How can viticulture contribute to reducing greenhouse gas emissions?

The world's grapegrowing regions are getting warmer, increasing by 1.26°C in the past 250 years (Jones et al. 2005). This warming trend is associated with increases in the concentrations of greenhouse gases (GHGs) in the earth's atmosphere. The impacts of a warmer and drier climate on viticulture have been the subject of much recent research and include earlier budburst, shorter winters, compressed vintages and more frequent extreme weather events such as frosts, heatwaves and bushfires. Strategies are being investigated to help grapegrowers adapt to a changing environment (Webb et al. 2012, Bonada et al. 2013, Sadras et al. 2012, Sadras and Moran 2012, Sadras et al. 2013a,b).

Agricultural and forestry producers, which include viticulture, account for 21% of the GHG emissions generated in Australia (National Inventory Report 2012). While the biggest contribution to these emissions comes from livestock production, the wine-grape sector can still play a part in emissions reduction. This article focuses on the options available to grapegrowers to reduce their GHG emissions.

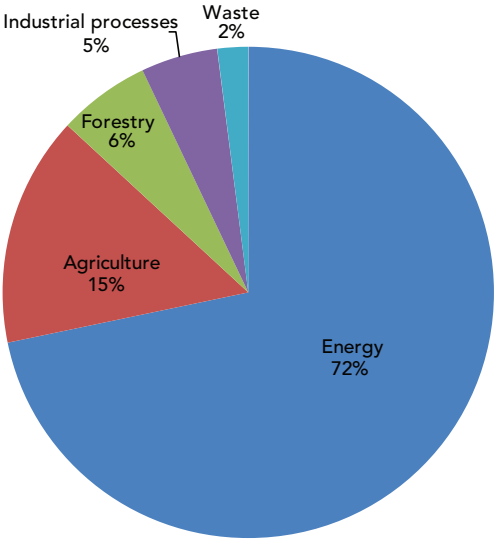

Figure 1. Australia's net greenhouse gas emissions (carbon dioxide equivalents, CO2-e) by sector in 2012 (National Inventory Report 2012, Volume 1)

The Australian Government, through the Emission Reduction Fund (ERF) is planning to provide incentives for landholders to combat the causes of climate change. If this scheme goes ahead, emissions reductions will be purchased by the Government in a reverse auction (at the lowest accepted cost) to ensure that the best value is obtained. The Australian Government will work with businesses to develop appropriate methodologies to calculate genuine reductions. Eligible activities will have to be approved by the government and must be new projects that are not business as usual or enforced by law, and have not been paid for under another program.

The ERF will build on the Carbon Farming Initiative (CFI) that was established in 2011. Under that scheme, farmers and landholders were able to earn carbon credits for reducing GHG emissions, provided their emission reduction methodology was approved. The only currently approved methodology that the grape sector can use to earn carbon credits is through activities that sequester carbon. This includes projects that protect native forests or regenerate native forest land by permanent environmental plantings of native tree species. Landholders may benefit from planting trees to minimise erosion, reduce salinity or establish a windbreak and at the same time potentially boost their income by generating carbon credits under the ERF. However, the plantings must be long term and therefore should only be considered in areas where they will deliver benefits for natural resource management or agricultural productivity.

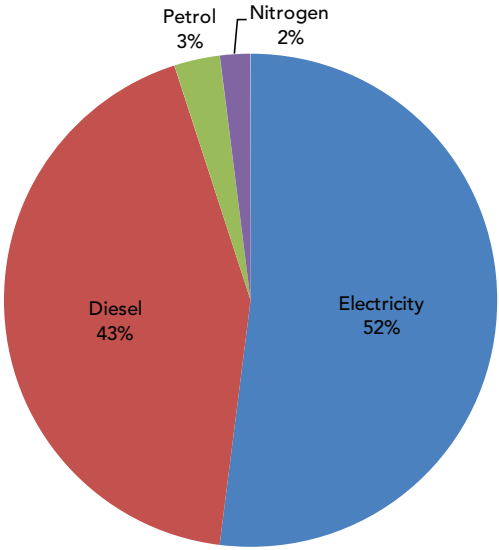

Figure 2. Greenhouse gas emissions from viticulture (CO2-e) in Australia (personal communication, Winemakers' Federation of Australia 2013)

Audits of vineyard businesses have shown that the greatest proportion of emissions comes from fuel and electricity use. Opportunities for both reducing emissions and saving money in those areas should be explored. Reduced fuel consumption has been reported through eliminating one or two tractor passes per year by grazing sheep in the vineyard during winter. The use of precision viticulture technologies and pest and disease monitoring can also reduce tractor passes and, in some vineyards, fuel savings have been achieved using multi-row spray equipment. Managers can audit their vineyard's fuel and electricity use by using the Australian Wine Carbon Calculator (available from the Winemakers' Federation of Australia).

Other methodologies that might be used to generate carbon credits in vineyards are being considered. Projects that show the most promise for use in viticulture include the sequestration of carbon in soil and emissions avoidance by improved fertiliser management. Even without the possible carbon credits to be gained, there are benefits to landholders from adding carbon to soil and/or carefully managing fertiliser inputs. The potential for reducing GHGs in these areas is explored below, with some of the material presented adapted from factsheets produced by Dr Jeff Baldock, CSIRO Land and Water.

Managing agricultural soils – soil organic carbon

Soil organic carbon (SOC) is the carbon stored within soil. It is part of soil organic matter (SOM) which includes other important elements essential for plant growth and soil health. SOM plays a role in the biological, chemical and physical properties of soil and importantly provides the soil with resilience. The amount of carbon in a soil depends on many factors such as rainfall, temperature, vegetation and soil type. While some of these factors are fixed characteristics or are determined by climate, others can be influenced by management practices. Practices that result in carbon losses from soil are those that reduce carbon inputs or increase the decomposition of soil organic matter. In viticulture these practices include leaving the ground bare (fallowing), cultivation or overgrazing. Positive practices that return plant residues to the soil include fertiliser application, irrigation and the planting of cover crops. The application of organic materials such as manure, plant debris and composts is a direct way to improve soil carbon levels in vineyards but it is important to note that often decades of constant management are required to make a significant difference.

Fertiliser management

Nitrous oxide (N_2O) is a greenhouse gas that is about 300 times more potent than carbon dioxide. It is formed in soils via biochemical reactions, in a process known as nitrification.

The greatest emissions of N_2O result from:

- Excess nitrates in the soil from nitrogen fertilisers that have been applied in excess, at the wrong time, in the wrong place or in an inefficient manner. For example, applying nitrogen in excessively wet periods significantly increases the release of N_2O into the atmosphere.
- Anaerobic soil conditions such as waterlogged or compacted soils.

N_2O losses are an indication of wasted fertiliser and reducing these emissions can improve economic and production efficiency. The viticulture sector can influence N_2O emissions by managing moisture levels and nitrogen supply in soil. A visual examination of vine growth is a useful way to evaluate a vine's nitrogen status, and analysis of yeast assimilable nitrogen (YAN) in fruit at harvest can also indicate whether or not the nitrogen needs of the vine are being met. If nitrogen is required, the times of peak nitrogen uptake in a vineyard are at flowering and before veraison. Nitrogen fertiliser should not be applied far ahead of when it is needed and not before a forecast heavy rainfall event. Nitrogen should be applied to the rootzone and, where runoff occurs, it is better that a cover crop is present to recover and reuse lost nutrient. Vegetation or yield mapping of the vineyard can be used to identify areas of low and high nitrogen demand and fertiliser application rate should be adjusted accordingly.

Products that can inhibit the reactions that form N_2O in soils have also been developed. Research is currently underway in horticultural crops to investigate how effective these products are in reducing N_2O generation and increasing farm productivity.

Conclusion

The wine-grape sector in Australia is likely to be significantly affected by changes in climate brought about by GHGs in the atmosphere. Our industry has a role to play in implementing actions that reduce GHG emissions. These actions may be rewarded through government incentives, but even without them, there is a responsibility to seek out and implement practices that reduce carbon pollution to contribute to long-term industry sustainability. Other than the planting of trees on otherwise unproductive land, the biggest opportunities for grapegrowers are in improvements in soil and fertiliser management, as well as minimising fuel and electricity use. For more information about greenhouse gas emissions or climate change adaptation in the grape and wine industry, visit www.awri.com.au/industry_support/new_climate.

References

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CSIRO fact sheets

http://www.csiro.au/Outcomes/Climate/Adapting/Soil-Carbon-Levels.aspx

http://www.csiro.au/en/Outcomes/Food-and-Agriculture/soil-organic-matter.aspx

http://www.csiro.au/Outcomes/Environment/Australian-Landscapes/soil-carbon.aspx

AWRI fact sheet

Building resilience and sustainability in the grape and wine sector (http://www.awri.com.au/wp-content/uploads/2014/06/CFI-ERF-factsheet.pdf)

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