# Farm Emissions Reduction Planning

## Information guide – Version 1

**Donna Lucas, July 2015**

## 1 Summary

This document provides a guide for the development of Farm Emissions Reduction Plans (ERPs). It is intended for advisors and consultants preparing farm plans for their Tasmanian clients, and can also be used by farmers to develop their own plans. This guide also has national relevance, but if used in other states, industry specific tools will need to be investigated e.g. greenhouse gas (GHG) calculators for tropical crops.

The approach used is through the 'lens' of on-farm activities and not the whole supply chain.

A flexible approach has been designed so that ERPs can be tailored to the needs of each individual farm business. An ERP can be developed as an addition to existing or new Property Management Plans (PMPs) or can be developed as a standalone plan.

## 2 Introduction

### The Tas Farming Futures project

The concept of ERPs was developed by the Tas Farming Futures project (the Project). The three-year project (June 2013 to April 2016), delivered by RM Consulting Group, provides support to Tasmanian farmers to reduce farm emissions and/or participate in the Emissions Reduction Fund (ERF, formerly the Carbon Farming Initiative, or CFI). The projectis supported by funding from the Australian Government.

During the first six months of the project, the project team found that farm planning was a useful way to support farmers to learn more about carbon sequestration (e.g. in trees), the sources and magnitude of their farm emissions, and how to reduce emissions and plan for increased efficiency. As a result, this ERP approach was developed.

Through a pilot trial of this guide with farmers in mid-2015, the Project team found that ERPs needed to:

- Be tailored to individual farm needs and situations (targeted)
- Be able to stand alone but also add to existing or new PMPs, Farm Water Access Plans (FWAPs) or other plans if applicable.

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*This guide is intended to be of assistance to people developing farm plans, in particular ERPs. RM Consulting Group does not guarantee that this document is without flaw of any kind or is wholly appropriate for individual purposes, and therefore disclaims all liability for any error, loss or other consequence, which may arise from relying on any information in these documents. These documents do not purport to provide legal advice.*

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# 3 The Tasmanian Property Management Framework

This section provides a background to Property Management Planning in Tasmania and how ERPs fit with existing and future property planning.

## 3.1 Main components of the Tasmanian Property Management Framework

Prior to 2009, several groups of properties across Tasmania had undertaken Property Management Planning. A variety of approaches and/or processes were used to develop the farm plans. This varied depending on the Natural Resource Management (NRM) regional priorities, the amount of funding available and the method used/preferred by different service providers engaged by the NRM regions.

In 2009, a Tasmanian Property Management Framework was developed, providing guidelines and standards for a more consistent approach. This included a modular approach with multiple levels of entry. The following three Property Management Planning modules were developed:

- Soil Module,
- Water Module, and
- Biodiversity Module.

Each module includes a risk assessment questionnaire.

Other modules subsequently developed include:

- Climate Change Module (2010)
- Drought Module (2010)
- Financial Management Module (2011).

Refer to the Tasmanian Farmers and Graziers Association (TFGA) website for more information on the Framework (http://www.tfga.com.au/policies/projects/).

## 3.2 How has the Framework been used since 2009?

Since 2009, the methods used for developing PMPs still vary, and can depend on the needs of participating farmers and the regional priorities. In addition, each of the three Tasmanian NRM regional bodies has developed programs for small landholdings, which generally include self-assessment booklets.

A majority of PMPs developed over the past four years were tailored to meet specific objectives or needs (e.g. a group of beef producers in the Cradle Coast region). Although some PMPs comply with the Framework Standards, others do not necessarily need to be consistent with the Standards. The Standards include components that may not be relevant or appropriate e.g. for the level of funding available.

Farmers who access water from Tasmanian Irrigation schemes are required to have a FWAP developed. These FWAPs include the three modules from the Framework: soil, water and biodiversity; and they focus on the area of the property where the irrigation water will be used (i.e. not necessarily the whole property).

## 3.3 Self-assessment tools

There are several existing self-assessment tools available to support effective property management planning:

- Risk assessment for each of the soil, water and biodiversity modules (Framework Modules) (http://www.tfga.com.au/policies/projects/)
- NRM North Small Holding Self Assessment Tool (http://www.nrmnorth.org.au/client-assets/content/NRM%20Small%20Holdings%20Self%20Assessment%20Tool.pdf)
- Dairy SAT (http://www.dairyaustralia.com.au/Environment-and-resources/DairySAT---Dairy-Self-Assessment-Tool.aspx)

These self-assessments already include questions about reducing emissions or storing carbon.

There are other self-assessment tools developed and tailored for specific programs e.g. 2014 Cradle Coast NRM Beef PMP Program, and tools have been developed in other states e.g. Western Australia.

The Project Extension Officers have found that when working with farmers:

- Talking through the checklist and then leaving it with the farmers to complete in their own time proved to be a better approach than going through it with them as they tended to rate themselves differently if their score was quite low when the Officers were there (and they felt they were being judged).
- Using a self-assessment checklist with farmers was often awkward for the Extension Officers. Some questions were very basic and many landholders already knew the basics. This suggests that the checklists need to be tailored to groups of producers.
- Self-assessment questions about emissions reduction should be embedded in other sections (e.g. soil or livestock management sections) rather than as a separate “add-on”,

because emission reduction should be incorporated into decision-making about those topics rather than as an optional extra.

## 3.4 Conclusion – how ERPs fit with the Framework

Given the varying types of farm plans, ERPs needed to allow flexibility, not only in their content (to address individual farm needs/questions), but also how they fitted with existing or future farm plans.

**An ERP can be:**

- A standalone plan,
- Added to a PMP, or
- Incorporated into a PMP.

Standalone ERPs may not necessarily meet the Tasmanian Property Management Framework Standards. However, the components of an ERP can easily be incorporated into other modules and/or plans that do meet the Standards, if required. Emissions reduction can be **incorporated into other existing modules** so an additional module for emissions reduction is not required.

Given that:

- there is a range of existing self-assessment tools that already include most of the relevant questions about emissions reduction,
- the NRM regions often tailor tools to specific programs, and
- there is a strong preference to discuss topics with farmers rather than completing self-assessment tools,
- existing tools (if self-assessment / risk assessment is appropriate) are sufficient and there is no need to revise or recreate new ones (even if a few questions / topics may be missing from them).

We have created a **checklist of topics** (see section 5.2.2) to discuss with farmers, rather than create a new self-assessment tool.

# 4 Why would farmers undertake emission reduction planning?

The Australian Government has a commitment to reducing emissions to 5% below 2000 levels by 2020 (Emissions Reduction Fund White Paper, Commonwealth of Australia, 2014).

Agriculture accounts for about 16% of Australia's emissions (Australian National Greenhouse Accounts 2011).

Farmers can benefit from reducing emissions through:

- Potential profits from productivity increases (e.g. if productivity can be increased without increasing emissions).
- Potential cost savings (e.g. from improved nitrogen use efficiency (NUE), energy efficiency)

- Potential marketing advantages (e.g. marketing products as "low emissions") and through demonstrating industry sustainability and environmental stewardship.

# 5 Developing an Emissions Reduction Plan

## 5.1 General approach

The following table provides an overview of the suggested approach. More details are provided in the next sub-sections.

**Table 5-1: Overview of approach**

| Step | Main tasks |
|---|---|
| 1. Pre visit | ▪ Before the farm visit, provide a list of potential data requirements so that farmers can consider the main topics and start collecting the data. It would be useful to provide this list in an Excel spreadsheet for the farmer to complete. |
| 2. Initial farm visit (allow about 2 to 4 hours) | ▪ Clarify business and family goals<br>▪ Confirm existing farm plans and / or maps<br>▪ Gather general farm data and information<br>▪ Identify topics / questions relevant to individual farm (use checklist)<br>▪ Provide general information (e.g. fact sheets) as appropriate<br>▪ Farm walk<br>(NB this might include assessment of soils (using soil kits including labile carbon test), pastures or crops)<br>▪ Obtain soil test results if relevant (carbon and/or nitrogen)<br>▪ Obtain data (or provide a list data required) for calculators<br>(NB you will need an understanding of which calculator you expect to use, in order to know what data to collect)<br>(NB some calculators, e.g. Nitrogen Use Efficiency (NUE)[1] and Black Magic, require only a small amount of easily recalled data, i.e. data that farmers will already know, so it is a good idea to ask for this information during the site visit rather than waiting for further information later on).<br>▪ Obtain data on production (e.g. total yields) to allow calculation of emissions intensity.<br>▪ Undertaken feed samples for testing, if relevant<br>▪ Undertake soil sampling for analysis, if relevant<br>▪ Climate adaptation can also be discussed including longer term issues such as potential changes in pest and disease pressure; and in the medium-long term, farm planning to reduce risks e.g. if moving crops upslope what is the effect on energy use. |
| 3. Calculate GHG emissions | ▪ Calculate GHG emissions using the most appropriate GHG calculator (see list in section 5.3.1 for links).<br>▪ Calculate emissions intensity (see section 5.3.3). |

| Step | Main tasks |
|---|---|
| 4. Other calculations | ▪ Undertake other calculations as appropriate/relevant:<br>– Nitrogen Use Efficiency (NUE%)<br>– Soil carbon (analysis of historical data)<br>– Black Magic (to model changes in soil carbon based on different crops and management) [2] NB see note below re Black Magic.<br>– Livestock feed protein and energy balance<br>– Energy efficiency<br>– Pump efficiency<br>– Farm waste (this can be a source of emissions, especially if large scale).<br>See section 5.4 for further information on the above tools. |
| 5. Draft report | ▪ Desktop research if required (including for example, industry benchmarks for GHG emissions intensity or crop NUE; investigating carbon offset options if the farmer is interested in this)<br>▪ Farm maps could be included (but are not necessary)<br>▪ Prepare draft report. |
| 6. Second farm visit to review report and action planning | ▪ Review GHG and other calculations and present draft report to farmer<br>▪ If relevant, suggest that the farmer invites their agronomist or field officer to this visit to discuss findings<br>▪ Support the farmer to develop their own action plan<br>▪ Cross-check actions with existing PMPs and/or FWAPs, if relevant<br>▪ Discuss how the ERP fits with information provided in existing plans (e.g. nutrient management, sol tillage, tree planting etc.). |
| 7. Finalise report and action plan | ▪ Incorporate feedback from farmer and their advisor (if applicable) and present final report. |
| 8. Group extension (optional) | ▪ Field days, guest speakers, workshops, discussion groups. |
| 9. Annual review | ▪ Re-visit annually to:<br>– Review progress against the plan<br>– Recalculate GHG emissions, carbon sequestration, NUE% and other calculations if appropriate<br>– Revise action plan. |

[1] **The NUE Calculator** developed by this project will be available online from June 2016.

[2] **Black Magic** was developed by the Tasmanian Institute of Agriculture and is designed to model changes in soil carbon under different crop rotations and management strategies. The model contains Tasmanian parameters from 30 crops, 14 soil/area combinations and 60 sets of climatic conditions (Bill Cotching, 2014, http://www.billcotching.com/Soil_carbon_Aug_2014.pdf). Black Magic may not be appropriate to use if the required crop / soil / location parameters are not among those included in the model e.g. if a particular soil type is not in the model. The model is very useful as an extension tool, because the data inputs are straightforward and the outputs can be used to compare different scenarios and to demonstrate the benefits of stubble retention, green manures and pasture.

## 5.2 Initial farm visit

### 5.2.1 Clarify questions and focus

The initial farm visit is an opportunity to clarify the farmers' main issues, opportunities, questions and business aspirations. This is important to establishing the main focus of the farm ERP. ERPs can be comprehensive and include all aspects of emissions reduction OR can be focussed on a particular issue or opportunity.

The following boxes provide examples of ERPs each with a different focus.

**Example: Supplementary feeding to balance protein and energy**

A producer felt that his sheep were not performing as well as expected. Feed testing identified that protein levels were sometimes too high (spring and autumn) especially in lucerne crops (Refer to Appendix 3 for information on high protein in pasture).

This producer is now trialling different fodder crops and supplements to increase efficiency. The focus of this plan was to increase efficiency of sheep, which will also reduce $CH_4$ emissions.

**Example: GHG estimate to examine overall farm efficiency**

A beef producer calculated his farm business GHG emissions. Opportunities for increased efficiency were identified e.g. ways to increase live weight gains. The GHG estimate provided a benchmark of emissions in $CO_2e$ / tonne of beef produced. This can be reviewed each year and also used to compare against industry averages.

**Example: Offsetting orchard GHG emissions**

An orchardist wanted to offset his GHG emissions. The focus of this ERP was to estimate GHG emissions, identify potential options to reduce emissions e.g. changing refrigerants and to determine how many carbon credits would need to be purchased. The plan provided information on the different options including:

- Participate in an accredited Carbon Neutral program - National Carbon Offset Standard (NCOC)
- Offset emissions using a registered Carbon Offset Provider (COP)
- Invest in a local environmental project to offset emissions
- Participate in the CFI and offset emissions through an approved project on the property.

### 5.2.2 Farm visit checklist

A farm visit checklist template is attached at Appendix 1. This provides a list of topics as a starting point for discussions. It can be adapted depending on the tools being used and the information required.

The following topics should be discussed where relevant:

| Topic | Discussion points / comments | Resources | Data to gather[1] |
|---|---|---|---|
| Greenhouse gases (GHGs) | The link between GHG and farm efficiency / profitability.<br>The main sources of GHG emissions for the individual farm enterprises. | Resources from Tas Farming Futures webpage:<br>▪ GHG Poster<br>▪ Case Studies | Data for the specific GHG calculator being used (advisors will need to be familiar with calculators).<br>(see list of calculators in section 5.3.1) |
| Carbon sequestration in trees and vegetation | Trees and vegetation included in the GHG calculation above (i.e. plantings after 1990).<br>Productivity benefits of trees. | Private Forests Tasmania 'Farm Forestry Toolbox'<br>(http://www.pft.tas.gov.au/index.php/services/services/41-farm-forestry-toolbox)<br>Reforestation Tools, Department of the Environment | Information required for GHG calculation e.g. area (in hectares) planted since 1990. Some calculators also require species planted. |
| Nitrogen (N) fertiliser | Types of N fertilisers used<br>Fertiliser management planning (rates, timing etc.)<br>NUE<br>Monitoring<br>Soil and sap testing<br>The link between NUE, nitrous oxide ($N_2O$) emissions and other N losses; and dollar value of potentially unused N fertiliser. | Resources from Tas Farming Futures webpage:<br>▪ NUE% Calculator (available June 2016)<br>▪ 'Good fertiliser decisions – nitrogen' Fact Sheet<br>▪ 'Nitrogen Use Efficiency%' Fact Sheet<br>▪ 'Quick guide to nitrogen fertilisers' poster<br>Soil nitrate test strips (Soil kits) for use in the field | NUE% calculator:<br>▪ Crop and varieties<br>▪ Yield (e.g. t/ha)<br>▪ Stubble management<br>▪ Fertiliser type and amount used<br>▪ Paddock sizes / total crop area (ha)<br>▪ Price of fertiliser (if the farmer wants to know potential savings)<br>▪ Soil type and condition, planting date (agronomists in particular have suggested these be recorded) |
| Soil carbon | Soil tests<br>The link between soil carbon, soil health / condition and | Obtain historical soil tests if available<br>Black Magic (soil carbon model) available from Tasmanian Institute of Agriculture (TIA) | Black Magic:<br>▪ Current soil carbon levels<br>▪ Farm location |

| Topic | Discussion points / comments | Resources | Data to gather[1] |
|---|---|---|---|
| | productivity / profitability. | Labile soil carbon test (Soil kits) for use in the field<br>Soil carbon dioxide ($CO_2$) respiration kits (these take 24 hours to run) | ▪ Soil type (select from options in model)<br>▪ Rotation details (crop type, pasture, green manures)<br>▪ Min Tillage (Y/N)<br>▪ For each crop in the rotation:<br>– Irrigation (Y/N)<br>– Crop growing period<br>– Yield<br>– Stubble management |
| Livestock | Productivity (e.g. kg meat produced per ha)<br>Reproduction efficiency (e.g. lambing %, weaning rates)<br>Finishing times<br>Feed (quality, protein to energy ratios)<br>The link between lifetime emissions and emissions intensity<br>The link between emissions and efficiency / profitability | Livestock records<br>MLA cost of production calculators (http://tools.mla.com.au/cop/)<br>Resources from Tas Farming Futures webpage:<br>▪ CT Legume poster<br>▪ Livestock efficiency case study | Livestock records and production figures. |
| Energy efficiency | Irrigation pumps<br>Lighting<br>Refrigeration<br>Packing lines | Energy Self Audit Tool for Tasmanian Farmers (http://www.farmpoint.tas.gov.au/farmpoint)<br>Pump Efficiency Calculator (http://www.tfga.com.au/policies/usefull-tools/)<br>Case studies from this Tas Farming Futures project<br>Apple and Pear Australia (APAL) 'Watts in your business' Fact Sheets (http://apal.org.au/watts-in-your-business/) | See specific data required for energy audit and for pump efficiency calculator. |

| Topic | Discussion points / comments | Resources | Data to gather[1] |
|---|---|---|---|
| | | Horticulture Innovation Australia (HIA) Fact Sheets and case studies | |
| Refrigerants | Type and amount of refrigerants used and the Global Warming Potential (GWP) of different refrigerants<br>Phase out of HFCs by 2016 | Apple and Pear Australia (APAL) 'Watts in your business' Fact Sheets<br>Australian Institute of Air Conditioning, Refrigeration and Heating (AIRAH) factsheets and Cold Hard Facts2 report | Refrigerants used |
| Emission intensity | What it means e.g. the difference between calculating total emissions and emissions intensity and how these can be used to monitor performance. | MLA Cost of production calculators (http://tools.mla.com.au/cop/) | Production data and yields<br>Total emissions |
| ERF;<br>Carbon offset schemes | Provide information as required / requested. | ERF Fact Sheets and case studies (http://www.cleanenergy regulator.gov.au)<br>My Carbon Farming website: (http://www.mycarbon farming.com.au) | |

[1] Calculating GHG emissions is suggested for all plans if possible. Data can be collected for other topics / calculators, if they are relevant and / or the farmer is interested in learning more about, or focussing on them.

### 5.2.3 Collect data for GHG and other calculators

The data required will vary depending on the type of enterprise as well as the calculator used. Some experience in using the calculators is required prior to collecting the data.

Generally, the following information / data is required (it is advisable to provide a brief list, prior to the visit, so that they can have the information ready):

- Electricity bills/meter records for the reporting year
- Fuel bills/receipts for the reporting year (i.e. natural gas, petrol, diesel, LPG, wood).
- Records of waste processed on-farm for the reporting year (for horticultural calculators) i.e. tonnes or cubic meters of wood waste burnt
- Records of N fertiliser usage for the reporting year (type and amount used)
- Service documents for on-site cold rooms or industrial freezers for the reporting year or on site inspection of refrigeration systems – look for stickers listing the refrigerant type (for refrigerants used)

- Livestock numbers by class (and by season and/or month depending on which calculator is used)
- Livestock average weight and live weight gain if known
- Livestock feed information
- Area (in hectares) of trees planted after 1990 (some calculators require additional information e.g. species planted)
- Annual production volume (e.g. tonnes of wool, meat, milk, fruit etc.).

## 5.3 Calculate GHG emissions

ERPs should include, wherever possible, an estimate of farm GHG emissions. This provides data on the sources and magnitude of emissions, can highlight where efficiency can be increased and is a useful engagement tool (for discussing emissions and efficiency).

**The main emissions sources from a typical Tasmanian farm business are:**

- Perennial horticulture – mainly electricity (for irrigation, pumping and packing sheds), diesel usage and refrigerant gas leakage (from packing sheds), plus a small amount from soil carbon and nitrogen fertilisers.
- Livestock – mainly enteric methane from sheep and cattle.
- Mixed farms – mainly methane from livestock and a small amount from nitrogen fertilisers.

### 5.3.1 Greenhouse gas calculators

The following table provides a list of the main calculators available. Note that:

1. These calculators will only provide an estimate of GHG emissions.
2. Most calculators are not sensitive enough to different practices e.g. using different fertiliser management strategies, and therefore outputs should be used/compared with caution.

Other calculators are available, in addition to those listed here, but remember that some are designed for use in other countries and/or are not consistent with the Australian Carbon Accounting system (this is the system that Australia uses to calculate national GHG emissions). One example is the 'Cool Farm Tool', which is used by farmers globally. Multi-national companies use the tool and some are members of the Cool Farm Alliance. So it may be appropriate to use this tool if farmers supply processing companies who are part of the Alliance. For more information see http://www.coolfarmtool.org

**GHG calculators consistent with the Australian Carbon Accounting system**

| Calculators / location | Industry | Notes |
|---|---|---|
| **University of Melbourne**[#] (http://www.greenhouse.unimelb.edu.au/Tools.htm)<br>(D-GAF) Dairy<br>(B-GAF) Beef<br>(B-GAFN) Beef (extra livestock category for northern beef)<br>(S-GAF) Sheep<br>(G-GAF) Grains<br>(F-GAF) Feedlot | Dairy<br>Beef<br>Beef (extra livestock category for northern beef)<br>Sheep<br>Grains<br>Feedlot | Various excel based, each for a specific enterprise. |
| **DGAS**<br>http://www.dairyaustralia.com.au/Environment-and-resources/Climate/MicroSite1/Home/Farm-Greenhouse-Gas-Calculator.aspx | Dairy | Excel based |
| **PigBal**<br>http://www.greenhouse.unimelb.edu.au/Tools.htm | Pork | Excel based |
| **Vegetable carbon calculator**<br>http://www.vegiecarbontool.com/login.php | Vegetables | Online |
| **HortCarbonInfo**<br>http://www.greenhouse.unimelb.edu.au/Tools.htm | Horticulture | Excel |
| **Australian Wine Carbon Calculator**<br>http://www.wfa.org.au/resources/carbon-calculator/ | Wine | Excel (separate version for Mac users) |
| **FarmGAS**<br>http://calculator.farminstitute.org.au | Beef breeding<br>Beef stores<br>Beef feedlot<br>Sheep<br>Cropping – dryland and/or irrigated | Online<br>Includes financial analysis.<br>Multiple farms/ scenarios can be set up. |

[#] Note! $CO_2$ from fuel and electricity is NOT attributed to the farm in the Australian National Greenhouse Gas Inventory (NGGI), but has been included in these calculators by popular request from users.

### 5.3.2 Mixed enterprise farms

If using enterprise specific calculators (e.g. the University of Melbourne calculators) for mixed farms, it will be necessary to use multiple calculators (e.g. sheep + beef + grains) and then add

the emissions from each calculator to provide overall emissions for the farming business. Care should be taken to not double count items e.g. N fertiliser used for multiple livestock enterprises should be counted only once (or split between enterprises); carbon stored in tree plantings should only be counted once.

FarmGAS is designed to handle multiple enterprises and provides an estimate of emissions for each enterprise as well as the overall business.

### 5.3.3 Emissions intensity

Emission intensity is the emissions in tonnes of carbon dioxide equivalents ($CO_2e$) per tonne of produce or per hectare. Emission intensity should always be calculated wherever possible, because it provides a useful benchmark for comparing efficiency with industry averages and for monitoring farm emissions over time.

Therefore, data should be obtained on total farm production e.g. tonnes of meat or fruit etc. Calculating emission intensity can be difficult with mixed enterprises e.g. wool plus meat from sheep. So, sometimes emissions per hectare are more appropriate or easier to calculate.

Tools are available on the Meat and Livestock Australia (MLA) website for calculating meat production (use the first section of the cost of production calculators to calculate production in kg of beef or lamb):

- http://www.mla.com.au/News-and-resources/Tools-and-calculators/Cost-of-production-**beef**
- http://www.mla.com.au/News-and-resources/Tools-and-calculators/Cost-of-production-**lamb**

When calculating and reporting **emissions intensity**, the product must be clearly defined e.g. for meat enterprises it should be clearly stated if it is live-weight, dressed weight or processed meat.

In the case of dairy, milk production needs to be **corrected for fat and protein** levels to be able to compare emission intensity with other producers.

## 5.4 Other calculations

Depending on the enterprises and the main focus of the ERP, a range of other calculations can be undertaken. These are listed in the following sub-sections.

### 5.4.1 NUE%

**NUE% calculator**

- Contact the Tas Farming Futures project team at RM Consulting Group on (03) 6437 2264
- This calculator will be available online by June 2016.

Refer to Appendix 2 for NUE% fact sheets.

### 5.4.2 Soil carbon

**Black Magic Model (Tasmanian Institute of Agriculture, TIA)**

A Microsoft Excel-based tool that models soil carbon in cropping soils based on soil type, location/climate and management (including irrigation, stubble management, tillage, cover crops or fallow periods).

### 5.4.3 Feed testing

Feed testing laboratories are listed in Appendix 3.

Consider the energy:protein ratio of feed as well as Crude Protein percentage (CP%).

Feeding high protein feeds, such as lush lucerne, can result in disappointing growth rates in lambs and will also increase methane ($CH_4$) and $N_2O$ emissions. Supplementary feeds can improve feed efficiency. However, the CP% can vary substantially throughout the season and the economics of supplementary feeds must be considered.

### 5.4.4 Energy efficiency

**Pump efficiency calculator (ARM, 2010)**

- http://www.tfga.com.au/policies/usefull-tools/
- http://www.farmpoint.tas.gov.au

**Energy Self Audit Tool (Hydro Tasmania Consulting, 2009)**

- http://www.farmpoint.tas.gov.au/farmpoint.nsf/downloads/A50A7A9E8E3FB9E8CA25774C007DEA72/$file/Tasmanian_Farm_Energy_Self_Audit_Tool.pdf

## 5.5 Draft report

Once the data has been collected and relevant calculations undertaken, the draft report can be compiled.

The following is an example / suggested table of contents but it can be tailored to suit each plan:

1. Summary, including table of actions
2. Property details
   *(including property size, enterprises, location, rainfall, soils)*
3. Annual GHG emissions, emissions intensity and sequestration

   *(include a table showing the sources and magnitude of GHG emissions and carbon sequestration)*
4. Reducing emissions / increasing efficiency:
   - Soil carbon

- N fertilisers
- Refrigerants
- Livestock e.g. reproduction
- Pasture e.g. protein to energy ratio
- Etc.

5. Emission Reduction Fund (ERF) information
6. References and further information

Although the reports are intended for the individual farmers' use, the report should include sufficient detail for other readers (in case the farmer provides it to his / her advisor e.g. agronomist), to understand how any assumptions or conclusions were reached, including information on:

- How data were collected
- Which calculators were used and their version numbers
- Information on the farming system e.g. how livestock are managed and type of grazing management system
- How recommendations / options for consideration were reached and how to implement them
- The impact of recommendations / options on net farm emissions and also emissions intensity.

In some cases, a case study may be more appropriate than an ERP. An example case study can be found in Appendix 4.

## 5.6 Second farm visit

The draft report should be reviewed with the farmer and if appropriate together with their advisor or field officer (with the farmer's permission). This allows discussion on the key points and the farmer to develop their own action plans.

## 5.7 Finalise report and action plan

Feedback is incorporated and the final plan compiled.

## 5.8 Group extension

A group event in addition to one-on-one extension can be effective for learning and problem solving, especially where a group of people have similar needs. This could include any combination of:

- Presentation of case studies
- Presentation of findings from reports (with the farmer's permission)

- Farm walks e.g. to visit demonstrations / trials or view changes the farmer may have implemented
- Presentations from industry experts (e.g. a livestock nutritionist)
- Workshops for specific problems / opportunities
- Facilitated discussion group around the options presented and how it can potentially work within their system
- Benchmarking group using emissions as the currency (with prior permission from the group to use anonymous data).

## 5.9 Annual review

The ERP should be reviewed annually to:

- Review progress against the plan and baseline calculations
- Recalculate GHG emissions, NUE% and other calculations if appropriate (to allow monitoring over time and to monitor effectiveness of actions / strategies)
- Revise and update the action plan.

# 6 For more information

If you would like further information contact:

- RM Consulting Group, Tasmania (03) 6437 2264
- NRM regional bodies:
    - NRM North, (03) 6333 7777
    - NRM South, (03) 6221 6111
    - Cradle Coast NRM, (03) 6433 8400
- Agricultural consultants

# Appendix 1: Farm visit checklist

"Tas Farming Futures:
Reducing land sector emissions
and effecting the CFI in Tasmania"

RMCG

## Farm visit checklist

### 1st point of contact with landholders

**Dec 2013**

## 1 Purpose of farm visits

A farm visit is often the first point of contact. Use it to provide information about our project and gather information about the farm, its management resources and landholder outlook. At the end of the visit you can discuss if the landholder is interested in any of our other services (refer to the Services Postcard and accompanying notes).

## 2 How to use this checklist

This list provides a starting point for your farm visits and/or discussions with landholders. It is structured to flow from introductory questions through to more detailed farm-specific content and end with some form of action planning or 'next steps'. The questions will vary from farm to farm, and should be tailored as part of your preparation, depending on the enterprise type, landholder capacity and initial reason for inquiry / visit. You can also change the order of questions to suit the situation.

*Amend the list, print it out and take it along with you to guide your note taking.*

## 3 Introductory topics

- Why the interest in our project? Expectations, questions, knowledge of emissions/CFI
- Landholder contact details / location
- Property details (farm name, enterprise mix, size in ha)
- Business name / type / history
- Goals and aspirations (short and long term)
- Whole farm plan / PMP / WAP available?

*It helps to start discussions around the kitchen table, if possible with a farm map (or use Google maps) and all partners present. Once the basics are covered, farm specific topics are more easily discussed during a farm walk. Take photos with the landholders' consent.*

## 4 Farm specific prompts

- Soil types / variations / issues / land capability if known
- Water sources / use / issues
- Weeds / pests / disease

- Nutrients / management / issues
- Trials / monitoring / outcomes
- Pasture types / management / issues
- Animal types / numbers / stocking rate / grazing management / issues
- Crop types / management / rotations / issues
- Native vegetation / plantations / management / issues
- Areas (ha) of different uses (e.g. crops, pasture improved/native, native veg etc)
- Key markets / buyers for product/s
- Farm record keeping / QA / HR
- Energy use / efficiency / issues
- Waste types / management / issues

## 5 Action planning / next steps for the landholder

*Note this may be done during a second visit as appropriate*

- Priority activities / issues (high-med-low)
- Desired outcomes
- What to do / management strategies
- How / when / where
- Estimated cost
- Monitoring – what / when / how

## 6 Other project services / activities

The information gathered during the first farm visit will help you and the landholder determine which other project services might be appropriate or needed. Each will have specific information requirements depending on the enterprise and needs of the landholder. *Use the first farm visit as the starting point THEN prepare / tailor further questions as appropriate*. Other services available (refer to our Services Postcard and notes):

- Emissions Estimate
- Emission Reduction Plan (ERP)
- Carbon Snapshot
- Carbon Capture Plan (C Plan)
- Guided Self Assessment
- Farm Management Plan (FMP)

# Appendix 2: NUE% fact sheets

"Tas Farming Futures:
Reducing land sector emissions
and effecting the CFI in Tasmania"

RMCG

## Nitrogen Use Efficiency (NUE %) and N Balance

### Information for Extension Officers

**Doris Blaesing, RMCG 31-1-14**

### What is NUE?

Nitrogen Use Efficiency (NUE) is a term used to indicate the **ratio** between the amounts of fertiliser nitrogen (N) applied to the crop and the amount of N removed from the paddock by the crop or product.

Fertiliser N inputs are the sum of nitrogen (N) contained in all fertilisers used for a crop in a growing season, whether pre-applied, banded or top-dressed. A list of fertiliser nitrogen contents is in the Appendix.

The ratio informs about the relative utilisation of fertiliser N[1] applied to a crop; it does not consider other soil N sources available to crops. **NUE is mainly an indicator for productivity**. High NUE means that more of the applied N is used by the crop and is therefore less likely to be lost to the environment through run-off, leached from the root zone as soluble nitrates or emitted as gaseous compounds.

### How is NUE calculated?

NUE for a crop and one growing season can be calculated as:

**NUE % = NCR / NFI x 100**

N crop removal (NCR) *(= all parts of the crop that are harvested and removed e.g. grain and straw*), **divided by** mineral N fertiliser input (NFI), both in kilograms per hectare (kg/ha). The result is expressed in % NUE.

[1] Additional N released from soil organic matter via mineralisation.

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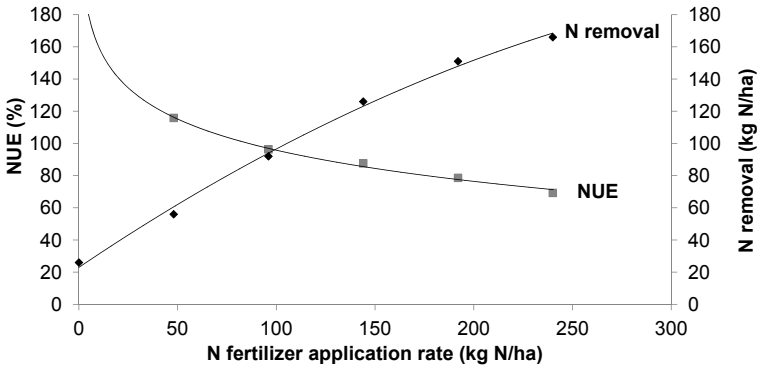
*"Reducing land sector emissions and effecting the Carbon Farming Initiative in Tasmania"* is supported by funding from the Australian Government.

**NUE = N removal / N application * 100**




Broadbalk long-term trial with winter wheat in Rothamsted, UK

*Source: Brentrup and Palliere (2010)*

The data from the Broadbalk long-term trial in Rothamsted, UK (see graph above), illustrates a relationship that has been reported in many publications: Increasing amounts of fertiliser N applied reduce NUE %. The higher the amount of fertiliser N applied, the greater the proportion of fertiliser N that is not used by the crop. This means that with higher amounts of N applied, there is increased risk of loss to the environment e.g. this can be lost through nitrous oxide emissions.

## How can NUE data be interpreted?

The below illustration using data from the Broadbalk long term (wheat) trial in Rothamsted, UK shows how NUE can be interpreted.

| N application rate (kg N/ha) | N removal (kg N/ha) | NUE (%) | Interpretation |
|---|---|---|---|
| 0 | 26 | - | Soil mining [1] |
| 48 | 56 | 116 | |
| 96 | 92 | 96 | Risk of soil mining [2] |
| 144 | 126 | 88 | Balanced in- and outputs [3] |
| 192 | 151 | 79 | |
| 240 | 166 | 69 | Risk of high N losses [4] |

(1) Soil mining = N removal exceeds N input -> declining soil fertility and yield = unsustainable

(2) Risk of soil mining = additional N requirement for roots and straw is not met by N input

(3) Balanced in- and outputs = N fertilizer input meets total crop demand (grain, straw, roots)

(4) Risk of high N losses = N fertilizer input exceeds total crop demand -> increased risk of leaching

Data from the long-term "Broadbalk Experiment", Rothamsted/UK, winter wheat, avg. yield of 1996-2000

**Factors affecting NUE:**

- Current soil N status (i.e. what N is available in the soil at the start of the crop)
- Soil temperature and moisture (through influence on mineralisation and also volatilisation rates)
- Seasonal climate (e.g. prolonged or multiple heavy rainfall events can result in N leaching)
- Previous crops (e.g. research in Tasmanian found that mineralisation rates in potato crops were 3.5 kg N/ha/day following pasture and 1.2 kg N/ha/day following cropped (Sparrow and Chapman, 2003)
- Irrigation management i.e. is irrigation matched to crop requirements or does water pass through the rootzone or runs of the soil surface; does erosion occur?
- Split applications of top-dressed N (to match plant needs and reduce risk of losses)

**Losses and emissions**

A high leaching risk may not necessarily mean that N losses to the atmosphere will be high.

Nitrogen can be lost through leaching from the root zone, as soluble nitrate. Heavy rainfall can increase the risk of leaching and runoff - this is a loss, but not a greenhouse gas emission.

The nitrous oxide loss risk depends on conditions and practices. Most nitrous oxide emissions result from denitrification, a process that occurs faster under warm and wet conditions. In other words, when irrigating during the hotter days or hotter parts of the day.

*N.B.: Soils with high organic matter content and a C/N ratio below 20 may release relatively high amounts of nitrogen and also the greenhouse gas, carbon dioxide, especially if the growing conditions provide adequate soil moisture and temperatures for microbial activity. The use of green crops, or organic amendments in cropping could lead to this situation. A high proportion of legumes in pastures could have a similar effect. Then NUE % may be >100%. An N-balance may then be used to capture these inputs and potential losses.*

## What is the N Balance?

The N balance is the **difference** between N fertiliser inputs, other N sources, such as organic amendments, and N outputs in kilograms per hectare. It indicates how much nitrogen is not captured in harvested products and other removed plant material and may therefore be lost. The N balance gives no information on nitrogen use efficiency (NUE). **The N balance is mainly a sustainability indicator.**

Manures and composts contain N in slow release form. Depending on conditions and the type of organic material about 5-20% of N from these organic materials may become available each year via mineralisation. Values outside this range are possible. They vary with type, C/N ratio, conditions and decomposition of material used If mineralisation rates can be estimated based on literature or measurements, they should be included in N Balance calculations, especially if high rates can occur. There can be substantial differences in mineralisation rates between different soil organic amendments.

Additional N sources ('other N' [kg/ha]) should be included if deemed significant such as:

- Residual soil N (nitrate and ammonium in the rootzone, e.g. measured via N-check)
- Irrigation / rain water-N, e.g. if nitrate is above 40 ppm
- Soil organic matter mineralisation (e.g. 5 – 30 kg/ha N per % Organic Carbon in a temperate climate annually)
- Nitrogen available from previous legume crop
- Nitrogen available from crop residues or incorporated cover crop
- Nitrogen mineralised from composts, manures and other organic amendments.

Nitrogen losses can be due to:

- Volatilisation (urea or ammonium fertilsers)
- Denitrification (e.g. under waterlogged / anaerobic conditions)
- Leaching or runoff

It is important to agree on a uniform set of N sources and losses to include and how to estimate these in the absence of hard data, if the N balance is to be used for benchmarking purposes e.g. for a crop or a region.

## How is the N balance calculated?

The N balance for a crop and one growing season can be calculated under practical conditions as:

[N fertiliser input (NFI) **plus** N from other sources (*other* N)] **minus** [N crop removal (NCR) **plus** N losses]; all of which are expressed in kilograms per hectare (kg/ha N). The result is also expressed in kg/ha N.

**N Balance [kg/ha] = [NFI + *other* N] – [NCR + N losses]**

Below is an example of an N balance calculation for a potato crop with a nitrogen crop removal rate of 5 kg/ha and tonne of product and a yield of 60 t/ha. In the example, the fertiliser input (NFI) matches the N crop removal (NCR), which is common practice. N from

other sources (e.g. other N from organic matter, crop residues and residual soil N) nearly matches N losses so that the N balance is positive at 15 kg N /ha. Agronomically, this positive N balance is a low value. Values of up to 50 kg/ha are acceptable and indicate that the crop should have had sufficient nitrogen available during the season. The N balance or remaining N can be utilised by a following crop; in the case of potatoes a suitable green crop.

| kg/ha | [NFI | plus | other N] | minus | [NCR | plus | N losses] | N Balance |
|---|---|---|---|---|---|---|---|---|
| | 300 | + | 75 | - | 300 | + | 60 | 15 |

## What are the two indicators (NUE and N-balance) used for?

The indicators are based on straightforward calculations with data that should be easily available and updatable, especially NUE. Therefore both indicators can provide **trends** for individual crops or farms or **comparisons** between crops or farms. They can even be used on a larger scale e.g. to compare catchments, regions or countries (for all agricultural land or selected crops). An important aspect of looking at NUE or N- balance is the link to productivity, environmental sustainability and emission reduction.

NUE provides an indicator of N efficiency, and therefore an indicator of losses. So, this can also give an indication of nitrous oxide emissions. By looking at NUE for different crops and/or trends, farmers and advisors can identify where efficiency could be increased and including where nitrous oxide emissions can be reduced. Reducing nitrous oxide emissions will help to increase NUE.

### References

Brentrup, F. and Palliere, C. (2010) Nitrogen use efficiency as an agro-environmental indicator. OECD workshop "Agri-environmental indicators: lessons learned and future directions", 23-26 March 2010, Leysin, Switzerland

Sparrow, L.A. and Chapman, K.S.R. (2003) Effects of nitrogen fertiliser on potato (Solanum tuberosum L., cv. Russet Burbank) in Tasmania. 2. Petiole and soil analysis. Australian Journal of Experimental Agriculture 43(6) 643 – 650

### Further information

For further information on fertiliser decisions, see the fact sheet, '*Good Fertiliser Decisions – Nitrogen (N) for Crops in Tasmania*'. Available here.

## Appendix: List of common fertilisers containing nitrogen

| Fertiliser Products | N% | P% | K% | S% | Ca% | Mg% |
|---|---|---|---|---|---|---|
| Blood and Bone | 6 | 5 | 0 | 0 | 0 | 0 |
| Calcium Nitrate | 15.5 | 0 | 0 | 0 | 19.6 | 0 |
| Calcium Ammonium Nitrate | 27 | 0 | 0 | 0 | 8 | 0 |
| Calcium Nitrate | 15.5 | 0 | 0 | 0 | 19 | 0 |
| DAP (NPKS 18-20-0-1) | 18 | 20 | 0 | 1.6 | 0 | 0 |
| Mag-Nite (N-P-K-Mg) | 12.2 | 0 | 34.9 | 0 | 0 | 1.2 |
| MAP (NPKS 10-22-0-1) | 10 | 21.8 | 0 | 1.5 | 0 | 0 |
| Nitrophoska Blue Special | 12 | 5 | 14 | 6 | 4.3 | 1.2 |
| Nitrophoska Perfekt | 15 | 2 | 17 | 8 | 0 | 1.2 |
| N-Sure | 26 | 0 | 0 | 14 | 0 | 0 |
| Potassium Nitrate | 13 | 0 | 36.5 | 0 | 0 | 0 |
| Rustica Plus | 12 | 5 | 14 | 8.3 | 4.5 | 0 |
| Sulphate of Ammonia | 20.5 | 0 | 0 | 23.5 | 0 | 0 |
| Sulphur coated Urea | 20.2 | 0 | 0 | 24 | 0 | 0 |
| Urea | 46 | 0 | 0 | 0 | 0 | 0 |

# Appendix 3: Feed testing

## Feed test labs

| Lab | Website |
|---|---|
| FeedTest (AgriFood Technology) | http://www.feedtest.com.au |
| Livestock Logic | http://www.livestocklogic.com.au |
| NSW Department of Primary Industries | http://www.dpi.nsw.gov.au/aboutus/services/das/feed-quality-service |

## Protein in pastures

*"When excess protein is fed, the protein is deaminated by rumen microbes to ammonia in the rumen. When inadequate dietary carbohydrates are available to "capture" the ammonia, the ammonia is absorbed from the rumen. High degradability of the protein in pasture can lead to losses of up to 50% of the ammonia-nitrogen from the rumen at high pasture intake. This ammonia is converted to urea in the liver to detoxify the excess ammonia. The metabolic costs associated with absorption of ammonia and detoxifying ammonia to urea require energy. This is commonly referred to as urea cost, or the energy that is used to excrete the excess ammonia from high protein diets. In turn, this energy is not available for milk production, and results in less than optimal animal performance."*

Source: Protein in Pastures: Can It Be Too High? http://extension.psu.edu/animals/dairy/nutrition/forages/pasture/articles-on-pasture-and-grazing/protein-in-pastures-can-it-be-too-high
Accessed 6 Jan 2015.

Fact Sheet 6 – Buy right

# Feed lab testing – getting a good sample


**Feed lab testing should provide you with the key information you need to buy on value. Do you ensure the feed lab gets a sample that is truly representative of the feed you plan to buy?**

## Collecting a good feed sample

There's not much point using a feed lab analysis report to guide your feed buying decisions unless the feed sample collected for analysis was truly representative of the feed on offer.

The aim should always be to collect the most representative sample possible.

Here are some suggested methods you can follow with confidence:

### Key tips

- Always be sure to collect a truly representative feed sample for testing.
- Label all feed samples clearly with a description and sample date.
- Ensure your feed samples arrive at the lab quickly, with minimal deterioration.

**Table 1: Collect the most representative sample you possibly can!**

| | |
|---|---|
| **Grains / concentrates and co-products** | ***Supplied in semi loads***<br>Collect several samples from at least 6 locations from the front to the rear.<br>Use a slotted grain probe that is long enough to penetrate at least ¾ the depth of the load. |
| **Grains / concentrates and other feed ingredients** | ***Supplied in bags***<br>1-10 bags – sample all bags, collecting at least five probes.<br>11 or more bags – sample 10 bags at random.<br>Stand each bag upright, insert the probe into the top corner and move diagonally through the bag to the bottom corner opposite the top corner and withdraw sample. |
| **Hays** | ***Small square hay bales***<br>Sample 10-20 bales, selected at random, using a probe or corer (grab samples are not good enough).<br>Take one core from each bale, near the centre of the 'butt' end, at right angles to the surface. Ensure that the corer doesn't get too hot.<br>***Large round or square bales***<br>Sample 10 bales, selected at random, using a probe or corer (grab samples are not good enough).<br>Take one core from the middle of the curved surface of each round bale taken through the middle of the bale.<br>Take one core from each side of each sqaure bale, at right angles to the surface and at different heights.<br>***Hay cubes or pellets***<br>Select a handful of cubes or pellets from at least 6 locations or bags. |
| **Silages** | ***Bunkers and pits***<br>Ideally, collect a sample before opening the bunker or pit, using a long coring device that extends deeply into the pit or bunker.<br>Alternatively, take random handfuls from at least 10 locations across a freshly cut face of the bunker or pit (understanding that the silage face represents only a small proportion of the silage in the bunker or pit, so it may not provide a good representative sample).<br>***Wrapped bales***<br>Sample 10 large bales, selected at random, using a coring device as for large round hay bales. Take great care to immediately re-seal the holes made in the plastic by the corer. |

Dairy Australia Your Levy at Work

GRAINS 2 MILK From grains to profit

**Fact Sheet 6 – Buy right**

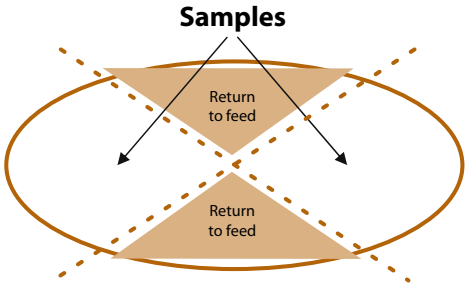
# Feed lab testing – getting a good sample


## Preparing a sample for the lab

Combine sub-samples collected, mix thoroughly to obtain a final sample size no greater than 500 grams for submission to the feed lab.

Often you will have collected much more than 500 grams. Here is a simple method called 'quartering' you can use to get your 500 grams:

- Mix the entire sample thoroughly.
- Pour it onto a clean sheet of plastic or paper to form an even layer.
- Mark into quarters.
- Take two opposite quarters, mix and repeat until the two quarters selected give the desired sample size.




*Note:*

- *Do not quarter hay samples to reduce sample size, as leaf loss can make the sample un-representative.*
- *Be sure to label all samples as you prepare them, marking them clearly with a description and date.*
- *Keeping a duplicate sample on-farm gives you the option of doing further testing later on if you wish.*

***Garry says: "My nutrition adviser told me that taking a few grabs out of one or two bales just isn't good enough. So I've got myself a hay corer now, which I attach to an electric drill. It makes sampling pretty easy, provided I make sure the battery is fully charged!"***

Dairy Australia Your Levy at Work | GRAINS 2 MILK From grains to profit

**Fact Sheet 6 – Buy right**

# Feed lab testing – getting a good sample


## Getting your feed sample to the lab safe and sound

The aim is to get your sample to the laboratory as quickly as possible, with minimal deterioration.

- Immediately after sampling, place the final feed sample in a press-seal plastic bag, remove the air by squeezing the bag and seal.
- If feed material is stalky and there is a risk of puncturing the bag, double seal the sample inside a second press-seal plastic bag.
- Never leave the sample in a vehicle, especially on a hot day. It will deteriorate quickly if allowed to heat during storage and transport. Store in a cool place immediately, such as an insulated cooler.
- Unless you can get the sample to the laboratory within 24-48 hours, refrigerate or freeze it to ensure dry matter is measured accurately and aerobic spoilage is minimised (this is especially important for high moisture feeds during hot weather!). Follow the feed lab's guidelines.
- Avoid mail delays over the weekend by posting samples early in the week. Use an express courier service.
- Label samples accurately.

Take the time to fill in the feed lab's sample submission form properly. You and other farmers benefit in the long-term as labs use the information to refine their testing methods and databases of results for particular feeds.

**For more information go to www.dairyaustralia.com.au**

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# Appendix 4: Example case study

Tas Farming Futures — Case Study 2014

## *Reviewing orchard efficiency to reduce energy use, costs & emissions*

Campania orchardist Ian Newnham is reducing his energy usage through upgrading irrigation pumps for the benefit of his bottom line and to combat greenhouse gas (GHG) emissions.

Campania, Coal River Valley, Tasmania

### *At a glance*

| | |
|---|---|
| Owner & location | Ian Newnham<br>Lowinda, Campania |
| Property size | 42 ha |
| Enterprises | Orchard (cherries and apricots) and cropping (vegetable seed production) |
| Average annual rainfall | 500 ml |
| Irrigation water use | 60 ML in an average season (ranging from 20 ML in wet years to 100 ML in dry years) |

## Goal to improve systems

Ian runs an 18 hectare (ha) cherry and apricot orchard at Campania in the Coal River Valley. Whilst orcharding is his main business he also has 17 ha of cropping land used for vegetable seed production, 3 ha of pasture and 4 ha forestry/ windbreaks. His farm is irrigated using on average 60 ML of water per year and ranges from 20-100 ML depending on the season.

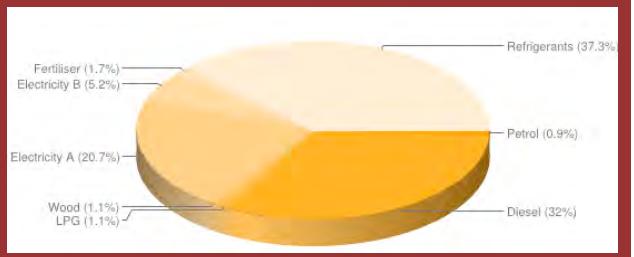
Ian has seen returns for his fresh market fruit diminish over the years and is keen to improve his systems to be as efficient as he can be in running his business and keeping it viable.

*"We try to run things as efficiently as possible, as margins for our product are getting less each year"* Ian Newnham

*Ian has been participating in the Tas Farming Futures (TFF) project and has worked with project extension staff to calculate the greenhouse gas (GHG) emissions derived from the orchard operations on his Lowinda property.*

Energy consumption at Lowinda accounts for 25.9% of the greenhouse gas (GHG) emissions. As this relates strongly to farm costs it is an area which farmers are often keen to reduce. Farm GHG emissions are 51 t $CO_2e$/year[1] or 1.2 tonnes $CO_2e$/year/hectare or 0.51 tonnes of $CO_2e$ / tonne of fruit produced.

Greenhouse gas emissions




*Above: Estimated GHG emissions at Lowinda are 51 t $CO_2e$/year, with 25.9% from energy use*

[1] $CO_2e$ (Carbon dioxide equivalence) - Greenhouse gases can be measured in carbon dioxide equivalents. This is estimated by multiplying the amount of gas by the global warming potential of the gas.

1

Tas Farming Futures Case Study 2014

# Farm energy usage and efficiency savings tips

## Irrigation

**Recently Ian has reviewed his on- farm energy use, which is made up of 80% irrigation and 20% for his packing shed operation. He has discovered that savings can be made in relation to his irrigation energy use through upgrading the efficiencies of the pumps used. This will not only provide him with cost savings but will also impact on reducing the GHG emissions from his property.**

### Tip 1 – Undertake a pump efficiency review

In conjunction with his irrigation advisor, Ian recently undertook a pump efficiency review of the pumps used to deliver irrigation water to his orchard and seed crops. This was last reviewed about 15 years ago and at the time they were upgraded to be as efficient as they could be. Ian was surprised to find that this was not the case now and things had slipped badly, costing him more in energy use and therefore dollars spent on pumping water and in green house gas emissions.

*"When we were growing Pyrethrum (15 years ago), CIG offered a free energy audit to their growers. We had Chris Thompson* [an irrigation consultant] *undertake an efficiency audit of our pumps. We changed both the pumps, which suited our pumping needs at the time, which was based on irrigation through travelling irrigators. Things change and we no longer use travelers* [irrigators]*".*

*"Pumping went from 160 psi to 100 psi in the main lines. We have changed to shifting volume without changing too much. We upgraded two thirds of the pump line at the river. Our failure to check the pump curves meant our power bill wasn't going down accordingly. Then Will Burden from Roberts Irrigation came in and used a pump efficiency calculator."*

### Tip 2 – Upgrade pumps to ensure that the pump size and pressure is optimised

Initially the upgrades and savings will be made at the river where Ian sources his irrigation water.

*"The pump at the river* [irrigation water source] *was expensive per ML of water. It has cost $10,000 to upgrade the pump but we can recover this in one year in power savings. The new pump has a bigger suction line and upgraded filter plate…. I will halve my irrigation costs."*

*"By installing a new pump we will save between $8,000 and $10,000 per year where we draw water from the river. Power usage should go from $12,000 per year to $2,000 per year at the river."*

*"My jaw hit the ground when I was told what the new price would be".*

### Tip 3 – Ensure that in-orchard irrigation delivery is designed to run efficiently

Ian has also reviewed his irrigation system within the orchard and is making changes to the sub mains and blocks to enable him to operate the system more efficiently.

*"In the orchard we are changing the block sizes for the irrigation to run a system of mains and sub mains. We are altering the size of the blocks to run them more efficiently. At the moment the blocks are slightly too large to run 2 blocks at a time."*

*"A block runs 3,000 sprinklers and all of our blocks have 2,000 sprinklers. We are going to bump them up to 3,000 per block. As we plant new blocks we are planning them with this in mind to fit in with the irrigation or we go to 1,500 for half a block. When it all comes together we can run 3,000 sprinklers on each side of the farm. It is all part of our irrigation plan."*

### Tip 4 – Use irrigation scheduling and moisture monitoring tools in the orchard

Ian uses a range of techniques when working out his irrigation scheduling in the orchard to ensure he delivers the right amount of water when it is needed. These include:

- The use of trans-evaporation figures to determine water needs
- Use of data loggers (Hansen logger) and g-dots to measure soil moisture levels

*"I have 2 loggers each with 3 sites. One is located at the centre of the main root zone (20 cm depth) and the other is 3-6 inches below that (30cm depth)."*

2

# More tips for energy savings …

**Tip 5 – Ensure irrigation type provides an optimal wetting pattern**

Ian has changed from drippers to mini sprinklers to achieve the best wetting pattern for his trees.

*"We use mini sprinklers. Originally we had drippers; the wetting pattern was not good and on a hot day couldn't get water on fast enough."*

**Tip 6 – Reduce irrigation needs through using mulches to help retain soil moisture**

Orchard floor management practices will influence water retention and soil organic carbon stores. Soil carbon is an important factor influencing the water holding capacity of the soil (greater soil carbon = greater water and nutrient holing capacity).

The use of compost or other organic amendments / mulches under trees will reduce water evaporation and increase soil organic carbon thus leading to increased water holding capacity, increased nutrient availability and increased microbial activity.

Ian has trialed the use of compost in his orchard.

*"We have used Renew compost. We used a mixed spreader to apply 10 cubic meters per ha. It seemed like not a lot really, it was only a trickle and we could have put on half as much again."*

The use of side throwing mowers to throw grass clippings from grassed alleyways to the tree mound is a useful way of providing a ground cover / mulch under the trees.

**Tip 7 – Save fuel and increase efficiency by applying fertilisers through irrigation (fertigation)**

Applying fertiliser through irrigation systems (fertigation) not only saves on diesel (through tractor use) but is also good practice for increasing the effective use and uptake of applied nutrients by the crop. Fertigation will also reduce the risk of nitrogen losses through volatilization.

*"Ninety percent of the fertilisers applied in the orchard goes on through the water and we use a bit of foliar application. I find that little feeds often are a better bang for your buck."*

## Renewable Energy

**Tip 8 – Investigate options for renewable energy use on farm**

The use of on-farm renewable energy sources such as wind, solar or mini hydro systems can be an option for some properties to fully or partially offset their energy use drawn from the national grid. Such systems are site specific and it is not a case of one system fits all – do your research before investing in a particular system.

Ian has looked into renewable energy options (wind and solar) but has decided not to go down that path yet due to the installation costs and currently low feed-in tariffs offered.

*"I did have a romantic notion of being carbon neutral."*

*"I had a consultant come and quote on a wind turbine. A 20kw wind turbine was going to cost $150,000 for the unit and then $10,000 per year to maintain the fans and head."*

*"I then looked into solar and was getting close to doing something when they started talking about reducing the tariffs [for feeding back to the grid]. I was going to put in a 20KW system on the shed and 10KW on the house and that was close to covering our energy use. It is a pity they amended the solar rebates."*

## Packing sheds

Although packing sheds are only run for a short period of time they can still account for a significant component of on-farm energy use. In Ian's case he estimates that this is 20% of his total energy usage.

Ian believes that he could have saved energy through installing the most appropriate grading system when he built his packing shed.

***"We bought a second hand cool-room from Shepparton. It was a quarter of the cost of a new one and only had a 3 inch panel. Knowing what I do now I should have bought a 6 inch panel and had half the energy costs. We run the shed for 6 weeks of the year for grading but it is an expensive 6 weeks."***

Ian has undertaken major upgrades on his refrigeration unit, which has increased the efficiency of the system from 60% to 95%.

*"We replaced the original evaporators and put in more efficient ones with variable speed drives. The old belt drive which was 60% efficient was replaced with a direct drive field unit with variable speed drives on the condenser which is 95% efficient."*

Tas Farming Futures

Providing on-farm services to support producers in improving farm efficiency & reducing GHG emissions

Contact our extension team:

Ashley Hobbins (NW)
0447 776 909
Adrian James (North)
0448 318 873
Sophie Folder (South)
0439 247 172

Access resources online:

www.rmcg.com.au

@TasFarmFutures

*Working with industry and NRMs statewide*

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## Packing Sheds …

It is important to review your grading, lighting and refrigeration systems to ensure that energy efficient systems are being used. The following tips are sourced from the APAL - Watts in Your Business factsheet series (2014);

- **Grading Systems**

✓ Fix air compressor leaks

✓ Improve dryer tunnel efficiency

✓ Install solar hot water heaters

✓ Insulate water chiller tanks on cherry graders

- **Lighting** Switch to more efficient types of lighting

✓ Replace halogen light bulbs with LED

✓ Replace older style fluorescent bulbs (T12 and T8) with newer, more efficient types (T5) or with LED tubes

✓ Replace Metal Halide lights with LED highbay lights

- **Refrigeration systems**

✓ Optimise head pressure on refrigeration systems

✓ Install variable speed drives on evaporative fan motors

✓ Automate cold storage doors

✓ Replace old inefficient compressor motors with high efficiency ones.

### Refrigerants

Ian's GHG calculation showed that 37.3% of emissions were derived from the refrigerants used in his packing shed operation. Many refrigeration systems used in orchard cool stores use Hydrochlorofluorocarbons (HCFC's) as the refrigerant gas. These have a very high Global Warming Potential (GWP) when leaked into the atmosphere. Most refrigeration systems have approximately 16% leakage or refrigerant gas per year.

Tips for reducing emissions from refrigeration systems include:

✓ Replace HCFC refrigeration with ammonia refrigeration systems. Most HCFC's are due for final phase down in 2016, so systems relying on them should be replaced (APAL 2014).

✓ Monitoring and regular servicing of refrigeration systems will identify if gas leakage levels are higher than industry accepted standards (16% annual loss), (DCCEE 2010a). Eliminating leaks will keep gas inside the system and reduce GHG emissions.

✓ Automatic refrigerant detection systems can be installed to monitor for refrigerant leaks.

# Summary

Reducing farm energy use is not only good for business by saving costs but it also has a win for the environment in reducing greenhouse gas emissions.

Ian's experience has shown that assuming that your systems are efficient is not enough. Things change and this is not always the case.

Regular review of energy efficiency and implementing changes when required will set you on the right path to an energy efficient farm business.

*By* Sophie Folder

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