Appendix 13: Development of the Carbon Offsets Scenario Tool (COST) calculator

Throughout this project the priorities for the dairy industry in terms of mitigating their GHG emissions has changed. In 2010, the Australian Federal Government proposed a cap-and-trade emissions trading scheme called the Carbon Pollution Reduction Scheme (CPRS). Due to a lack of bipartisan support, the CPRS was not legislated. However, a new emissions trading scheme, the Clean Energy Future Plan, was legislated in 2011 and to be implemented in 2012. One component of the Clean Energy Future Plan was a shift in the focus from agriculture being a sectoral source of GHG emissions, and thus requiring 'taxing' of a proportion of their GHG emissions (as proposed with the CPRS), to agriculture being a sector of the economy that could implement practices that achieve mitigation and gain financial incentive to do so. To facilitate this, the Carbon Farming Initiative (CFI) was the proposed mechanism within the Clean Energy Bill for assisting agricultural farmers and land managers to obtain carbon offset credits by sequestering carbon on-farm or by reducing/avoiding on-farm GHG emissions. These carbon credits could then be tradable, allowing for other high carbon polluting industries (e.g. electricity companies) to offset their GHG emissions.

In 2011 the TIA project team were approached by this projects' Dairy Australia steering committee member to assist Dairy Australia in developing a list of standard practices for the Department of Agriculture, Fisheries and Forestry (DAFF) in formulating farm practices that could be included as methodologies that qualify for the 'additionality' requirements in the CFI. These farm practices were broadly grouped into the 3 broad themes of nutrients and effluent, pasture management and herd and dairy shed practices. For each theme, current farm practices were described and a list of potential mitigation strategies identified as they relate to each of the five Dairy Australia defined farming systems (FS). For example, FS1 farms currently are predominantly pasture-based with a low amount of grain supplement per cow (i.e. < 1 t DM/cow.lactation). Therefore a potential mitigation strategy for these farms could be to supplement the pasture feedbase with a source of supplements high in dietary fats/oils to lower methane production. This strategy is less likely to be relevant for FS5 farms where a large proportion of their diet is through supplements and thus might not meet the 'additionality' requirement in the CFI.

In addition to assisting Dairy Australia to formulate this list of farm practices and potential mitigation strategies, the TIA team were also asked by this projects' Dairy Australia steering committee member to develop a tool to explore the viability of a range of mitigation strategies that could be potentially included as CFI offsets. The MS Office Excel spreadsheet Carbon Offset Scenarios Tool (COST) calculator was developed and expanded the three abovementioned themes and potential mitigation options provided to DAFF into four theme areas. These were herd and breeding management, diet management, feedbase management and waste management (Figure 1). Within each theme area, mitigation strategies were identified and at the time of finalising the final report, seven individual mitigation strategies had been identified and incorporated into the COST calculator (Figure 1). However, several more have been identified (e.g. improved reproductive performance, manure digesters to reduce the amount of stored animal waste in lagoons; *listed in italics in Figure 1*) and these will be incorporated into the COST calculator into the future. In addition, as science progresses and/or the CFI encourages the development of new technologies to reduce and/or remove on-farm GHG emissions, these too will be incorporated into the COST calculator.

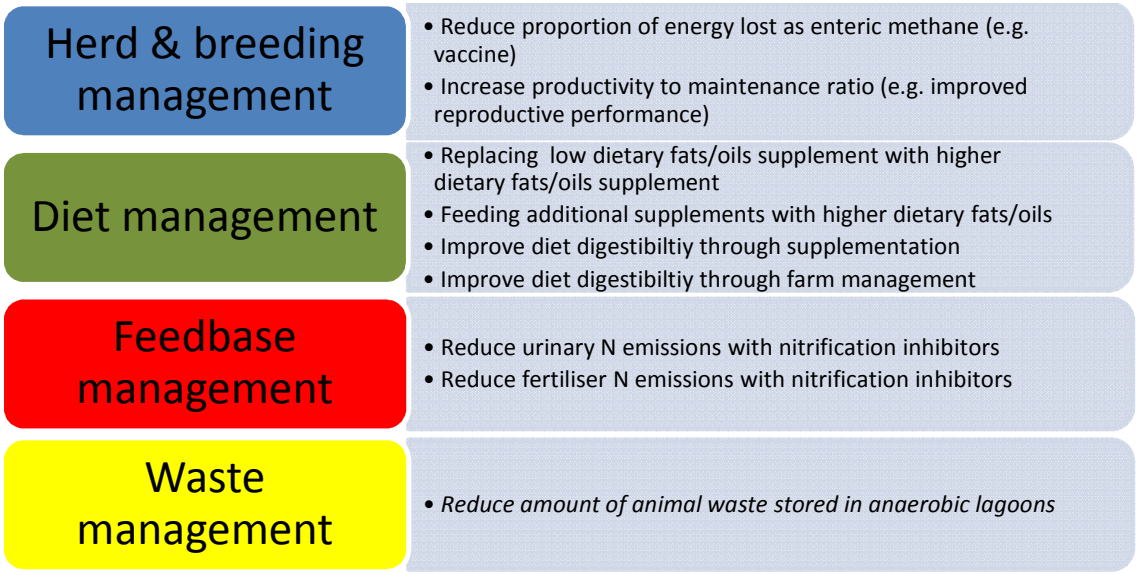

Figure 1. Schematic diagram of the four broad theme areas and individual mitigation strategies currently incorporated into the COST calculators for reducing on-farm dairy greenhouse gas emissions (*italics strategies are to be incorporated into the calculator at a later date)*.

Within the COST calculator, each mitigation strategy has four main data entry/calculation sections (highlighted in green, pink, purple and blue; Figure 2). The first section (highlighted in green) relates to the baseline farm system which allows the COST calculator to estimate the baseline farm GHG emissions associated with the milking herd, based on currently agreed NGGI methodology. These questions varied between mitigation strategies to estimate the baseline on-farm GHG emissions. For example, to estimate the baseline emissions for supplementing with dietary fats/oils, the questions related to milking herd size, average live weight of the milking herd (kg/cow), current average milk production per cow (litres/cow.day), and diet digestibility and crude protein concentration (%). In contrast, the only key question to estimate the baseline GHG emissions for the mitigation strategy of coating nitrogen fertilisers with a nitrification inhibitor was the amount of nitrogen fertiliser applied to pastures (t nitrogen/annum).

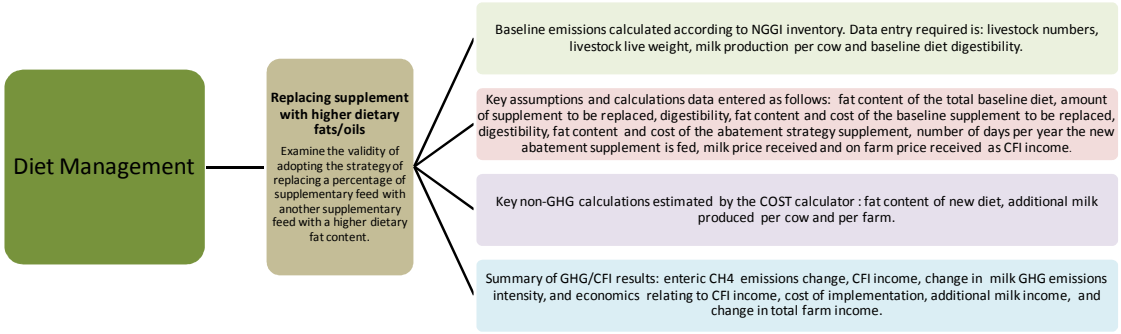

Figure 2. Schematic diagram illustrating the abatement strategy of replacing a supplement with a low fat content with another supplement with a higher fat content, the four main data entry/ calculation sections and the specific questions needed to estimate the GHG emissions reduction associated with the mitigation strategy and potential farm profit as associated with the Carbon Farming Initiative.

The second section (highlighted in pink; Figure 2) in each COST mitigation strategy are key questions as they relate to either the estimation of reduction in GHG emissions or the likely change in expenses and income associated with implementing the mitigation strategy in combination with the CFI. For some mitigation strategies there are many aspects that need to be considered while for others, there are only a few questions required to estimate the reduction in GHG emissions and the changes to income and expenses associated with the mitigation strategy. For example, the mitigation strategy of applying a nitrification inhibitor to urine patches only has five specific questions. These questions relate to the proportion of urine deposited onto pastures, the number of days per year that the nitrification inhibitor is effective, the efficacy of the nitrification inhibitor (i.e. % reduction in urinary N with the strategy), the cost of implementing the strategy (i.e. $/cow) and the on-farm income received with the CFI ($/t COe_2).

In contrast, the example of a mitigation strategy of replacing one supplement lower in dietary fats/oils with another supplement higher in dietary fats/oils has many specific questions. Given that the diet quality and quantity will change with this strategy, users need to estimate the fat concentration of the baseline diet (%), the quantity (kg DM/cow.day) and quality (digestibility and fat %) of supplement to be replaced, the cost of the supplement to be replaced ($/t DM), the quantity (kg DM/cow.day) and quality (digestibility and fat %) of the new higher fat supplement to be fed, the cost of the new higher fat supplement to be fed ($/t DM) and the number of days per annum that the new higher fat supplement will be fed. Within the COST calculator, an estimation of the change in diet energy is estimated with this energy assumed to be converted into additional milk production (i.e. an extra litre of milk/ 5.5 MJ of Metabolisable energy). Therefore within this section, users are also required to estimate the average annual price received for milk ($/ litre) and the price received for milk ($/ litre) when the mitigation strategy is implemented as milk prices could be different and thus influence income from any additional milk when the mitigation strategy is implemented The last question is an estimation of the on-farm income received with the CFI ($/t COe_2).

The third section in the COST calculator (highlighted in purple; Figure 2) gives users an indication of changes to non-GHG related aspects of the mitigation strategy. For example, in the mitigation strategy of replacing a low dietary fat source with a supplement with a higher concentration of dietary fats/oils, it is critical that users understand that the dietary fat concentration should not exceed 6 to 7% as milk depression can occur with diets above this level. Therefore with this mitigation strategy, users can view how the manipulation of the baseline diet with additional dietary fat alters the overall diet fat concentration. If users implement a supplement which is either too high in dietary fat concentration or too much supplement is replaced, a warning message informs users to reconsider the diet. An estimation of the additional milk produced per cow (litres/cow.day) and per farm (litres/farm) is also indicated.

The last section in the COST calculator (highlighted in blue; Figure 2) is a summary table indicating the reduction (t CO_2e/annum). For most mitigation strategies currently in the COST calculator, there is a reduction in GHG emissions (reported as a positive number) but in the case of the improved diet quality through supplementation mitigation strategy, enteric methane could increase due to increased intakes (reported as a negative number as it's a negative reduction in GHG emissions. Other results in the summary table are the potential CFI income ($/farm), the cost to implement the mitigation strategy ($/farm), the change in income associated with the mitigation strategy assuming no change to milk production ($/farm), the estimated additional income from milk production associated with the mitigation strategy ($/farm), the estimated change in income associated with the mitigation strategy taking into consideration the income from the CFI and from milk production ($/farm), an estimation of what proportion of total income from milk production and the CFI is attributed to the CFI (%) and an estimation of the change in milk GHG emissions intensity (kg CO_2e/ litre of milk) associated with implementing the mitigation strategy. In addition to the summary section, a graph to the right of the mitigation strategy illustrates income from the CFI ($/farm), the

cost to implement the mitigation strategy ($/farm), any additional income from additional milk production ($/farm) and the total farm income benefit of implementing the mitigation strategy ($/farm) (Figure 2).

An example of the COST calculator can be seen in Figure 3 where the impact of replacing a supplement with low dietary fat concentration (i.e. 2.5%) with a supplement with a higher dietary fat concentration (i.e. 18.0%) would have on enteric methane production. For this farm example, GHG emissions were reduced by 22.7 t CO_2e/annum, giving a potential CFI return of $340 to the farm, based on a carbon price of $15/t CO_2e. To implement this offset method, an additional outlay of $4,793 would be required to purchase the higher fat concentration supplement. This high fat supplement was predicted to increase milk production by approximately 28,000 litres for the 90 days it was fed, thus increasing milk income by $11,740. The increase in milk production in this example was driven by the relatively higher digestibility (75% DMD) of the high fat supplement compared to the baseline supplement (65% DMD) that was being replaced. Taking into account the income from the CFI and from the additional milk minus the cost of implementing the mitigation offset, this offset strategy was predicted to have a net increase in income of $7,288/annum. This COST calculator will most likely be incorporated in DGAS in 2012 so that a full farm assessment (i.e impact on pre-farm, methane and nitrous oxide emissions) of a CFI offset methodology can be explored. A full farm systems analysis is critical as changes to diet quality (as explored in the above mentioned example) could also alter the crude protein concentration of the diet, thus altering the nitrous oxide emissions.

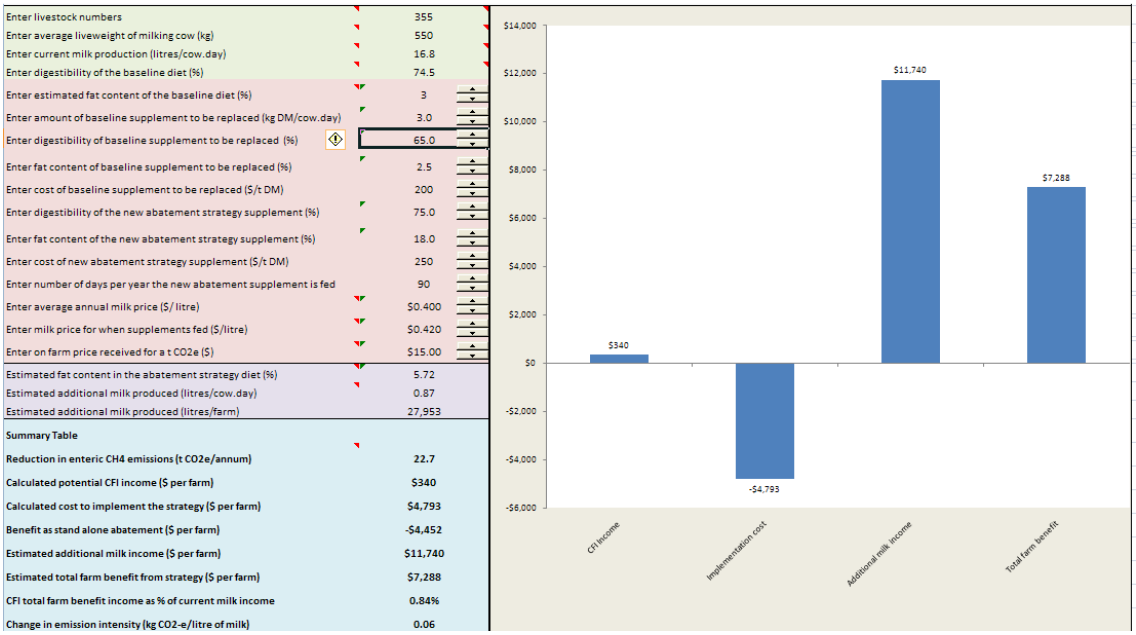

Figure 3. Screenshot image of the Carbon Offset Strategies Tool calculator exploring the net income benefit and reduction in farm methane emissions associated with replacing a low fat content supplement with a higher fat content supplement.