KEITH WOODFORD

SHORT AND LONG-LIVED GREENHOUSE GASES NEED DIFFERENT ACCOUNTING SYSTEMS

Keith Woodford explains why methane and carbon dioxide need separate accounting systems rather than being aggregated into a 'catch-all' single emissions trading scheme.

Methane accounting

A key issue for New Zealand is how to meet the 2015 Paris Agreement commitments for greenhouse gas (GHG) emissions. Fundamental to any analysis is the different attributes of long-lived and short-lived gases. In particular, how should methane be accounted for, and how should it be brought into any emissions trading scheme (ETS).

Back in 2016, the current Commissioner for the Environment Simon Upton raised the importance of placing short-lived gases in a different regulatory 'basket' from long-lived gases (see www.rmla.org.nz/2018/02/21/managing-biological-sources-and-sinks-in-the-context-of-new-zealands-response-to-climate-change-2/#_ftn13). Remarkably, our rural leaders appear to have failed to pick up on the importance of this issue.

More than any other country in the world, New Zealand's gross emissions are influenced by methane-producing ruminant animals. No other developed country has a comparable emissions profile, with the arguable exception of Uruguay. Accordingly, the issue of methane accounting, which is crucial to us, really does not matter to almost everyone else so no-one else will lead on this one. It is up to New Zealand to lead the debate.

Stocks and flows of various gases

At the heart of the issue is the concept of stocks and flows of the various gases. In the case of methane from all New Zealand sources, but predominantly ruminant agriculture, the flow of emissions into the atmosphere is now lower than 20 years ago, having peaked in 2006 at 35,915 kt of CO_2e, declining to 33,784 kt of CO_2e in 2016 (see www.mfe.govt.nz/climate-change/state-of-our-atmosphere-and-climate/new-zealands-greenhouse-gas-inventory).

For those who like bathtub analogies, in the New Zealand methane bathtub the tap and the plughole are roughly in balance. For the CO2 bathtub, the tap keeps flowing at a fast rate while there is still only a dribble coming out the bottom.

The other key metric for determining the net flows and pools of methane is that the atmospheric residence time of methane is 12.4 years (calculated as a logarithmic decay function). This is the average amount of time that a methane molecule remains in the atmosphere before being converted back to CO_2.

Bringing these metrics together, the current situation for methane from all New Zealand sources (but largely pastoral agriculture) is that the amount of methane entering the atmosphere is approximately equivalent to the amount that is leaving via conversion to CO_2 and then back into grass and related feeds via the carbon cycle. Given that inflows roughly match outflows, then atmospheric heat sources are being lost approximately as fast as they are being gained. The quantity of methane in the atmosphere is therefore staying much the same.

In contrast, CO_2 is largely a stock resource. Every time we produce more CO_2, mainly from burning fossil fuels, it stacks up in the atmosphere in amongst all the CO_2 that is already there. It takes some hundreds and even thousands of years for the extra CO_2 to be dissolved in the oceans or converted into inert forms, such as new coal or oil.

This means that if we keep burning fossil fuels at the current rate, then atmospheric levels of CO_2 will increase. Even if we reduce the burning of fossil fuels, the stock of CO_2 in the atmosphere will still increase. Also, even if we stopped all use of fossil fuels, then it would probably be many decades before we would see a meaningful decline of atmospheric CO_2.

And there lies the nub of the issue. Methane from ruminant nutrition is essentially a flow resource, which flows in and out of the atmosphere, while CO_2 is a stock resource that keeps on building up.

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These concepts of stocks and flows are embedded within modelling techniques called system dynamics. Developed originally in the 1960s by an American Jay Forrester, I used these techniques within my own PhD a long time ago. I used them in a biological context, although the principles are the same as is needed to model the stocks and flows of GHGs.

A mostly unrecognised issue

The recognition that short and long-lived GHGs need to be considered differently has escaped both policy-makers and the general public. Our current Commissioner for the Environment stands out for his recognition of the issue, but he has largely been a voice in isolation.

In contrast to the public and the policy-makers, the importance of choice of accounting metric is understood within at least parts of the scientific community. This is clearly laid out in Chapter 8 of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). However, these important issues do not get carried forward to the report summary for policy-makers, and almost no-one but a few career scientists would read the full document, which is some thousands of pages.

Counter arguments

There are two key counter arguments. The first argument is that the carbon equivalent system already takes into account the short-lived gas effect. The answer is that it does indeed do so in terms of comparing the gross emissions over a 100-year period, and this includes an allowance for the fact that these same methane molecules are also departing from the atmosphere over that time. But it does not take account of the net emissions (inflows versus outflows) and hence the stock of methane that is occurring at any point in time. In other words, it does not measure the amount of water in the bathtub, yet it is the amount in the bathtub that determines the heating effect at any point in time.

To reinforce that point, what the current measurement system does not do is allow for the fact that methane does its damage quickly and then goes away. In contrast, whatever damage CO_2 does is long, drawn out and irreversible.

There is also a remarkable assumption buried within the current measuring system that we are only interested in global warming potential (GWP) for the next 100 years, which is called the GWP100. This means that we effectively capture all of the methane effects, but miss most of the CO_2 effects, because these relate to beyond 100 years.

If we were to measure the relative effects of methane and CO_2 over a 500-year time period, then we would be saying that whereas each methane molecule equates to about 28 molecules of CO_2 within the GWP100 (the current best estimate), then that number is reduced to around eight CO_2 molecules using a GWP500. I first wrote about those issues back in 2006 (*Primary Industry Management* 9(1): 7-8). There are, of course, considerable uncertainties relating to all of these numbers and all GWP estimates are likely to change again in the future.

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The second argument is likely to be around the issue that there has been a 2.5-fold increase in global concentrations of methane in the atmosphere since the pre-industrial era. Clearly, it would seem, something needs to be done.

However, what also needs to be recognised is that on this global scale, unlike in New Zealand, most of the methane has nothing to do with ruminants. Reducing methane leakage from oil and gas fields would be a good place to start. Another reduction focus could be from landfills and associated wastes, plus wastewater, which jointly contribute about 20% of the world total. Rice paddies are also a major source, but there is no current or likely solution to that issue.

A fundamental issue with most of these other sources is that, unlike New Zealand ruminant agriculture, the gross emissions tap has continued to run faster. If this tap were turned down, then global warming from methane would also soon decline.

Rural leaders and rural professionals GHG aware

Within the current context of the Paris Agreement, agriculture emissions are indeed important and that includes methane. Also, agriculture produces another gas called nitrous oxide and this is a long-lived gas. So, in a world that is worried by climate change, regardless as to one's perspective about the science of global warming, agricultural industries, along with others, do have to step up to the table. Or as one rural leader recently put it, if you don't come to the table then you will undoubtedly be on the menu.

In stepping forward to the table, rural leaders must come to grips with the underlying GHG science and associated GHG issues. There is also a role in all of this for rural professionals. A key starting point is to accept that methane does indeed have warming potential for the period it is in the atmosphere. From there, the key issue is that the most insightful metric is the stock of any gas and how that changes over time. It is all about stocks and flows.

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