

How will carbon footprinting address the issues of reduction, mitigation, emissions trading and marketing

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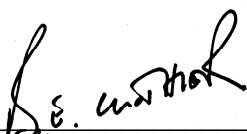
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HAL DISCUSSION PAPER 2

How will carbon footprinting address the issues of reduction, mitigation, emissions trading and marketing?

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A report for HAL, Project VG08107
“Vegetable Industry Carbon Footprinting Scoping Study-
Discussion Papers and Workshop”

EXECUTIVE SUMMARY

- In this discussion paper we consider how carbon footprinting will address the issues of reduction, mitigation, emissions trading and marketing for the Australia vegetable industry.
- Greenhouse gas (GHG) footprints can be calculated for nations, and for sectors of a nation's economy. The contribution of horticulture to the GHG footprint of agriculture is small, primarily because of its smaller area of land use. However, on a per hectare basis, horticulture in general, and vegetable production in particular, have a higher impact than other agricultural sectors, primarily through more intensive practices and especially higher fertiliser use. Yet, given the greater sophistication of vegetable production practices, there are good opportunities to reduce GHG emissions. Vegetable growers should recognise that the density of their GHG footprint is larger than most agricultural sectors, but they have greater opportunities to reduce it.
- GHG emissions from agriculture, in general, and commercial vegetable production, in particular, are part of Australia's commitment to the Kyoto Protocol. Thus the vegetable industry, as part of this national commitment, even though it is a small contributor, still needs to understand its carbon footprint.
- The Australian Government intends introducing a cap and trade GHG emissions trading scheme (ETS), the Carbon Pollution Reductions Scheme (CPRS) in 2010. Although agriculture may not be included in the first phase of implementation, given its role in the Australian GHG emissions profile, as well as LULUCF (Land Use Land Use Change and Forestry) emissions in the second commitment period of Kyoto, it is likely that the GHG footprint of the vegetable industry will come under closer governmental scrutiny in the future.
- Various forms of life cycle assessment (LCA) are available to size the GHG footprint of both businesses and products. This is a rapidly developing, and presently confusing and competitive field of both science and business.
- Internationally there are four large initiatives underway to develop LCA-based protocols for the GHG footprinting of products. The first of these, the Publicly Available Specification (PAS) 2050 of the BSI (British Standards Institute), will be released in October, and large British retail chains are expected to adopt it for product labelling. The other three protocols are being developed by the World Resources Institute (WRI), the International Organisation for Standardisation (ISO), and the Japanese trade ministry. It is unclear if, or how, these product-based footprinting protocols will be harmonised, compete, conflict or cooperate. Further, it is unclear as to how the various retail chains will use these protocols through purchase decisions or labelling. What is more certain is that GHG footprinting will be required, in some way, by retailers, especially for GHG-intensive products like food.
- There can be both business and shelf-access advantage in having a certified GHG footprint, and there will be increasing demands for such labelling. Footprint labelling will require new ways of collecting information.

- Should the Australian vegetable industry wish to retain market share domestically for its products, and should it wish to raise its export-product levels then it needs to prepare for some form of GHG labelling.
- Carbon footprinting is, and increasingly will be a key part of marketing, shelf access, and risk management, both for products and businesses. It is unclear how purchasers of food will weigh-up and trade-off perceptions between price, health benefit, convenience, and the GHG footprint. However, it would seem prudent for the vegetable industry to consider the marketing advantages conferred by GHG footprinting protocols, even if just to dispel erroneous perceptions such as ‘food miles’.
- There already exist voluntary markets for trading carbon. In the future, the Australian ETS of the CPRS will require that emitters of carbon have a pollution permit. Trading of these permits will provide the incentive for emitters to reduce the size of their GHG footprint. Agriculture is slated to enter the CPRS in 2015.
- In developing, adapting, or using GHG footprinting protocols, especial attention will need to be given to induced-changes in soil carbon. Soil carbon losses, exacerbated by tillage, have the potential to be one of the largest sources of emissions from the vegetable industry. They are not included in the current CPRS, but in the future they may need to be considered.
- For any ETS, including the CPRS, it will be crucial to discriminate between natural changes in the level of soil carbon, and those induced through land management practices. For the vegetable industry, through the adoption of improved growing practices, and possibly through the use of biochar, there will be opportunities to build up levels of soil carbon. Soil carbon sequestration is not claimable as a carbon credit under current protocols, partly because if it were there would be a concomitant liability as a result of inadvertent losses through fire or drought.
- There are a range of footprinting protocols in operation, in development, or being proposed. The vegetable industry should proactively investigate, in conjunction with other agricultural sectors, what form, or forms of footprinting protocols will best suit their needs, and meet the appropriate compliance requirements.
- The vegetable industry should develop a plan to ensure that it, and its growers and their subcontractors, can collect and record the necessary information that will be necessary to meet the requirements for reporting its GHG footprint.

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ACRONYMS

AVIDG – Australian Vegetable Industry Development Group
BSI – British Standards Institute
CCX – Chicago Climate Exchange
CDM - Clean Development Mechanism
CPRS – Carbon Pollution Reduction Scheme
Defra- Department of Environment, Food and Rural Affairs, UK
EBEX21® Emission Biodiversity Exchange 21st century
ETS – emissions trading scheme
EU ETS – European Union Emissions Trading Scheme
FDI – foreign direct investment
GHG – greenhouse gas
GWP – global warming potential
HAL – Horticulture Australia Ltd
JI – Joint Implementation
IPCC – Intergovernmental Panel on Climate Change
ISO – International Organisation for Standardisation
LCA – life cycle assessment
LULUCF – The Land Use, Land-Use Change and Forestry sector
NGA –National Greenhouse Accounts
NGER – Nation Greenhouse and Energy Reporting
NGO – non governmental organisation
MAF – Ministry of Agriculture and Forestry, New Zealand
MfE - Ministry for the Environment, New Zealand
OECD – Organisation for Economic Cooperation and Development
OTC – over the counter
PAS – Publicly Available Specification
PERF – Product-related GHG Emissions Reduction Framework
SETAC – Society of Environmental Toxicology And Chemistry
TNC - trans-national corporations
UNFCCC – United Nations Framework Convention on Climate Change
WBSCD – World Business Council for Sustainable Development
WRI – World Resources Institute

INTRODUCTION

THE AUSTRALIAN VEGETABLE INDUSTRY

The Australian Vegetable Industry Development Group (AVIDG) was established to set directions for the Australian vegetable industry through its strategic plan of *Vegvision 2020*. Five key strategies have been developed to improve the industry's capacity to compete with China in both domestic and third-party markets, as well as to develop export opportunities for Australian vegetables, and vegetable products into China (AVIDG 2008).

There are some 115,000 hectares in vegetable production in Australia and the gross value of production is \$2.4 b. The top four vegetable products by tonnage are potatoes, tomatoes, carrots and onions. The revenue from vegetable exports is just \$250 m, with the big three products being by volume carrots, onions and potatoes (AVIDG, 2008). Since its peak in 2003, Australian export volumes have declined by 50% to 193,000 tonnes in 2007, in response to competition from China and currency fluctuations (HAL 2008).

A report commissioned by Horticulture Australia Ltd (HAL) concluded that there is a need to address competitiveness issues in the industry through:

- Understanding and awareness on global developments
- Consumer trends
- Strategic planning
- Discussion with Government on policy.

The spectre of climate change is an issue that encompasses all of these points: global developments, consumer awareness, strategies and Government policy.

CLIMATE CHANGE

Climate change is acknowledged as one of the greatest challenges facing nations (IPCC 2007). There is wide recognition that greenhouse gas (GHG) emissions into the atmosphere caused by human actions are having deleterious impacts on the environment. The release of CO₂ and other greenhouse gases through human activities, including the burning of fossil fuels, emissions from industrial processes, plus land-use activities and land-use change will have an effect on future climate change.

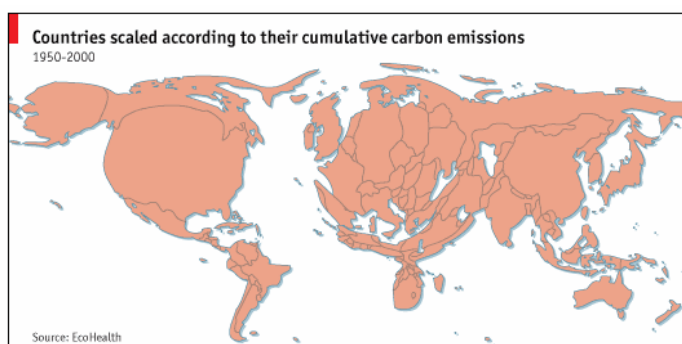


Figure 1. A map of the world with the area of each country scaled to its carbon emissions over the 50 years prior to 2000 (The Economist, 11 September, 2008)

Over a decade ago, most nations joined the international treaty of the United Nations Framework Convention on Climate Change (UNFCCC) to address the issues of global warming. Subsequently in 1998, a number of nations entered into the Kyoto Protocol. The Protocol is an international agreement linked to the UNFCCC and in which binding target emissions were set for 37 industrialised countries. Whereas the Convention merely encourages stabilisation of GHG emissions, the Protocol commits them to do so, with serious financial penalties for failure to comply. Articles 3.3 and 3.4 of the Kyoto Protocol state that “... *the net changes in greenhouse gas emissions ... from agricultural soils, human induced land-use change and forestry activities shall be used to meet the commitments*”. The emissions from activities in this land use, land-use change and forestry sector (LULUCF) were not considered compulsory in the first commitment period. However, Article 3.4 notes that “... *such a decision shall apply in the second (post 2013) and subsequent commitment periods*”. Under Kyoto, Australia is charged with reducing its 2008–2012 emissions to 108% of 1990 levels.

The National Greenhouse Accounts (Department of Climate Change 2008a) cover the LULUCF sector and includes emissions from grazing, cropping, horticulture and agricultural burning as well as from land-use change and forestry. The 2007 projection by the Australian Department of Climate Change reported that agricultural emissions in 2005 represented over 15% of Australia’s total greenhouse gas emissions (Department of Climate Change 2007). This was 89.8 Mt CO₂-e, which is 2.5% higher than the 1990 emissions. The Australian Department of Climate Change considers that taking into account existing measures, emissions from agriculture are projected to be 92.8 Mt CO₂-e, or 6% higher than 1990 levels. Peter Deuter (pers. comm. 2008) estimated that all horticultural activities across Australia emit about 1 Mt CO₂-e, or only about 1% of the total emissions from agriculture, which agrees with that in the National Greenhouse Accounts of the Department of Climate Change (Department of Climate Change 2007, Table 2).

New Zealand, by way of contrast, has a unique emissions profile with 49% (37.4 Mt CO₂-e) of emissions produced by the agricultural sector (MfE 2007), with over 34% of this coming from agricultural soils (12.7 Mt CO₂-e), which is 27% higher than 1990 levels. New Zealand has a Kyoto target of 2008–2012 emissions being 100% of 1990 levels.

GHG emissions from agriculture, in general, and commercial vegetable production, in particular, are part of Australia’s commitment to the Kyoto Protocol. Thus the vegetable industry, even though it is a small contributor, still needs to understand its carbon footprint as part of the national commitment.

Under the UNFCCC, countries must meet their emissions targets primarily through national measures. However, the Kyoto Protocol provides for three market-based mechanisms to provide those countries that have ratified the Protocol with additional means for meeting targets. These are: emissions trading, also known as ‘the carbon market’, the clean development mechanism (CDM), and joint implementation (JI). Here we only consider emissions trading and discuss the implications for the vegetable industry. The CDM and JI are probably irrelevant to the Australian vegetable industry.

The global climate seems to be changing faster than even recent models have predicted, so pressure to reduce GHG emissions may become more intense (see <http://www.abc.net.au/news/stories/2007/11/15/2091879.htm?section=australia>).

EMISSIONS TRADING

Penny Wong, the Australian Government Minister for climate change has stated that Australia's emissions trading scheme (ETS), the Carbon Pollution Reduction Scheme (CPRS), will seek to reduce emissions by 60% of 2000 levels by 2050, and that this 'cap-&-trade' ETS will be introduced in 2010.

Meanwhile, the European Union emissions trading scheme (EU ETS) became effective and compulsory for the 25 EU members, on 1 January 2005, creating the world's largest market for GHG emissions credits. This mandatory cap-&-trade scheme allocates emissions allowances based on historic performance and other parameters. Participants reducing their emissions below their cap can sell the resulting excess allowances. On the other hand, those companies which find reducing emissions internally to be prohibitively expensive, or those needing to increase production, can buy allowances on the open market.

The EU ETS was established primarily to help EU member states meet their Kyoto protocol targets. The current price of carbon is about €20–25 per t CO₂. Although the EU ETS does not currently include sinks, these are being considered elsewhere, such as in ecosystem services markets. For example, Carbon Farmers of Australia is a company trading Australian Farm Credits that can be sold in the fast-growing voluntary markets. These markets are developing for consumers and corporations who wish to purchase carbon credits to promote their brands.

Recently in Australia, the Garnaut Climate Change Review (2008) provided a perspective on the impacts of climate change and the contribution that Australia can make to mitigation of climate change. The Garnaut Review notes that despite being the second biggest emitter of GHG in Australia, behind stationary energy, for agriculture it may "*be difficult to include agriculture and forestry as full participants in a cap and trade ETS in the first phase of implementation*" (Growcom 2008b). Growcom, the peak representative organisation for the fruit and vegetable industry in Queensland, has suggested that they should develop a policy on CPRS and raise awareness of the impending scheme. In particular, they suggested supporting studies that calculate total on-farm horticultural emissions, and in particular support research into nitrous oxide emissions from fertiliser application. Nitrous oxide, with its global warming potential (GWP) of nearly 300, is a potent GHG. GWP defines the impact of a gas, weight for weight, to induce greenhouse warming of the atmosphere (Australian Greenhouse Office, 2003). Given the high level of nitrogenous fertiliser use in vegetable production, this would be of especial interest. The (then) Australian Greenhouse Office outlined 12 land-management practices that will help reduce the contribution of nitrous oxide in GHG emissions, especially since 80% of the N₂O in the national inventory is produced by the agricultural sector (Australian Greenhouse Office, 2006).

The Australian Government intends introducing a cap-&-trade GHG ETS, the CPRS, in 2010, and although agriculture may not be included in the first phase of implementation, given its role in the Australian GHG emissions profile, as well as LULUCF emissions in the second commitment period of Kyoto, it is likely that the GHG footprint of the vegetable industry will come under closer governmental scrutiny in the future.

FOOTPRINT PROTOCOLS

Wiedemann and Minx (2007) defined the carbon footprint as being “... *a measure of the exclusive global amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product*”

The life cycle concept of the carbon footprint means that it is all-encompassing and includes all possible causes that can give rise to carbon emissions. In other words, all direct emissions, on-site and internal, are accounted for, as are indirect emissions which include off-site, external, embodied, upstream, downstream emissions. Normally, a carbon footprint is expressed as a mass of CO₂ equivalent, and this accounts for the different global warming effects of different greenhouse gases. A carbon footprint is a subset of the ecological footprint, which includes all human demands on the biosphere.

In response to pressures from governmental policies, public demands, and consumer trends, protocols have been developed to size the GHG footprints of industry sectors, enterprises and products. Even others are currently under development. There are three types of protocols, with variations and add-ons that can be used to size GHG footprints.

At the national level, the Australian Government reports on its GHG footprint through its National Greenhouse Accounts, and the Department of Climate Change publishes the factors it uses to calculate this national footprint (Department of Climate Change 2008b). We will not consider further the NGA, but rather we will focus on the vegetable industry and its products.

For enterprises and products, some form of life cycle assessment (LCA) can be used to determine the GHG emissions from a company in relation to its operations, or for a product from its ‘cradle-to-grave’. The LCA approach encompasses all three of the emission scopes of the National Greenhouse and Energy Reporting (NGER) guidelines (Department of Climate Change 2008b). This covers emissions as a direct result of activities (scope 1), the release of GHGs as results of electricity, heating and cooling used in the activities (scope 2), as well as emissions due to distribution, use consumption and waste (scope 3). So whereas reporting of only scopes 1 and 2 is required under the NGER guidelines, GHG footprints based on LCA encompass all three scopes. In a recent study on a particular New Zealand horticultural product consumed in Europe, we have recently estimated that the GHG footprint can be apportioned into: orchard establishment (10%), orchard operations (15%), packhouse and coolstore (11%), shipping (37%), repackaging (3%), retailer (5%) and consumer (19%).

LCA determination of the GHG footprint is an emerging field of science and of business. Companies and consumers are calling for ways to measure the GHG footprint. Not surprisingly, several approaches for carbon footprinting are either in place and available, or under development. The LCA Steering Committee of the Society of Environmental Toxicology and Chemistry Europe (SETAC Europe LCA SC 2008) expressed concerns that “... *over simplified methods [for carbon footprinting] may misguide stakeholders on the environmental implications of products and services*”, which raises the spectre of the so-called ‘greenwash’. Greenwashing is used to refer to a wide range of corporate activities, including, but not limited to, certain instances of environmental reporting, event sponsorship, the distribution of educational materials, and the creation of ‘front groups’. However, regardless of the strategy employed, the main objective of greenwashing is to give consumers and policy makers the impression that the company is taking the necessary steps to manage its ecological footprint (<http://www.businessethics.ca/greenwashing/>).

As we will detail later, there are already many and different tools available to size the carbon footprint of products and this is a rapidly developing field of science and business. These tools are designed and used for different purposes.

For example, an enterprise or supply chain can use the LCA footprinting exercise to increase the efficiency of its resource use by reducing its footprint. It could also, if it wished, mitigate the size of its footprint by purchasing offsets so that it might advertise itself as being ‘carbon’ or ‘climate’ neutral. Here we use the word ‘reduce’ simply to mean a change in practice that reduces the size of the GHG footprint, such as a lower use of fertiliser. In contrast, we use the word ‘mitigate’ to mean that there has been an external process used to offset the size of the GHG footprint, such as the purchase of carbon credits outside of the business. The assignment of the appellation ‘carbon neutral’ may be used to provide a marketing edge, such as by New Zealand’s Grove Mill winery (<http://www.grovemill.co.nz/page/home>).

A carbon footprint can also be assigned to a product, such as potatoes, beginning with the tillage of the soil, through processing, distribution, consumption and wastage. For a product, a retail chain might demand some eco-verified footprint size so that it can respond to, or motivate its customers to make better purchase decisions by choosing a product with a smaller footprint, say the comparison of air-freighted product compared with rail or shipping. The product footprint can also be used to inform consumers of better means of using the product (Carbon Trust, 2007). In relation to the use of potatoes, boiling has a footprint of 80 g CO₂-e per 250 g serving, whereas baking has 250 g CO₂-e (Tesco 2008).

There are increasing demands from the large retail chains to ensure that GHG-intensive products have some certified form of GHG footprint labelling before they are provided with ‘shelf access’.

An issue that rapidly arises when an LCA analysis for GHG footprinting is embarked upon is the need for primary data. Often, these numbers are either not immediately available, or difficult to obtain using present accounting and business recording systems.

Various forms of life cycle assessment (LCA) protocols and tools have become available to size the GHG footprint of both businesses and products. This is a rapidly developing, and presently confusing and competitive field of both science and business.

There can be both business and shelf-access advantage to have a certified GHG footprint, and there will be increasing demands for such labelling. Footprint labelling will require new ways of collecting information. Should the Australian vegetable industry wish to retain market share domestically for its products, and should it wish to raise its export-product levels then it needs to prepare for some form of GHG labelling.

SCALE AND TYPE OF FOOTPRINT

The GHG footprint is one specific example of an environmental footprint; others might include the ecological footprint, the toxicity and quantity of pesticides used, the eutrophication, salinisation and acidification potential, virtual water and the water footprint, or labour intensity.

Milà i Canals et al. (2008) used LCA to determine for broccoli, salad crops and green beans:

- Which is best – local production of vegetables in the UK, or those imported from overseas?
- What are the comparative environmental impacts of the different supply options?

They used nine impacts, or ‘footprints’ in their LCA analysis of imported and local products. These were abiotic resource depletion, global warming potential, acidification potential, eutrophication potential, smog, soil quality, primary energy use, land use, and water use.

Footprints can be calculated at a national level, as is done for example for the GHG footprint through the National Greenhouse Accounts by the Department of Climate Change. Other footprints are recorded through the OECD country reports on the environmental performance of agriculture which not only cover GHG emissions, but also the area of agricultural land use, nutrients, pesticides, energy, soil health, water quantity and quality, biodiversity and farm management (OECD 2008). The OECD concludes that, in general, agriculture’s footprint in Australia is significant and that since 1990 GHG emissions from Australian agriculture have risen by 6%, whereas there has been a -3% change in the OECD average. The growth was mainly due to fertilisers and manure, burning, and the clearance of land. Given the smallness of the horticultural and vegetable industry, these national footprints are presented here mainly as a background to the scale and type of environmental footprinting that is being carried out at a national level. Smith et al. (2008) have reported on greenhouse reduction possibilities in global agriculture, and they have outlined that many agricultural practices can indeed serve to mitigate GHG emissions. These include improved cropland management and restoration of cultivated organic soils.

Footprinting can also be carried out for sectors within agriculture, and even for commodities within a sector. The University of Warwick (2007) recently published a report on the environmental footprint of horticulture in relation to other agricultural sectors, and the difference between sectors with horticulture. For the UK, 44% of the total environmental burden of agriculture comes from dairying, whereas just 1% is attributed to horticulture, because of its smaller land area. By commodity, however, on a per hectare basis, the greatest footprint was for protected lettuce (59.1 – scaled average of 6 indicators), with potatoes at 27.1, onions 20.3, and carrots 19.3. In comparison, milk was 34.6, lamb 18.4 and winter wheat 11.3. So on a per unit area basis, the footprint of vegetable production is quite high. However, the Australian Greenhouse Gas Office produced an issues paper in 2002 (Australian Greenhouse Office 2002) on GHG and noted that because horticultural management systems are sophisticated and well-controlled, they provide strong opportunities to manipulate and reduce emissions. Better emissions information was thought to be needed for annual and perennial horticulture, as was the need to determine which management options offer the greatest environmental benefits.

Life cycle assessment can be used by enterprises and supply chains to determine their environmental impact and GHG footprint, and there are various protocols and tools, many commercial, to do this. For example, carbonZero is a New Zealand company which offer a tool that can fulfil any, or all, of three tasks:

- Measure GHG emissions through a calculation tool
- Manage and reduce GHG emissions by identifying management and reduction options
- Mitigate (offset) by facilitating the purchase of carbon credits.

Five types of certification can be provided: for the entire business, partial business, product, service, and event (www.carbonzero.co.nz)

GHG footprinting tools are even becoming popularly available. As Time magazine recently (1 September 2008) noted, thanks to websites like Carbonrally.com, new web tools are enabling people to measure and shrink their impact on global warming, and even to compete with others to reduce their footprint. They wryly note that such tools can turn “... *passive victims into climate warriors*”.

GHG footprints can be calculated for nations, and for sectors of a nation's economy. The contribution of horticulture to the GHG footprint of agriculture is small, primarily because of its smaller area of land use. However, on a per hectare basis, horticulture in general, and vegetable production, in particular, has a higher impact than other agricultural sectors, primarily through more intensive practices and higher fertiliser use. However, given the greater sophistication of vegetable production practices there are strong opportunities to reduce GHG emissions. Vegetable growers should recognise that the density of their GHG footprint is larger than most agricultural sectors, yet that they have greater opportunities to reduce it.

From an industry perspective, probably the footprinting that is of the greatest importance is that which can be associated with a product. Through using the rigour of LCA to calculate a GHG footprint, it has been possible to confirm that working simply with ‘food miles’ as an environmental indicator can be potentially misleading. Indeed, imported produce might even have lower environmental impacts than domestic produce (Milà i Canals et al. 2008) and that carbon efficiencies elsewhere in the food chain may more than offset the emissions associated with transportation (Brenton et al. 2008).

Consumer demand for the more greenhouse-gas-intensive fruits and vegetables is growing (Garnett 2006). Meanwhile, consumers, who control 60% of their own emissions through their own actions, are considered to be keen to play their part in reducing GHG emissions. Retail chains have identified that a lack of information is a key barrier to enabling their clients to consume in a sustainable way. Sir Terry Leahy CEO of Tesco said in January 2007 that “... *we will begin the search for a universally accepted and commonly understood measure of the carbon footprint of every product we sell*”. The Carbon Trust in the UK said that “... *in order to produce a reliable footprint, it is important to follow a structured process and to classify all the possible sources of emission thoroughly*”. They noted that the two main reasons to calculate a carbon footprint for a product are:

- To manage the footprint and reduce emissions over time
- To report the footprint accurately to a third party.

The Carbon Trust have joined with the British Standard Institute (BSI) and Defra (Department of Environment Food and Rural Affairs) to produce the PAS 2050 (Publicly Available Specification v3.1) an LCA “Specification for the assessment of the life cycle greenhouse gas emissions of goods and services”.

Associated with this PAS 2050 are the Carbon Trusts documentation of the PERF (Product-related GHG Emissions Reduction Framework – currently v2.0) and the Code of Good Practice for claims relative to product-related life cycle greenhouse gas (GHG) emissions (current v1-0). The PERF encourages a reduction target of 2% per year. The final version of the PAS 2050 is slated for release by the BSI in October 2008.

Meanwhile, there are two other global GHG footprinting initiatives: one being developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), and the other being developed by the International Organisation for Standardisation based on the ISO14064. The WRI protocol is slated for release in 2010, and the ISO standard in 2011. It is unclear how the three protocols will interact, and whether they will be compatible or competitive. The PAS group are joining the working party of the WRI initiative.

At an interview presented by video to a recent GHG labelling meeting sponsored by New Zealand’s MAF (Ministry of Agriculture & Forestry), David North, Community & Government Director, Tesco, said that “ *...in the UK, Tesco will label their products with a GHG footprint using the PAS. Further, we have invested £25M in a Sustainable Consumption Institute at Manchester University to research sustainability issues for the retail sector, and to encourage customers to adopt a more sustainable lifestyle. By labelling we hope to motivate consumers to think differently, and through labelling to make choices. The labelling is not intended to enable a price premium. Rather it is about sustainability choices and affordable choices. It is about choosing between products, and between methods, say, microwaving and baking*”.

The US retail chain Wal-Mart has stated that they will develop a GHG scorecard, probably the WRI footprint tools, for products, which they hope will drive efficiency gains and cost competitiveness. Their GHG scorecard will attest that:

- Products are sustainable
- Operations are efficient
- Enterprises are economically viable.

Wal-Mart will not label products, but will use their scorecard in their supplier purchases and it will be communicated through to their buyers. At an interview presented by video to the same MAF meeting in New Zealand, Jim Stanway, Senior Director, Global Supplier Initiatives, Wal-Mart, said that “*Wal-Mart will focus on the top 20% of high GHG impact products, and this generally means food products. Cheaper products consume less resource, so a lower GHG footprint means lower costs.*” Like Tesco, Wal-Mart are not interested in offsetting to mitigate the GHG footprint for carbon-neutral enterprises, for this just means more cost in the production system. The GHG scorecard can be used to benchmark growers and enterprises. They will not label products with the GHG footprint – “*People don’t read labels*” Mr Stanway said.

In a very recent Guardian Weekly (29 August 2008) it was reported that Japan is also to launch carbon footprinting labelling. It was reported that “... *the labels will appear on food, drink, detergents and electrical appliances from next spring, providing a detailed breakdown of each product’s carbon footprint under a government approved calculation and labelling system. [It is] an ambitious scheme to persuade companies and consumers to reduce their greenhouse gas emissions.*”

Thus at an international level, governments, retail chains and non-governmental organisations (NGO) are developing a range of GHG footprinting tools and protocols. There is the prospect of confusion, competition and conflict between these various protocols. The only certainty is that GHG footprint labelling will occur, and that it will occur increasingly around the world, given the retail reach of the retailing giants like Tesco and Wal-Mart. Thus, it is likely that China will also enter some form of GHG footprinting, whether it will be through the retail giants, or through the adoption or modification of international protocols. If the Australian vegetable industry adopts the *Vegvision 2020* strategy of exporting more to China, it should prepare for GHG footprinting there if large retail chains are to be the points of sale.

The wine industry has anticipated this ‘shelf-access’ and marketing imperative through its own development: a “Greenhouse Gas Accounting Protocol for the International Wine Industry”. Provisor Pty Ltd and Yalumba Wines have developed a Wine Industry Greenhouse Gas Calculator (<http://www.provisor.com.au/index.php?id=30>)

A wide range of GHG footprinting tools and types of GHG footprinting protocols have been developed. These have been developed for industry sectors, enterprises and supply chains, as well as products. Some footprinting protocols are freely available over the web, and others are operated through businesses whose commercial activity is to size, mitigate and accredit a businesses GHG footprint. Internationally, there are four large initiatives underway to develop LCA-based protocols for the GHG footprint of products. The first of these, the PAS 2050 of the BSI, will be released in October, and large British retail chains are expected to adopt it for product labelling. The other three protocols are being developed by the WRI, ISO, and the Japanese trade ministry.

It is unclear how these product-based footprinting protocols will be harmonised, compete, conflict or cooperate. Further, it is unclear as to how the various retail chains will use these protocols, either through purchase decisions or labelling.

What is more certain is that GHG footprinting will be required, in some way, by retailers, especially for GHG-intensive products like food, and especially vegetables – both domestically and, more so, in export markets.

At the MAF meeting in New Zealand, there was also a video interview with Colin McLeod, Department of Environment, Food and Rural Affairs (Defra), UK. Colin is leading the development of the PAS 2050. When asked what next, Colin said “... *the next footprinting exercise will involve water footprinting. This will involve the size and impact of ‘virtual’ water on inter-country trading of products, and the amounts of ‘blue water’ and ‘green water’ used in the life cycle of the product.*” On 19 May 2008, The Economist published an article entitled “Green pedicure: Footprints in carbon, nitrogen and water”. The article concluded that “... *these metrics bring to light the broad but subtle implications inherent to various activities. Paying for them is another matter.*”

GHG footprinting is in vogue, with there being a wide range of stakeholders and end-users: from the public, popularly through the web and by labelling; through industries and sectors for marketing and shelf-access purposes; to protocols for international treaties. In the future, footprinting protocols will increasingly be used to size the environmental impact of activities that use water and fertilisers. Vegetable growers as consumers of these resources should maintain a watching brief on developments.

REDUCTION VERSUS MITIGATION

The size of the GHG footprint can be reduced in one of two ways: reduction or mitigation. Reduction is simply about doing things in a different and less GHG-intensive way. Mitigation we take to mean continuing with ‘business-as-usual’, but taking an external action to offset the GHG footprint through some form of carbon ‘capture’.

The size of the GHG footprint can obviously be reduced by the adoption of new, less GHG-intensive practices. This could include less use of fertiliser, thereby reducing nitrous oxide emissions, more efficient post-harvest facilities and the use of low GWP (global warming potential) refrigerants, as well as less packing materials, and more efficient means of transport and distribution. Through LCA, these reductions will reveal a smaller GHG footprint. For the product-based footprint from the PAS, the latest version of reduction framework of the PERF notes that reduction “... *declarations shall be of the general form ‘We’ve reduced the GHG emissions of X product by Y% or Y g/kg over the past Z years’*” (section 3.2.3). The objective of the PERF is to support continual reduction of the product GHG emissions. The latest version of the PERF notes “... *declarations shall be made of the general form ‘We are committed to reducing the life cycle GHG emissions of product X within two years. No quantified declarations of future reduction commitments shall be made’*” (Section 2.2). The PERF also provides an alternative option (A1) in which users must meet a minimum annual reduction requirement of an average of 2%. Reduction is thus about adopting new, more efficient and less GHG-intensive practices for producing, distributing and consuming products, such as vegetables.

In a recent report to MAF, we have estimated that for the consumption in Europe of a product from a horticultural sector in New Zealand, it would be possible in the short-term to reduce the LCA GHG footprint by up to 15%. It should be possible in the medium-term to reduce that by another 15%.

AUSTRALIAN ACTIONS

At a national level under the Kyoto Protocol, Australia will need to reduce its GHG footprint to 108% of 1990 emission levels during the first commitment period of 2008–2012. These reductions must be achieved primarily through domestic actions. Australia is on track to meet its 2012 target, which means it should avoid a 30% penalty in the post-2012 commitment period. To supplement domestic actions for reduction, the Kyoto Protocol established three flexibility mechanisms, one of which is the use of ETS.

The CPRS, Australia’s ETS, clearly states that it has created limited scope for mitigation activities to create offset credits. In part, this limited scope reflects that offset schemes are

complex and require judgement against a baseline to determine the level of credit. More importantly, offsets do not reduce national emissions. Thus the Australian Government is not currently proposing to establish an offset scheme in the CPRS for the agriculture sector prior to its inclusion in CPRS.

Carbon sequestration through growing vegetation, increasing soil carbon levels, and possibly through incorporation of biochar into soil are being used, and proposed as offsetting mechanisms to mitigate GHG emissions. Biochar is a stable charcoal, or biomass derived black carbon, resulting from anaerobic pyrolysis of biomass. A biofuel is a co-product. (<http://www.biochar-international.org/>)

Credits for these offsets are already being traded on voluntary markets. Some GHG footprinting protocols allow them, others do not. The PAS 2050 allows carbon sequestration to be accounted for “... where the permanent removal (i.e. net removal remaining over a 100-year time period) of GHGs from the atmosphere occurs as part of the life cycle of timber fibre, cement or lime” (Section 5.4). So this would not include the induced rise in levels of soil organic matter, and it is unclear whether it includes biochar.

Businesses such as Carbonneutral (www.carbonneutral.co.au) will help you “... for only \$10 per tonne or around \$3 per tree to offset your carbon dioxide emissions by planting native trees on your behalf”. The New Zealand company carboNZero will facilitate and certify the purchase of carbon credits to offset emission through EBEX21® (Emission Biodiversity Exchange 21st century). EBEX21® is a unique carbon credit because EBEX21® does not actually plant the trees, rather it selects privately owned marginal land, retired from agricultural production to enable natural forest regeneration.

Through the purchase of offsets, industries and business can then assert that they are carbon-neutral, and this might afford them a marketing advantage. These offsets might not, however, be counted in other protocols such as the international Kyoto Protocol, the CPRS, and also the shelf-access and labelling protocols of the PAS 2050.

The size of a GHG footprint, depending on the calculation protocol, can be made smaller either by a change in practices that reduce GHG emissions, or through mitigation whereby external offsets are put in place.

Some protocols such as the CPRS and PAS only consider a change in footprint size through reduction. Other protocols, generally commercial certifications for carbon-neutrality, do allow mitigations.

The sophisticated nature of the supply chain management of vegetable production means that there are good opportunities to realise a smaller GHG footprint for the sector and its products through reductions.

CARBON FOOTPRINTS AND MARKETING

Carbon footprinting has entered public consciousness. Tesco (2008) reported the results of a consumer survey of the British public in which they were asked ‘Which three or four concerns do you think companies should pay attention to over the next few years?’ With a hit rate of 45%, ‘Concern for the environment’ ranked top, up 11% from 2001. In response, CEO Sir Terry Leahy said *“I am determined that Tesco should be a leader in helping create a low carbon economy. Our carbon labelling initiative will enable us to label our products so that customers can compare their carbon footprint as easily as they can currently compare their price or their nutritional profile. Armed with this information the customer is really in charge.”* As noted above, although Wal-Mart are not intending to label their products, they will use a GHG footprint scorecard to direct their purchase decisions, and a motivation for this is to realise cheaper prices through selecting products that are less-resource intensive.

Carbon footprinting is, and increasingly will be a core part of marketing, both for products and by businesses.

For products, the use of GHG footprinting protocols will enable producers to advertise the sustainability of their products in relation to others. It is, as yet, unclear how much the actual purchase decisions of consumers will be governed by the size of the GHG footprint in relation to other purchase incentives such as price, nutrition, and novelty. What is certain is that GHG footprinting will be used increasingly as a marketing tool for products. The use of GHG footprinting might in future alter the consumers’ preferences for fresh products rather than processed ones. Tesco (2008) reported that for juice from Brazilian oranges consumed in the UK, the juice fresh squeezed in Brazil, and then shipped chilled, had a GHG footprint of 360 g CO₂-e per 250 ml. Whereas that made from concentrate in Brazil and subsequently shipped had a footprint of just 260. Nonetheless, the production phase, that is the growing of the oranges, accounted for 85% of the total footprint, predominantly because of the use of inorganic fertiliser! The consumer would need to weigh up and trade off perceptions of price, health benefit, convenience, and carbon footprint.

The food industry is seeing a range of trends that would suggest that GHG footprinting offers marketing advantages. Locavorism, that is eating locally, is being suggested as the sustainable way to consume. This has led to the 100-mile diet movement, and has seen the rise of farmers’ markets. The trend of ‘eating-with-the seasons’ is another manifestation of this. It is unsure how far these trends will continue, but it would seem prudent to consider GHG footprinting protocols for the vegetable industry, even if just to dispel erroneous notions such as ‘food miles’.

For businesses, the use of GHG footprinting is already being used, and companies are quickly engaging with accredited schemes, such as carboNZero and Carbonneutral, to tout their carbon neutrality. This trend is more rapid in highly differentiated sectors that are characterised by high levels of brand imaging, such as the wine industry. That there is burgeoning growth in such appellations would tend to suggest that businesses see marketing benefits in using GHG footprinting as an advertising tool.

It is unclear how a purchaser of food will weigh-up and trade-off perceptions between price, health benefit, and convenience, with the GHG footprint. However, it would seem prudent for the vegetable industry to consider the marketing advantages conferred by GHG footprinting protocols, even if just to dispel erroneous perceptions such as ‘food miles’.

How GHG footprinting protocols are used for marketing will depend largely on the behaviour of the large trans-national corporations (TNC) that dominate supermarket retailing. Reardon et al. (2003) predicted that ‘product markets’ will eventually mean ‘supermarkets’, and because three or four chains can command up to 50% or more of the supermarket sector, producers will need to learn to deal with the policies of just a few TNCs. Reardon et al. (2008) reported that the ‘third wave’ in the diffusion of supermarkets is by far the slowest and longest to become established, namely the supermarket dominance in vegetable markets. However, the supermarket share of the vegetable market has nearly doubled in three decades, even in countries such as France, or in Asia, where it was assumed that modern retail would never penetrate the traditional, culturally-cherished produce retail system. As a result, there are implications for Australian vegetable marketing in Asia, and eventually this could be linked to GHG footprinting. When TNCs set up supermarkets in Asian countries, the supply chain for products generally begins in the ‘south’, say Australia, but then it shifts to the ‘north’. By taking advantage of relaxed rules around foreign direct investment (FDI) in Asia, TNCs then set up sourcing hubs for products close to where they undertake retailing, thereby shortening the supply chain. Not by design, but they have then reduced the transport component of the GHG footprint, which would likely be used for marketing advantage. In a study in Indonesia, Reardon et al. (2008) found that in the early 1990s when supermarkets were being set up, nearly all fruit products were imported. By 2000, the import share had dropped to 60%, with 40% being sourced locally, with these developments being assisted by FDI guided by the TNCs. So, this local sourcing in export markets is not driven by climate-change concerns, rather it is a result of FDI. However, the marketing edge that TNCs might use in relation to GHG footprints could make for additional difficulties for foreign suppliers if GHG labelling were required and marketing strategies then used these numbers.

CARBON FOOTPRINTS & EMISSIONS TRADING

There already exist voluntary markets that are trading carbon so as to enable producers and businesses to offset their emissions in a quest to achieve carbon-neutral status. The Katoomba Group’s Ecosystem Marketplace website provides useful information about such voluntary markets (<http://ecosystemmarketplace.com/index.php>). In their 2008 ‘State of the Voluntary Carbon Markets’, they begin by noting that “... *over the past two years, numerous analysts have likened the voluntary carbon markets to the ‘wild west. In 2007 market trends highlight that this frontier has become a settlement zone’*”. Voluntary carbon markets are twofold: the Chicago Climate Exchange (CCX), which is a structured and closely monitored cap-&-trade system, and the more disaggregated over-the-counter (OTC) markets. The weighted average price of carbon on the CCX was nearly half that of the OTC figure, namely US\$3.15 per t CO₂-e, reflecting lower confidence in the reliability of the trades. Some 50% of credits were by private businesses to offset emissions and reduce their GHG footprint, and 30% were purchased for investment and resale. The CCX has reported a 180% growth in trading in the first quarter of 2008.

Should businesses in the vegetable industry wish to purchase carbon credits to offset their GHG footprint, or if they were able to sell credits say through sequestration of carbon in the soil, there are indeed voluntary markets that enable this. However, it would seem that the GHG footprinting protocols that are most likely to affect the vegetable industry and its businesses do not place much store on offsetting; rather they are more interested in accounting for continuous improvements through reductions in the size of the GHG footprint.

In July, the Australian Government released its Green Paper on the nature of the ETS proposed in its CPRS. The CPRS, which is slated to come into force in 2010, will likely have an impact on the Australian vegetable industry in relation to the size of its GHG footprint. The Government considers this to be the best way to reduce carbon pollution while minimising the impact on businesses and households. Under the CPRS, businesses will need to buy a 'pollution permit' according to the size of their GHG footprint, thereby giving them a strong incentive to reduce its size. Australia's ETS is similar to and based on the EU ETS, and other schemes in place, or proposed. The 'pollution permits' will, in sum, be limited to the total cap for Australia. This creates a carbon price. Firms will compete to purchase the 'pollution permits', and those businesses that value them most will buy them at auction, or on a secondary trading market. Instead of purchasing, other firms will find it cheaper to reduce the size of their GHG footprint and thereby meet their quota.

The Government does not, however, consider it presently practical to include agricultural emissions in the trading scheme, and it has decided that the earliest that agriculture should join the CPRS would be in 2015. Thus the vegetable industry has some lead-time to prepare for the inclusion of agriculture in the CPRS. It is unclear where the point of obligation will be located for agriculture in the CPRS, and there is currently much debate. The difficulty with the point of obligation in agriculture is acknowledged, and the Green Paper which states that *"most of the sector's emissions are produced by thousands of small farm businesses, making it potentially costly and inefficient to impose obligations on emissions at the entity level"*. The Government's preferred position is that the point of obligation for the agriculture sector be placed indirectly up or down stream of the farm.

Growcom have recently made a submission to Department of Climate Change's Green Paper (Growcom 2008b) and some of their points are salient here. They make the link between the GHG footprint and the proposed CPRS. Growcom recommends that simple, yet accurate methods of emission be developed for horticultural production systems. In other words, Growcom are suggesting that a carbon footprinting protocol be developed, or adapted, to size appropriately the emissions from horticulture. The CPRS can then be applied to enable horticulture to increase productivity through efficiency gains that reduce emissions. As noted earlier, there are a range of footprinting protocols in operation, in development, or being proposed. The vegetable industry should proactively investigate what form, or forms, of footprinting protocols will best suit their needs.

An LCA-based GHG footprinting tool covering all three scopes of emissions could be linked to an ETS trading scheme. This can then be used to examine the impact of the price of carbon on the value chain of vegetable production.

There already exist voluntary markets for trading carbon. In the future the Australian ETS of the CPRS will require that emitters of carbon have a pollution permit, and trading of these permits will provide the incentive for emitters to reduce the size of their GHG footprint. Agriculture is slated to enter the CPRS in 2015.

There are a range of footprinting protocols in operation, in development, or being proposed. The vegetable industry should proactively investigate, in conjunction with other agricultural sectors, what form, or forms of footprinting protocols will best suit their needs, and meet the appropriate compliance requirements.

Consideration also needs to be given to the accounting rules that will be used in the second commitment period of the Kyoto Protocol, and how these will be implemented in the CPRS. A particular issue will relate to soil carbon. Globally, there is a rise in atmospheric carbon of about 4–6 Gt C per year. The soil store of carbon is about 1500–1800 Gt C, twice that stored by plants. So a small change in soil carbon can have a large influence on the global carbon cycle. Furthermore, land management practices strongly influence whether soil carbon levels rise or decline. In anticipation of the CPRS, Growcom called for research to enable separation of natural changes in soil carbon from those induced by land management practices. If practices such as by tillage were to result in a loss of soil carbon, this could potentially be a carbon debit. Whereas if improved land management, say through residue management, resulted in a rise in soil carbon, this could be traded as a credit. The use of biochar to sequester carbon in soil, or the use of compost, could be examples of such practices. These could likely have other productive benefits by improving soil functioning.

Soil carbon sequestration is not claimable as a carbon credit under current protocols, partly because if it were there it would be a concomitant liability as a result of inadvertent losses through fire or drought.

In developing, adapting, or using GHG footprinting protocols, especial attention will need to be given to induced-changes in soil carbon. Soil carbon losses, exacerbated by tillage, have the potential to be one of the largest sources of emissions from the vegetable industry. They are not included in the current CPRS, but in the future they may need to be considered.

For any ETS, including the CPRS, it will be crucial to discriminate between natural changes in the level of soil carbon, and those induced through land management practices. For the vegetable industry, through the adoption of improved production practices, and possibly through the use of biochar, there will be opportunities to build up levels of soil carbon.

QUESTIONS AND REPOSES

The previous sections have outlined the issues around GHG footprinting: their scale and type, the difference between reduction and mitigation in reducing the GHG footprint, their role in marketing, and their importance for emissions trading, whether voluntary or by regulation. Now, on the basis of the information presented, we provide responses to the questions posed by HAL for this discussion paper.

WHY DOES THE INDUSTRY AND GROWERS NEED TO UNDERSTAND THEIR CARBON FOOTPRINTS?

The vegetable industry and its growers need to understand their GHG footprint for three prime reasons:

- To meet the increasing use of GHG labelling and scorecards for obtaining shelf access in retail stores, both in Australia and overseas
- To respond to sustainability drivers in the purchase-decision making processes of consumers
- To meet the legislative and benchmarking requirements that will come into force when agriculture is incorporated, in some form, into Australia's ETS, the CPRS.

WHAT IS THE INDUSTRY NEED FOR A TOOL TO MEASURE ITS FOOTPRINT?

These three reasons then determine what the industry needs from a GHG footprinting tool. The vegetable industry needs a decision support tool (DST) to calculate:

- The GHG footprint of the industry and its supply chain through to its domestic and export markets
- The GHG of individual companies within the vegetable industry to minimise their footprint, and work towards carbon neutrality if so desired
- The lifecycle GHG footprint for the fresh and processed products of the vegetable industry to secure market access and premium prices
- The product GHG footprint to rebut food-miles claims in export markets, and to enhance locavore advertising in domestic markets
- The GHG emissions to enable the vegetable industry to benchmark its GHG performance and join the CPRS in 2015.

WHAT ARE THE BENEFITS AND COSTS OF FOOTPRINT MEASUREMENT?

The benefits of measuring the GHG footprint of vegetable producers and the industry include:

- Compliance with market requirements and assurance of shelf access for vegetable products in domestic and export markets
- Benchmarking and continuous improvement in reducing emissions

- Increased resource-use efficiency and cost savings in the production, processing, distribution and consumption of fresh and processed vegetables
- The opportunity through adopting improved land management practices to trade carbon credits
- Avoid the cost of purchasing pollution permits under the CPRS
- Develop LCA reporting procedures for GHG footprinting that could be used in other resource-footprinting protocols that might in future be required, such as for water and fertilisers
- Highlighting that ‘vegetables are not only good for you, but they’re good for the planet’
- Identifying that home storage and the mode of cooking of vegetables can have a large impact on the footprint, and so the consumer can be empowered to do ‘the right thing’.

The costs might not be insignificant. The first and most important cost will be:

- Data collection, information recording, and reporting. It would be beneficial if the information collected for carbon accounting requirements were linked to financial recording and reporting systems. Because of scope 2 and 3 requirements for some forms of GHG footprints, this system should also enable capture of emissions by sub-contractors and other parts of the supply chain.

Other costs will include:

- Revising production practices
- Purchase of new equipment and software
- Purchase of additional materials, for example, compost and biochar
- Moving production to more suitable locations where soils are more fertile and the weather is more favourable
- Moving to locations where transport costs and modes are less GHG-intensive.

WILL FOOTPRINTING ENABLE BENCHMARKING IN THE VEGETABLE INDUSTRY?

The Climate Change in Agriculture and Natural Resource Management (CLAN) Agriculture Working Group have published a discussion paper on ‘Reducing Greenhouse Gas Emissions from Australian Agriculture: The Role of Benchmarking in Driving Best Management Practice’. They define benchmarking as an on-going systematic process to search for and attain best practice. This entails identification of key indicators, comparison of current practice against the best, implementation of changes, and monitoring of performance. The Working Group proposes developing benchmarks in five areas, of which the following three are important for the vegetable industry:

- Nitrous oxide emissions from nutrient and soil management
- Carbon dioxide from energy use on farm
- Vegetation as carbon sinks.

A GHG footprinting protocol would enable such benchmarking. Indeed, the PERF guidelines associated with the BSI’s PAS 2050 GHG footprint protocol represents a tool for setting targets and reporting on the continuous improvement in reducing GHG emissions.

Benchmarking will be used in the CPRS, where the Department of Climate Change define benchmarking as “... a system of allocating permits based on an individual’s emission performance against a sector-wide yardstick. The yardstick can be forward looking (that is a target) or based on historical performance. Typical benchmarks could include emission per unit product, value added, or other relevant unit of measurement”.

Benchmarking, as required under the CPRS, will depend on a GHG footprinting protocol.

WHAT ROLE DOES RISK MANAGEMENT PLAY IN REDUCTION, MITIGATION, EMISSIONS TRADING AND MARKETING?

A GHG footprinting protocol would enable development of a decision support tool to assess the threats, risks and opportunities that could result from:

- Efficiency gains in production, processing, packaging and distribution
- The potential size and opportunities for employing less GHG-intensive practices in the production, processing, packaging and distribution of vegetables
- The development of new ways of selling vegetable products, both fresh and processed
- The size of offsets that would be needed to move the industry and vegetable production companies towards carbon neutrality
- The size of the pollution permits that might be required under the CPRS
- Benchmarking and targets in the CPRS
- The impact of the price of carbon in ETS on the value chain of vegetable production
- The value in the market place of being able to advertise the size of the GHG footprint and differentiate vegetable products from each other, competing food products, and products from other countries both locally and in export markets.

CONCLUSIONS

Consumers, retailers, businesses, and governments are focussing increasingly on greenhouse gas emissions as the spectre of climate change looms large. The imperatives of these four groups have established the need to determine and reduce the size of the GHG footprint associated with products and activities.

Consumers are seeking information about the GHG emissions of the products they purchase. In response, retailers are requiring GHG footprints, or scorecards, of products so that they can modify their purchase decisions and allow shelf-access to products with lower emissions. Businesses are seeing marketing advantage of being able to report their GHG emissions, and move towards carbon neutrality. Governments, as signatories to international treaties are committed, on pain of penalties, to reduce their nation's emissions. Countries are using emissions trading schemes to provide incentives that will reduce their carbon footprint. Agriculture is destined to join the Australian Carbon Pollution reduction Scheme in 2015.

Many forms of GHG footprinting exist, and there are a number of protocols. It is a rapidly evolving and presently confusing area of activity: business, regulation, and science. What is not confusing is that it will be inevitable that GHG footprinting will be required at some time, for some purpose. The vegetable industry should develop a plan to ensure that it, and its growers, can collect and record the necessary information to meet the requirements for reporting its GHG footprint.

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