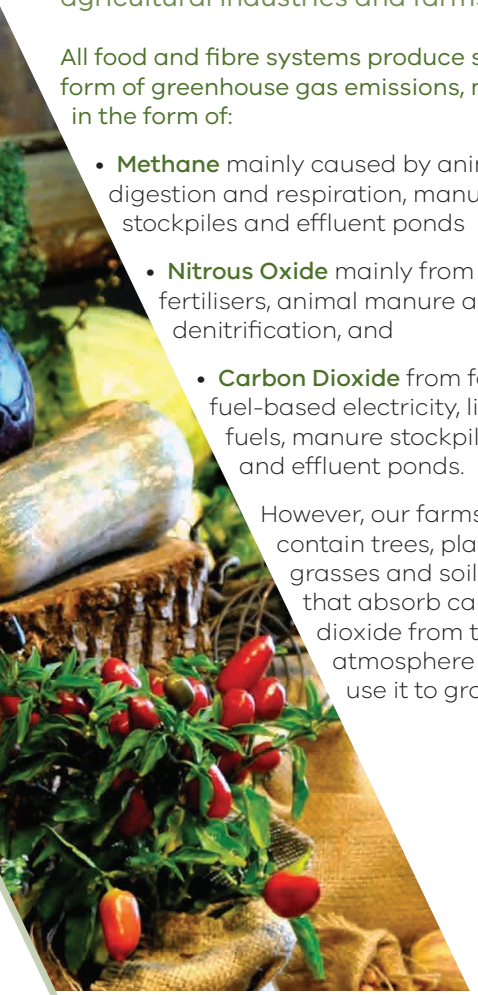
Making cent$ of carbon and emissions on-farm

AGRICULTURE VICTORIA

More food and fibre, more profit, less emissions

Victorian farm businesses are getting on with the job of growing more food and fibre, while dealing with changeable seasons and weather patterns. We also know that more attention is being paid to the carbon and emissions performance of our agricultural industries and farms.



All food and fibre systems produce some form of greenhouse gas emissions, mostly in the form of:

- **Methane** mainly caused by animal digestion and respiration, manure stockpiles and effluent ponds
- **Nitrous Oxide** mainly from fertilisers, animal manure and denitrification, and
- **Carbon Dioxide** from fossil fuel-based electricity, liquid fuels, manure stockpiles and effluent ponds.

However, our farms also contain trees, plants, grasses and soils that absorb carbon dioxide from the atmosphere and use it to grow.

It may seem surprising but, in general, farming produces more greenhouse gas than it removes, which contributes to an increased concentration of greenhouse gases in the atmosphere. These additional heat trapping gases are increasing global temperatures and causing other changes in local (and global) climates. This will mean an increase in average daily temperatures in Victoria over time and less predictable seasonal rainfall patterns.

Learn more about these gases on pages 16 and 17.

We know we must grow more food and fibre as the demand for food steadily increases. Farmers are constantly looking for efficiencies to improve farm productivity and resilience, while maintaining profitability. **This booklet aims to introduce management options to lower farm emissions that may also reduce operational costs and improve profits along the way.**

Benefits to farm businesses from improving their emissions performance may include:

- Decreasing costs and increasing productivity, particularly by minimising energy losses in the farm system, and
- Increasing market opportunities as supply chains and consumers become more aware of increasing demand for food and fibre produced with lower emissions.

Taking action on-farm

A number of farmers are proving there are ways to increase on-farm productivity while also reducing greenhouse gas emissions on-farm.

In many cases, actions to reduce emissions or increase carbon on farms have multiple benefits for farm businesses, such as increasing farm health and profitability. Most farmers have already made great resource efficiency improvements, helped by new technologies, new practices and skills. Such improvements can also result in reduced overall emissions.

The following pages provide examples of actions that farm businesses can take to improve their emissions performance on-farm under the key action areas identified below.

The key actions aim to assist farm businesses take control of their situation and consider options to improve the resource efficiency of their operations. Research and development will identify additional options and solutions over time.

To stay updated, go to www.agriculture.vic.gov.au/carbon-emissions

Read on for some practical tips on how you can continue to manage carbon and emissions on your farm. You might be surprised at how much you are already doing.

☑ Use the tick boxes to check what you already do and/or to plan your future actions.

When thinking about how to manage carbon and emissions on farms, it is useful to think of a farm as having the following key action areas:

- **Energy:** increasing efficiency, renewable energy and emissions reduction
- **Nitrogen use efficiency and fertilisers:** improving efficiency and saving money
- **Healthy soils:** to grow food and store carbon
- **Livestock:** improving performance and reducing energy loss
- **Trees:** for farm health
- **Supply chain:** prepared for what others are doing

Energy: increasing efficiency, renewable energy and emissions reduction

Energy efficiency both on-farm and along the supply chain will help minimise impacts of rising energy costs for heat, electricity, gas and liquid fuels. Additionally, there is a range of cost-effective alternatives to fossil fuels for energy generation either currently available or in development.

Greenhouse gas calculators often show that farm energy use is a small portion of overall farm emissions. However, for many farmers (such as those involved in more intensive agriculture such as dairy and horticulture) energy is a significant and growing cost, so finding alternative energy sources and improving energy efficiency can save money and reduce emissions.

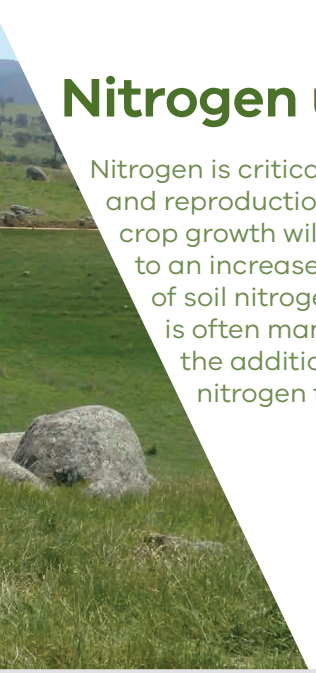
Management options

Farmers who increase their energy efficiency and find alternative, low cost sources of fuel, heat and electricity may become more resilient, energy efficient and profitable.

- ☐ Understand your energy use:
  - ☐ get an energy assessment or audit to the national standard (AS/NZS 3598.2:2014) to measure your current energy use and highlight areas for improvement.
  - ☐ compare your energy bills to other offers available in your area by visiting the independent Victorian Government energy price comparison website.
  - ☐ check your tariff and your off-peak rates to make sure you are getting the best deal.
  - ☐ explore ways to reduce energy use by focusing on high energy input areas. Investigate opportunities to reduce energy inputs by changing practices or doing the same operation more efficiently.
  - ☐ take time to understand how to interpret your energy bills, usage and costs. The way you are charged for electricity use depends on a number of factors including your electricity distributor, the type of meter you have and the size of your business which is determined by your network demand (kVA) and consumption (kWh).
  - ☐ energy meters may assist in working out where and when you are using the most power as well as how much energy different appliances use.
- ☐ Consider your options:
  - ☐ identify if it is possible to be flexible about when you use your energy and consider opportunities to shift the time you use energy to off-peak to reduce energy costs.
  - ☐ consider energy efficiency as a factor when making changes to farm management or investing in new equipment or infrastructure.
  - ☐ develop a long-term plan to replace inefficient equipment.
  - ☐ develop and follow a regular maintenance schedule for machinery, equipment and vehicles and ensure modifications do not affect their efficiency.
  - ☐ carefully match engine power to the requirements of irrigation pumps. Three phase motors are often more energy efficient. Consider installing variable speed drives (VSDs) onto pumps on the farm to match flows to requirements.
- ☐ Make efficiency gains:
  - ☐ improve the efficiency of irrigation practices. For example, schedule irrigation based on soil moisture monitoring devices, use solar power for electricity-based irrigation pumps and set irrigation schedules to minimise use of peak tariff rates.
  - ☐ perform a pump test to identify how efficiently pumps are operating. Installing an hour metre on a pump is a low-cost strategy that can provide valuable information on how to prioritise pump improvements.
  - ☐ optimise irrigation pump performance to reduce diesel consumption and increase water flow rates.
  - ☐ move from conventional tillage to minimum tillage. This can create savings of around 10 percent of fuel on farm.
  - ☐ insulate buildings, storage and refrigeration devices, and heating and cooling pipes. Use light coloured, heat reflective paint on roofs and walls.
  - ☐ invest in energy efficient cool rooms and refrigeration. Quick cool-down of meat products and pre-cooling of fruit and vegetables will provide energy savings along the 'cold chain' while maintain product quality and food safety standards.
  - ☐ maximise the use of natural light and ventilation in farm buildings.
  - ☐ consider efficient home heating using efficient split systems (heat pumps) combined with solar power to reduce winter heating costs.
  - ☐ install energy efficient lighting and equipment sensors making sure you always turn the lights off when they are no longer needed.
  - ☐ choose the most efficient and cost-effective fuel source such as renewables rather than fossil fuels.
  - ☐ consider production of bioenergy to generate heat and/or electricity from agriculture or plantation waste and residues (wood chips to run heaters/hot water, biogas from effluent, straw for pellets or energy/heat/hydronic systems etc).
  - ☐ obtain energy from renewable sources such as solar panels and accessories including inverter and batteries, wind and ground sources heat pumps, where possible.
  - ☐ explore options for renewable energy and energy efficiency retrofit grants and incentives such as the Victorian Energy Up-grades program (VEU) and the small-scale renewable energy scheme.

Further information: www.agriculture.vic.gov.au/carbon-emissions

Nitrogen use efficiency and fertilisers: improving efficiency and saving money



Nitrogen is critical to plant growth and reproduction. Pasture and crop growth will often respond to an increased availability of soil nitrogen. This situation is often managed through the addition of nitrogen fertilisers.

Nitrous oxide is a powerful greenhouse gas and accounts for 5 percent to 7 percent of global greenhouse emissions with 90 percent of these derived from agricultural practices. Nitrogen based fertilisers and livestock manure (urine and dung) are the key sources of nitrous oxide emissions on farms.

Follow the 4 **R**s

Right product, **R**ight rate,

Right time and **R**ight place

www.fertilizer.org.au/Fertcare/Nutrients-And-Fertilizer-Information

Greater efficiency in the capture of nitrogen in products has the greatest impact on reducing nitrous oxide losses, as well as reducing ammonia volatilisation to the atmosphere and nitrate leaching and runoff to groundwater and waterways. Improved nitrogen use efficiency (NUE) has both productivity and profitability benefits.

NUE indicates the ratio between the amounts of fertiliser nitrogen (N) applied to a crop and the amount of N removed from the paddock by the crop or product.

Nitrous oxide is most likely released from warm, waterlogged soils where there is excess nitrogen in the form of nitrate. Volatilisation of nitrogen as ammonia can also lead to indirect nitrous oxide emissions through redeposition contributing to excess nitrate elsewhere in the landscape.

Farmers can save money, boost pasture and crop production and reduce nitrous oxide losses by carefully planning and implementing best management practices with regards to the 4 Rs - the 'right' rate, source, timing and placement of nitrogen fertilisers to match plant needs.

Management options

Research has estimated that usually 40 percent to 60 percent of nitrogen inputs into cropping and grazing systems, respectively, is lost to the environment. By improving agricultural practices we can reduce these losses, improve productivity and save money.

- ☐ Match nitrogen supply to crop/pasture demand by:
  - ☐ using soil or plant testing to assess plant available nitrogen supply. Apply nitrogen fertiliser rate based on target yield and crop or pasture nitrogen requirement over the growing season.
  - ☐ account for soil moisture availability and seasonal forecasts for more timely and calibrated fertiliser decisions support.
  - ☐ use industry-relevant decision support tools (e.g. Yield Prophet in Grains; Dairy nitrogen fertiliser Advisor; GrazFert for beef and sheep).
  - ☐ avoid high application rates of nitrogen in any single application (i.e. never exceed recommended rates, split applications may be more effective and adjust rates according to rainfall and temperature).
- ☐ Time fertiliser application to minimise nitrogen loss:
  - ☐ where possible, align nitrogen fertiliser applications with crop and pasture demand. Crop/pasture demand is highest when growth rates are highest.
  - ☐ avoid applying nitrogen fertiliser to warm (>10°C) waterlogged soils.
  - ☐ avoid tillage under wet conditions.
  - ☐ consult a 7-day weather forecast to identify risks of soil saturation and if likely delay nitrogen fertiliser application.
  - ☐ in summer, avoid applying urea fertiliser after irrigation as this is likely to increase volatilisation losses.
  - ☐ minimise the length of fallow when converting long-term pasture to crops, especially in high rainfall zones and irrigated crops.
- ☐ Determine and improve plant access to nitrogen by improving soil health and nutrient status – see next section on 'Soils'. Adding nitrogen to soils that have inherent limitations to plant growth is unlikely to result in higher productivity and financial gain.
- ☐ Choose the best type of nitrogen:
  - ☐ avoid Nitrate based fertilisers which are more prone to losses.
  - ☐ Enhanced Efficiency Fertilisers e.g. coated for slow release, or with nitrification inhibitors may better match the fertiliser supply and plant demand for soil nitrogen.
  - ☐ chemicals can be added to fertiliser (inhibitors) which can reduce nitrate leaching and ammonium volatilisation. However, it is recommended to seek expert advice when choosing inhibitors.
- ☐ Incorporate fertiliser at the top of raised beds or ridges to avoid concentration and losses in furrows and wet areas.
- ☐ Estimate the methane and nitrous oxide emissions on your farm using a greenhouse gas accounting tool (go to www.agriculture.vic.gov.au/carbon-emissions for links to appropriate tools for your type of enterprise).

Further information: www.agriculture.vic.gov.au/carbon-emissions

Healthy soils: to grow food and store carbon

A healthy soil is productive, sustainable and resilient to withstand the impacts of farm management practices and changing climatic conditions. Healthy soils undertake many functions for healthy plant growth, including storing and providing water and nutrients, maintaining biological activity, maintaining good soil structure and the ability to resist erosion.

Soils can store carbon and soil carbon is strongly linked to soil quality and productivity. How much and for how long varies depending on factors such as soil texture (the clay and fine silt fraction), climate - temperature and annual rainfall (amount and distribution over the year), soil moisture and importantly farm management practices.

Soil organic matter makes up a small component of the soil mass, yet it has an important role in the functioning of the physical, chemical, and biological properties of the soil. Soil organic carbon is a measure of the carbon contained within soil organic matter. Soil carbon provides a source of nutrients through mineralisation, helps to aggregate soil particles (structure) to provide resilience to physical degradation, increases microbial activity, increases water storage and availability to plants, and protects soil from erosion. Ultimately, increasing soil carbon levels can lead to better plant establishment and growth. While increasing soil carbon is highly desirable, it is also easily lost, so maintaining what you have is important. Climate is a strong driver, affecting accumulations and decomposition of soil organic matter in soils.

The following management options aim to improve soil condition by improving soil structure, reducing losses of carbon and nitrogen from the soil and building soil organic matter. Improving soil condition will enhance a plant's ability to access the nutrients it needs, capture and retain soil moisture for longer and reduce losses of nitrogen to the atmosphere, groundwater and waterways.

Management options

There are ways to increase soil carbon while also increasing productivity, water holding capacity and nutrient cycling. This will reduce input costs and produce wider natural resource management benefits.

- ☐ Monitor soil nutrient levels:
  - test your soil to check the nutrient status and structure of your soil and develop a plan to improve constraints to nutrient and water access e.g. physical (structure, compaction, drainage), chemical (pH, salinity, toxicities/deficiencies), biological (micro-organisms).
  - monitor soil organic matter/soil organic carbon over time via testing.
  - complete a nutrient balance/budget to match fertiliser requirements to crop/pasture demand.
  - manage soil structure to maximise water infiltration and retention for plant uptake and aeration.
- ☐ Consider application of soil amendments:
  - addition of organic amendments (manure, crop residues) where practical and economically viable. Know the quality of any products, have them tested and ensure any claimed benefits are supported by sound evidence and research.
  - manage application of gypsum on sodic soils to maintain/improve soil structure.
  - manage livestock manure (dung and urine) to minimise nitrous oxide emissions – see 'Livestock' section for further details.
- ☐ Manage the soil resource:
  - use direct drill, minimum/ conservation tillage and controlled traffic techniques in cropping operations to avoid compacting soils and losing carbon and nutrients through soil cultivation and erosion.
  - avoid burning crop residues and retain where possible.
  - cultivate soils at an appropriate moisture content – not too moist for soils to smear, or too dry that the soil is pulverised.
  - avoid bare fallows, and have continuous plant cover where possible e.g. green/brown manure crops between seasons and crops can maintain groundcover, provide active root material and organic matter as well as use available nitrogen and avoid losses by leaching.
  - manage irrigation and soil drainage to avoid waterlogging. Use irrigation scheduling and monitoring.
  - rotate crops and include perennial pastures and legumes phases in rotations. In general, perennial pastures will improve or stabilise soil carbon more than annuals can.
  - do not overgraze pastures. Ensure there is sufficient groundcover throughout the year (>50 percent cover). Consider stock containment areas to ensure improved pasture and groundcover management options.
  - manage livestock movement and paddock rotations to distribute animal deposited dung and urine evenly and reduce compaction from hoof traffic.
- ☐ Keep an eye on policy changes relating to potential incentive payments for carbon stored in soil. Always seek legal and financial advice first.

Further information: www.agriculture.vic.gov.au/carbon-emissions

Livestock: improving performance and reducing energy loss

There are management strategies that can improve livestock performance and efficiency while reducing emissions produced on-farm.

Methane is the main greenhouse gas produced in grazing systems. Ruminant livestock (cattle, sheep, and goats) have microbes in their rumen called methanogens. These microbes produce methane (from the fermentation of feed) that is then belched out. Feed with lower digestibility produces more methane than higher quality feeds. Belched methane represents energy lost from your production system that might otherwise be converted to the milk, meat or fibre that generates income.

Methane is a major inefficiency in animal production systems with 6 percent to 10 percent of gross energy intake lost as methane. This energy loss has been calculated as the equivalent of up to 55 to 60 days grazing intake for ewes and steers, and 40 days for dairy cows.

Livestock urine and dung deposition, nitrogen fertiliser applications and atmospheric nitrogen fixed by legumes are the largest inputs of reactive nitrogen to soil for grazing enterprises. Livestock manure (i.e. dung and urine) contains a high concentration of nitrogen. Around 80 percent of all nitrogen consumed by ruminants is excreted in dung and urine. Both directly deposited animal manure and collected manure, which is land applied, should be used efficiently to improve pasture or crop growth.

Management options

- ☐ Improve the quality of the feed that livestock eat to reduce methane emissions:
  - ☐ improve the quality of pasture or forage by optimum grazing management, growing high quality forage crops (e.g. legume forages which contain tannins, reduce methane and urinary nitrogen losses) or supplementing the diets of grazing livestock when necessary with grain or other high oil, energy-rich, low fibre feeds (e.g. during summer and autumn) while optimising protein intake.
  - ☐ finish prime stock in feedlots on high quality optimum diets to reduce finishing times and meet market specifications.
  - ☐ use feeding systems that reduce spillage and spoiling to maximise feed usage.
  - ☐ optimise silage and hay quality by harvesting when appropriate and when quality is high using short lockup periods and good storage practices.
  - ☐ use feed testing to assess the feed value of grain, hay or silage.
  - ☐ stay tuned to industry research as methane reducing feed additives become more widely available.
- ☐ Manage the flock or herd to optimise reproductive efficiency:
  - ☐ maximise the proportion of young, growing or lactating stock.
  - ☐ ensure that breeding stock are managed according to their nutritional requirements.
  - ☐ optimise fertility through good health and body condition.
  - ☐ minimise young stock losses through good husbandry and provision of adequate shelter.
  - ☐ cull unproductive reproducing stock.
- ☐ Consider ram/bull selection and breeding to achieve increased reproductive rates and shorter finishing times:
  - ☐ utilise Australian Sheep Breeding Values (ASBV's) when selecting rams, Estimated Breeding Values (EBVs) for beef cattle and Australian Breeding Values (ABV's) for dairy cattle.
  - ☐ include breeding values for productivity traits such as fecundity, growth rate, reproduction, feed conversion efficiency, feed intake and disease resistance in your ram and bull selection criteria.
  - ☐ identify, and cull less productive stock.
- ☐ Reduce the loss of nitrogen from animal manure (dung and urine) to minimise nitrous oxide emissions:
  - ☐ avoid applying slurries or manure to land in wet conditions, such as wet winter soils.
  - ☐ avoid causing conditions that lead to poorly aerated soils (e.g. pasture pugging and compaction).
  - ☐ when using manure as fertiliser, test for its nitrogen content and apply at a rate based on crop or pasture requirements.
  - ☐ manage manure stockpiles to avoid anaerobic conditions.
  - ☐ de-water storage ponds (approximately every six months) and anaerobic ponds (approximately every three years) by irrigating to crops or pastures. Where possible manage the timing of application to replace the need for nitrogen fertiliser.
- ☐ Estimate the methane and nitrous oxide emissions on your farm using a greenhouse gas accounting tool (go to www.agriculture.vic.gov.au/carbon-emissions for links to appropriate tools for your type of enterprise).

Further information: www.agriculture.vic.gov.au/carbon-emissions

Trees: for farm health

Trees on farms have benefits of improving productivity and land health, as well as capturing and storing carbon.

Trees store carbon in their branches, stems, leaves, bark and roots. As trees grow, they remove carbon dioxide from the atmosphere through photosynthesis and convert this into carbon to make wood. When wood rots or is destroyed (e.g. by fire) the carbon is returned to the air.

When carefully integrated into farms, trees can improve soil, water and biodiversity conservation, provide shade and shelter to livestock, rehabilitate unproductive land and improve the look and feel of a property. Farm productivity will increase as a result, with improved farms often having a percentage of land planted to trees which complements agricultural production.

Trees on farms can store carbon, which could offer an offset against a farm business's greenhouse gas emissions and may be combined with other benefits such as shelter, timber production, environmental protection, added biodiversity and improved aesthetic value on-farms.

Good planning for strategic planting of trees ensures they become an asset not a liability. Well managed trees may provide extra income if harvested following appropriate approval processes.

Management options

Many farmers have revegetated degraded or unproductive sections of their farms or waterways. Farmers have shown that they can revegetate from 5 percent to 20 percent of their farm without loss of food or fibre production.

- ☐ Identify on your farm plan areas that might be suited for shelterbelts, woodlots or wildlife areas, or for managing problem areas (unproductive or erosion prone areas) - most farms have some parcels of land that are less productive and make sensible locations for plantings.
- ☐ Ensure tree species match the site conditions (e.g. soils and climate) and the farm objectives.
- ☐ Establish new tree plantations and ensure species selection and site preparation are geared towards optimal survival and growth – find out from a local expert suitable tree species, establishment techniques for your site, suitable nurseries and revegetation contractors.
- ☐ Consider growing some woodlots with tree species that can be used on-farm (e.g. for fodder, fence posts, poles or firewood), ensuring not to use species classified as weeds.
- ☐ Encourage regeneration of native trees and shrubs (e.g. by fencing out established native vegetation), according to a well thought-out farm plan.
- ☐ Protect and manage existing native trees and shrubs from loss or damage by fire, land clearing or animals.
- ☐ Use an appropriate carbon calculator to estimate how much carbon is being stored in your farm woodlot (go to www.agriculture.vic.gov.au/carbon-emissions for links to appropriate tools).
- ☐ You could also consider participating in carbon credit or incentive schemes, noting that:
  - ☐ the rate of carbon sequestration of farm trees is directly related to the type of trees, their age and how fast they grow.
  - ☐ carbon credit schemes are subject to ongoing conditions and contracts, which should be thoroughly investigated before proceeding.
  - ☐ or maybe you might just want to measure and record your farm carbon to balance against your own farm emissions for use in trade, market or low emissions food-fibre verification schemes (such as carbon neutral wine, milk or meat).

Further information: www.agriculture.vic.gov.au/carbon-emissions

Supply chain: prepared for what others are doing

How are our supply chains responding to the challenge of reducing carbon emissions? Reducing on-farm and through chain emissions may make good business sense by increasing efficiencies and reducing costs.

Retailers and food processors are already looking to reduce emissions along their supply chain to save costs, capitalise on market opportunities or meet new trading requirements. Increasingly, retailers are quantifying emissions through the chain from input suppliers to farming, transport, retail, product consumption and disposal. Some retailers are requesting this information from their suppliers. There is also significant activity underway by banks, financiers, insurers and other parties that service agriculture as they prepare for managing the risks of climate change and establish programs to reduce greenhouse emissions. Farm businesses that understand their farm emissions profile will be better prepared to respond to these external pressures and find new opportunities and markets.

Profitable farming involves growing more of what our domestic and export markets demand. While we may not be in control of the future mix of products we produce, we can make sure that our products are amongst the lowest emissions per unit of product.

Management options

Farm businesses that understand their farm emissions profile will be better equipped to capitalise on new market opportunities and respond to emerging supply chain and consumer pressures.

- ☐ Keep accurate records on the inputs and outputs of the production system.
- ☐ Use an on-farm greenhouse gas accounting tool to estimate the on-farm emissions. These are available across a range of industries including grains, sheep, beef, dairy, viticulture, vegetables and other horticultural enterprises.
- ☐ Consider collaborating and understanding the needs of other members of the supply chain and any opportunities to reduce energy consumption (e.g. potato producers can use a lot of energy keeping potatoes moist, which can then flow on to their processor by needing to use more energy to take that moisture out again).
- ☐ Consider potential waste along the supply chain (e.g. spoilage can reduce the overall effectiveness of your emission reduction activities).
- ☐ Keep across market news and trends in order to capitalise on new and emerging markets and reduce market impacts on your farm business:
  - ☐ understand the complete supply chain from input suppliers to farming, transport, retail, product consumption and, finally, disposal.
  - ☐ understand what retailers are asking their suppliers to do to reduce emissions and how this might affect your farm business.
  - ☐ profitable farming involves growing more of what our domestic and export markets demand. While we may not be in control of the future mix of products we produce, we can make sure that our products are amongst the lowest emissions per unit of product.

Further information: www.agriculture.vic.gov.au/carbon-emissions

Greenhouse gas cycles in agriculture

Nitrous Oxide

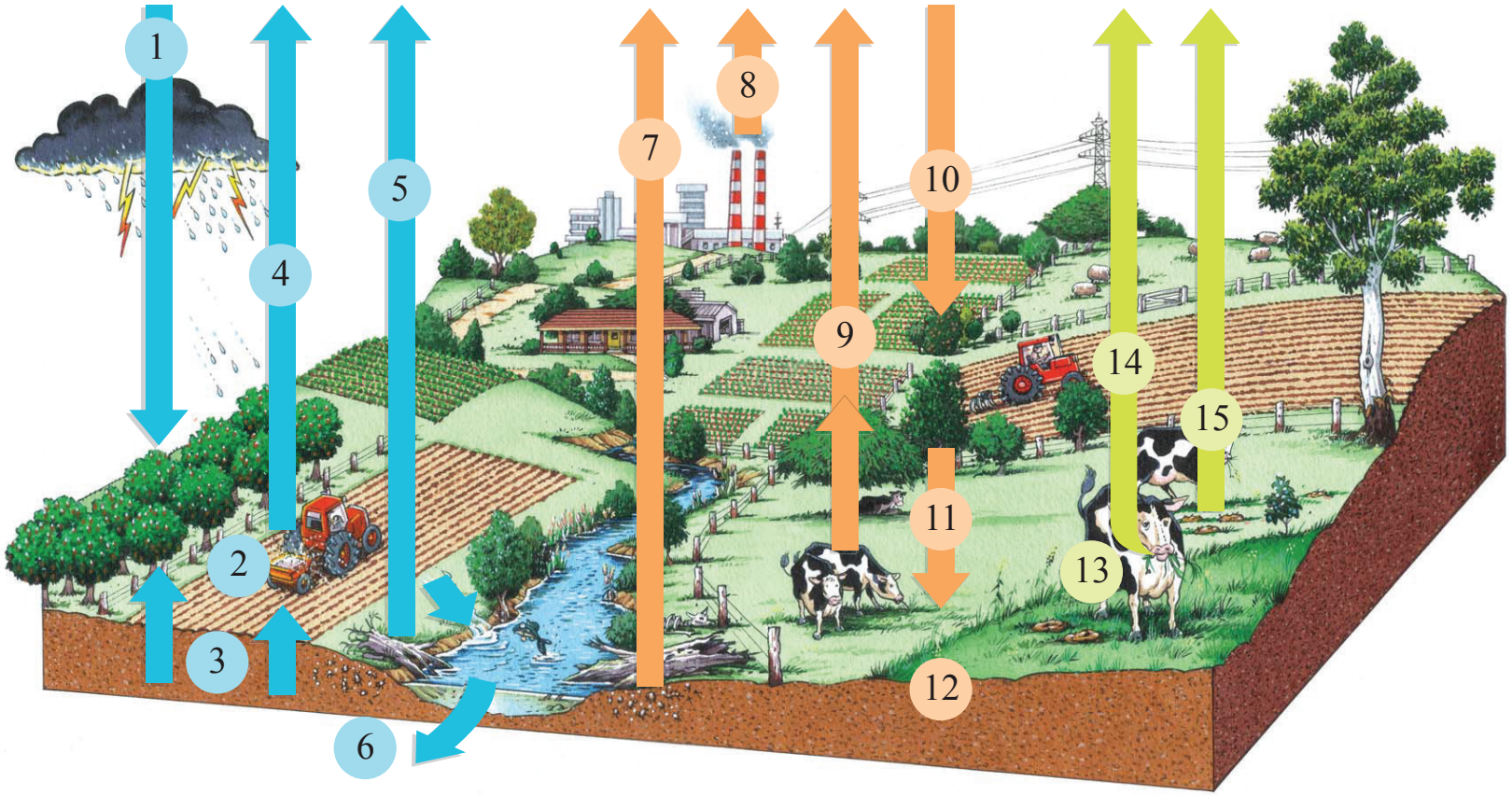
is mainly released through soil disturbance, nitrogen fertilisers, urine and dung. The global warming potential of nitrous oxide is 310 times that of carbon dioxide over a 100 year period.

Carbon Dioxide

is mainly released through burning of fossil fuels, plant decay and insect and microbial activity in soils. It is also absorbed by plants through photosynthesis and stored in soils and trees.

Methane

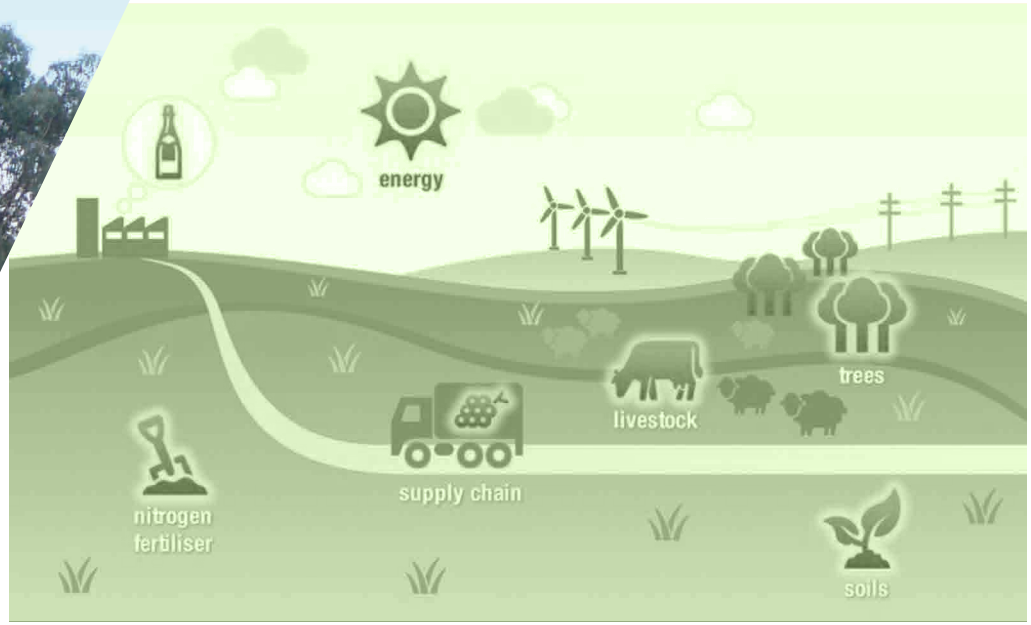
is mainly released from cows and sheep following digestion of plant matter. The global warming potential of methane is approximately 21 times that of carbon dioxide over a 100 year period.



1. Nitrogen absorbed by lightning (falls in rain) and nitrogen fixing bacteria in legumes
2. Nitrogen-based fertilisers applied to pasture or crops
3. Nitrogen taken up by pasture, crops and trees
4. Nitrous oxide released through volatilisation of urea fertiliser
5. Nitrous oxide released through process of denitrification
6. Nitrogen loss through runoff and leaching from fertilisers and nitrification process in soil
7. Carbon dioxide released through plant decay, and insect and microbial activity in the soil
8. Carbon dioxide released from burning fossil fuels to produce electricity and fuel
9. Carbon dioxide released by animals and plants through respiration
10. Carbon absorbed by trees, pasture and crops through photosynthesis
11. Animals consume carbon by eating plants
12. Carbon from organic residues (e.g. dead leaves, roots, manure & urine) absorbed into the soil
13. Methane (CH_4) is produced within the rumen (fore-stomach) during digestion, via a chemical reaction between carbon and hydrogen
14. Methane released by cows and sheep burping following ruminant digestion
15. Small amounts of methane released from fermentation of animal dung and urine under anaerobic (no oxygen) conditions

Further information

For more information on carbon and emissions management and each of the key action areas, visit www.agriculture.vic.gov.au/carbon-emissions



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