorine atoms released from chloro-fluoro compounds (CFCs) in the upper atmosphere.

By the 1970s CFCs had largely displaced other refrigerant gases (propane, ammonia etc), especially for smaller devices such as domestic 'fridges and air conditioners, including vehicle air conditioners. There were other uses such as fire fighting extinguishers such as BCF. With some health and fire-fighting exceptions, the Montreal Protocol set out to stop the production and use of CFCs and control the collection and disposal of the remaining stock.

During the 1980s, there was rising concern that emissions of carbon dioxide, a known greenhouse gas (GHG), were having an adverse effect of global temperature by increasing the greenhouse effect. The Kyoto Protocol was an attempt to mitigate this effect by limiting emissions of GHG to the atmosphere.

Both the protocols seek to control the emission of gases seen as pollutants on a worldwide basis. The key differences are set out in Table 1. The first major difference is who the protocols affect. The Montreal Protocol probably affected only about ten producers who were all very large industrial conglomerates. Closure of CFC production did not have a major impact on the company revenues and each was in a position to research and develop substitutes. The producers agreed and the Montreal Protocol was easy to implement and did not lead to leakage by technology transfer.

By contrast GHG emissions effects virtually every manufacturing company and household. Recognising this the main curbs were aimed at developed economies with developing countries not required to limit GHG emission. This led to the mass transfer of GHG intensive industries from the developed economies (including Australia) to developing countries. This is widely known for China and India but in 1997 both Qatar and Singapore were in the developing country camp and

consequently benefitted. Now both have significantly higher GHG emissions per capita than Australia and significantly higher incomes per capita.

Table 1. Comparison of Montreal and Kyoto Protocols

	MONTREAL PROTOCOL 1987	KYOTO PROTOCOL 1997
Problem	Ozone depletion	Global warming
Limits to	CFCs	GHGs
Affecting	Major conglomerates	All industry and households
Number being affected	Probably less than 10	Millions
Countries affected	Major industrials (G8)	Primarily OECD countries
Outcomes	CFC production stopped	GHG emissions transferred to developing countries
Leakage	None	Widespread
Verification	Straight forward	Difficult if not impossible
Overall	Effective reduction of CFCs	Ineffective
Overall Outcome	Some closure of ozone holes; scheduled closure 2050-70	No observable effect
Sceptics and alternative theories	Largely ignore and relegated to areas of historical interest	Denounced as heretical

As well as transfer to other countries, The Kyoto Protocol encouraged green-washing by individual companies by which greenhouse intensive operations were sold or transferred to others hence improving the GHG credentials of an individual market brand relative to its peers. The Montreal Protocol demanded and obtained CFC plant closure.

Another issue is verification. Although there are a lot of different chemicals covered by the Montreal Protocol, verification is relatively straight forward because there are still relatively few producers with product being used in small specialist industries. For the Kyoto Protocol, although there are relatively fewer chemicals, the widespread emission of GHGs makes verification difficult. This is exacerbated by the opposition of some major country emitters to independent verification.

CFC substitutes or lesser ozone depleting materials were quickly developed and used without having to resort to dangerous materials such as propane or ammonia for domestic appliances. By contrast, because of widespread opposition to nuclear power, it is debatable if any of the GHG reducing substitutes actually result in lower GHG emissions. For instance photo-voltaic (PV) cells are produced using cheap coal fired power, particularly in China, and consequently many PV generators (such as domestic roof-top solar) results in more GHG emissions than they save. Furthermore, many of the GHG emission savings (such as the US power sector) have occurred from forces other than the Kyoto Protocol (in the US power case the availability of cheap gas displacing coal generators).

We should note that despite meeting its technical objectives the Montreal Protocol has been slower than expected in closing the ozone holes. This is being tackled by further elimination of ozone depleting chemicals including some of the earlier CFC substitutes.

At this time although there is little questioning of the background theory that ozone depletion was the consequence of CFCs, this was not always the case. There were several issues one of which was the fact that the largest ozone hole is in over the Antarctic whereas most CFC emission was in the northern hemisphere. One theory to explain this was that the hole has always been there and was

due to sodium chloride catalysing ozone depletion, the salt having been transported to the higher latitudes by the great southern vortex. Proponents of this theory were largely ignored and the CFC theory adapted to explain the phenomenon. Should the hole not close by 2070 (say) this possibility may be revisited.

Contrast this with the Kyoto Protocol. No alternative theory to global warming by GHGs is tolerated. Alternative theories and their proponents are denounced and it is even suggested they receive psychological treatment. This also affects the scientific elite. I have heard one luminary remark on one radio programme in the UK state that all scientific theories are subject to question and inquiry and a week later on another radio programme in Australia state that global warming by GHG was an indisputable fact.

The conclusion is that the Montreal Protocol was relatively easy to agree and implement and its continued success is assured at this time. By contrast, Kyoto is extremely complex and difficult to enforce. Its failure has led to a reappraisal (the Paris Accords) which are much weaker in their demand for action. Verifying emissions appears impossible with several countries opposing independent inspection. We have to look forward to continued major conferences (in exotic locations) aimed at trying to improve the situation but from this observers point of view these seem to be rather self-serving by GHG regulators rather than trying to find tangible solutions.

D. Seddon

August 2016