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Australian
Farm Institute

The Impact of a Carbon Price
on Australian Farm Businesses:
Beef Production

mla
MEAT & LIVESTOCK AUSTRALIA

Australia's Independent
Farm Policy Research Institute

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Summary

Farm level modelling was carried out of the impact of an economy-wide carbon price on the costs and profitability of model beef farms in Queensland and Victoria, and an Australian average beef farm. Three carbon price scenarios were examined, one of which commenced at $20/t CO_2-e, and the other two of which utilised modelling by the Australian Treasury of the carbon price associated with emission reduction targets of either 5% or 15% by the year 2020.

Five years after the introduction of a carbon price, beef farms are projected to experience total annual business cost increases of between 1.7 and 4.6% compared to a business-as-usual scenario, and between $2,791 and $13,068 in additional annual costs, depending on the carbon price and the nature of the beef farm under investigation. The additional costs included both on-farm costs, and also additional processor costs which were assumed to be fully passed on to the farm businesses. These increases in business costs (in the absence of the potential for farm businesses to increase beef prices) would result in a reduction in farm net income of between 6.2% and 16.5%, relative to a business-as-usual scenario, depending on the carbon price.

The modelling does not incorporate any assumptions about additional dynamic responses (over and above normal productivity growth) by farm business managers to the additional costs, and as such provides a projection of the potential challenge these policies will pose for farm businesses, rather than attempting to predict future outcomes. Nevertheless, the results highlight that the proposed carbon policy represents a major challenge for Australian beef production businesses, irrespective of any future decision to also include direct farm emissions under that carbon policy.

Introduction

The Australian Government has proposed to introduce a policy that will impose a price on greenhouse gas emissions produced by some Australian businesses from 1 July, 2012. The details of this policy are still to be finalised, although it has been announced that the carbon price mechanism will initially be a fixed carbon price specified by the Government, which will continue for 3-5 years before transitioning into a market-based emissions trading scheme similar to the previously announced Carbon Pollution Reduction Scheme (CPRS).

The Government has announced that direct emissions from agricultural activities will not incur a cost under the proposed carbon scheme for the foreseeable future, although the possibility of imposing a cost on agricultural emissions at some future time has not been ruled out, and has been proposed by a number of prominent persons and groups involved in advising on carbon policy.

While agricultural emissions will not incur a direct cost under the proposed carbon price mechanism, major emitters such as electricity generators will have a cost imposed on their greenhouse emissions, and other major sources of emission such as fossil fuels are also likely to be included in the scheme. This will mean that the proposed carbon price mechanism will increase the price of energy, and hence the cost of farm inputs that involve the use of energy in their production or delivery.

Generally speaking, the price that Australian farmers receive for the agricultural commodities they produce is set in the international marketplace, in which Australian farmers are price-takers. This means farmers are not able to increase the prices they receive, and that any additional costs incurred by Australian farm business have a direct impact on farm profitability. Even in the absence of a direct cost being imposed on agricultural emissions, the implementation of a carbon price mechanism in Australia will have a negative impact on farm profitability. The scale of the adverse impact will vary depending on a range of factors, including the degree of reliance of different farm business and their related sectors on energy and energy-related farm inputs.

The aim of the research reported here is to gain an understanding of the potential impact of the proposed carbon price mechanism on the profitability of beef farms in Australia.

Methodology

In order to project the impact of the proposed carbon price mechanism on Australian farm businesses, financial models were developed of typical farm businesses, based on data available from ABARES farm surveys. The methodology utilised has been described in a previous research report (Keogh and Thompson, 2008). In summary, a set of 'normal' assumptions (including rates of farm productivity growth) was applied to the relevant ABARE farm financial data in order to project trends in farm costs and farm revenue into the future under a "business as usual" scenario.

The impact of a carbon price mechanism on farm businesses was then estimated using formulae that create a link between the price of carbon, the impact of that carbon price on fuel and electricity costs, and the impact of changes in fuel and electricity prices on the cost of farm business inputs, including upstream and downstream sectors. The responsiveness of farm input costs to a change in energy prices was calculated on the basis of the significance of energy as an

input to the goods or services being utilised by the farm business. This enabled the impact of the carbon price mechanism on farm inputs costs and farm profitability to be calculated based on projected future changes in the price of carbon. Projected farm costs and farm profitability under a carbon price mechanism could then be compared with the business-as-usual scenario in the absence of a carbon price mechanism, in order to estimate the impact of the policy on future farm profitability.

Previous research by ABARE (Tulloh et.al. 2009) has identified that post-farm transport and processing costs will also be impacted by a carbon price, and given the international exposure of Australia's farm commodity and food sectors, it is also anticipated that these additional costs will be passed back to farmers in the form of higher processing costs and/or lower farm commodity prices. These additional post-farm costs identified by ABARE have been incorporated in this analysis. The following Table identifies these estimated costs, which have been converted to 2009-10 dollars. In the ABARE research, these costs were associated with a carbon price of $26.05 ($2009-10). For the purposes of this research, available data was used to calculate the size of these additional costs if fuel emissions were excluded from a carbon price, and the methodology employed in this calculation is detailed later in the report.

Table 1: Post-farm processor costs arising from a carbon price.

Sector	Units	Additional cost ($2007/8)	Additional cost ($2009/10)	Additional costs, No-fuel scenario [a]
Beef processing	$/head	$7.60	$7.96	$1.59
Sheep processing	$/head	$0.72	$0.75	$0.15
Grain processing	$/tonne	$2.34	$2.45	$0.61
Dairy processing	$/litre	$0.005	$0.00524	$0.0021

a For details of the calculation associated with these numbers see the explanation of the no-fuel scenario below.

Model farm businesses

The ABARES Agsurf database (ABARES, 2011) was accessed to extract farm financial data for 'average' beef farms, one located in Queensland (Qld) one located in Victoria (VIC) and another which is an average of all Australian beef farm data (Australia). These farms represent an average of the beef farms included in ABARES farm surveys in these regions, where ABARES defines a 'beef farm' as farms engaged mainly in producing cattle through beef breeding enterprises.

Itemised annual farm financial data (in 2009-10 dollars) was obtained for the five years from 2006 – 2010 and averaged to provide 'typical' farm financial data for each of the three farms. Some characteristics of each of the farms are displayed in Tables 2 and 3 below.

ABARES data provides an estimate of the number of cattle sold each year. The data outlined in Table 1 above applies to domestic processing; cattle exported live from Australia will not be subject to these additional costs.

To incorporate this, live export percentages were obtained from Meat & Livestock Australia (MLA) as a national average for the Australia farm, and for Qld and Vic, and applied to the number of cattle sold. That is, if 100 cattle are sold each year according to ABARES data, and MLA data indicates 5% of cattle from farms located in that region are exported live from

Australia, the adjusted number of cattle processed domestically will be 95. The processor costs outlined above in Table 1 are applied to the adjusted number of cattle sold.

The live export percentage is assumed to apply only to the primary enterprise activity of the model farm, in this case beef cattle production. Despite all three model beef farms having some sheep present according to ABARES data, the number of cattle sold is the only farm data adjusted to account for live exports. This is because it's likely the small number of sheep sold each year would be sold locally and processed domestically.

The modelling does not incorporate any assumptions about additional dynamic responses by farm business managers to additional costs or seasonal change. The purpose of the modelling is to examine the impact of a carbon price on beef farms, with all other factors being equal. Because of this, all farm level information remains the same between years, including the number of cattle sold. By keeping all factors equal, the modelling provides a projection of the potential challenge these policies will pose for farm businesses, rather than attempting to predict future outcomes or activity changes.

The farm production information was utilised together with the FarmGAS farm greenhouse emissions calculator to calculate annual greenhouse emissions arising from these farms. Data on nitrogen fertiliser use (an important source of greenhouse emissions in cropping) was not available, therefore an assumption was made that an average of 50 kilograms of Urea was applied per hectare for all crops except grain legumes for the farms where grains were produced. The greenhouse emission data enabled modelling of a scenario in which the farm businesses incurred a cost for farm emissions.

Table 2: Characteristics of the cropping enterprise for the three model beef farms.

Crop	Australia Hectares	Australia Yield (t/Ha)	Qld Hectares	Qld Yield (t/Ha)	VIC Hectares	VIC Yield (t/Ha)
Canola	0.8	1.5	0	0	0.4	2
Lupins	0.2	2	0	0	0	0
Barley	4.8	1.75	2.4	0.9	2.8	1.9
Grain legumes	2	1.3	1.2	1.3	1.4	2.4
Oats	8.6	0.2	7.6	0	1	0.8
Oilseeds	1.2	1.8	0.2	1	0.8	6.5
Sorghum	3	2.8	6.8	2.6	0	0
Wheat	12.4	1.6	11.2	1.7	4.6	3
Total cropping area (ha)	33		29		11	

Table 3: Production and greenhouse gas emission details for the three model beef farms.

Cattle details	Australia	Qld	VIC
Bulls	18	26	5
Calves	183	256	83
Cows	380	557	123
Steers	224	392	57
Heifers	87	123	29
Total beef herd	892	1,353	297
Live cattle exports	9%	3%	4%

Sheep details	Australia	Qld	VIC
Ewes	50	26	25
Lambs	23	11	14
Rams	1	1	1
Wethers	15	16	5
Total sheep flock	89	53	44

Farm costs breakdown	Australia	Qld	VIC
Fuel	6%	6%	6%
Freight	3%	4%	2%
Electricity	1%	1%	1%
Fertiliser	3%	1%	6%
Chemicals	1%	1%	1%
Total farm area (ha)	13473	17555	346
Farm emissions	1506.7t CO_2-e	2688.1t CO_2-e	539.1t CO_2-e

Scenarios examined

Three carbon price series were used in the analysis, to provide a picture of the impact of different carbon prices. The three price series used were as follows;

- **LOW** – the carbon price commenced at $20/t CO_2-e in the 2013 year (2012-13) and increased at an average of 4% per annum.

- **MEDIUM** – the carbon price utilised the Australian Government Treasury modelling (Australian Treasury, 2008) of a carbon price series that would be required to reduce national emissions by 5% by 2020 (updated to 2010 dollars). This price series commences at approximately $28/t CO_2-e and increases by an average of 4.4% per annum.

- **HIGH** - the carbon price utilised the Australian Government Treasury modelling of a carbon price series that would be required to reduce national emissions by 15% by 2020 (updated to 2010 dollars). This price series commences at approximately $39/t CO_2-e and increases by an average of 4.3% per annum.
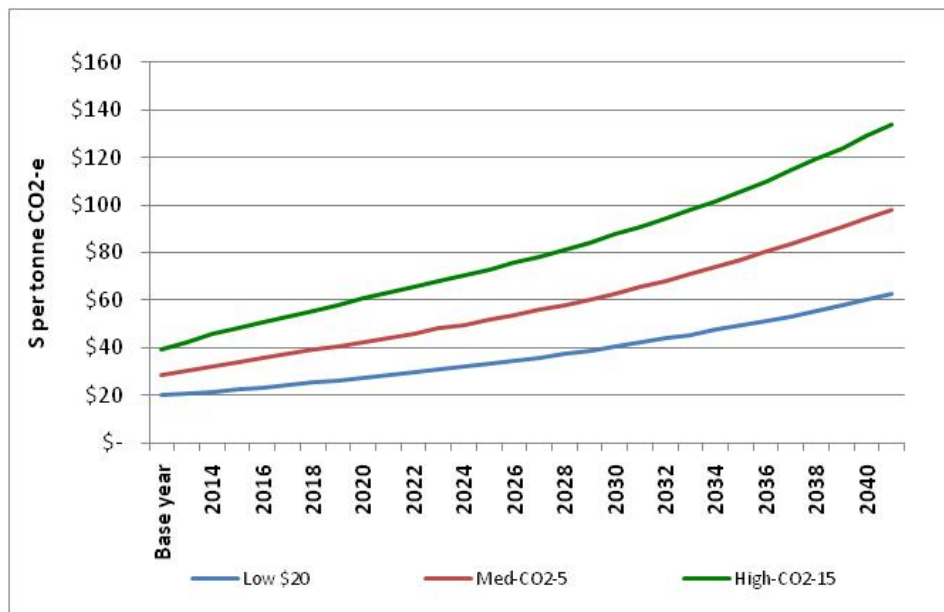
Figure 1: Carbon prices utilized in modelling.

The modelling provided an opportunity to project the impact of three different carbon prices on farm input costs and farm profitability over an extended period of time, assuming historical rates of farm productivity growth are maintained into the future. The modelling also provided an opportunity to examine the potential implications for farm businesses if agricultural emissions incurred a carbon price at some future time (**Agriculture Covered**). In this scenario, it was assumed that agricultural emissions incur a carbon price after five years, commencing with the carbon price being applied to 10% of farm emissions, increasing by 1.5% per annum. This broadly reflects the coverage of agricultural emissions included in the CPRS proposal, and is also similar to the coverage of agricultural emissions included in the New Zealand ETS.

A final scenario that was also able to be analysed utilising the modelling employed here was one under which a carbon price is implemented in the economy, with no cost imposed on emissions arising from fuel. This scenario – **No Fuel** – utilised the same carbon price series detailed

previously. For on-farm input costs, all linkages between changes in the price of fuel and farm input costs were removed. For off-farm costs specifically related to the processing sector, ABARE data (Tulloh et al 2009) in combination with data from a number of other sources was used to calculate the proportion of processor input costs that were not fuel related costs, and this was used to estimate cost increases for processors under a carbon price which excluded fuel. The methodology associated with the calculation is explained below.

Results

Agriculture as an uncovered sector

It should be noted that the following discussion relates to projected changes from the business-as-usual scenario under which no carbon cost mechanism is implemented in the Australian economy. As such, the projections being discussed are relative rather than absolute changes. Tables 4, 5 and 6 below display changes in farm input costs and farm cash income (gross farm cash revenue minus farm cash costs) arising from the impact of the carbon price, assuming agriculture remains an uncovered sector, under the three different carbon prices under consideration.

Table 4: **Projected change in farm business costs and farm cash income, average Australian beef farm.**

Change in total costs and cash income (agriculture uncovered)			Year 5	Year 10	Year 15	Year 20	Year 25	Year 30
Carbon price scenario								
		Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
		Cost - Processor ($)	$ 2,106	$ 2,562	$ 3,117	$ 3,793	$ 4,615	$ 5,614
Low $20		Cost - farm ($)	$ 2,759	$ 3,339	$ 4,039	$ 4,885	$ 5,906	$ 7,136
		Cost Total ($)	**$ 4,865**	**$ 5,901**	**$ 7,157**	**$ 8,678**	**$ 10,521**	**$ 12,750**
		Cost change (%)	1.8%	2.2%	2.7%	3.2%	3.9%	4.7%
		Income change (%)	-7.6%	-6.8%	-6.4%	-6.2%	-6.2%	-6.4%
		Carbon Price	$ 35.78	$ 44.34	$ 53.61	$ 65.53	$ 80.35	$ 97.83
		Cost - Processor ($)	$ 3,220	$ 3,991	$ 4,825	$ 5,899	$ 7,233	$ 8,806
Med-CO2-5		Cost - farm ($)	$ 4,202	$ 5,167	$ 6,200	$ 7,517	$ 9,135	$ 11,019
		Cost Total ($)	**$ 7,422**	**$ 9,158**	**$ 11,025**	**$ 13,416**	**$ 16,368**	**$ 19,825**
		Cost change (%)	2.8%	3.4%	4.1%	5.0%	6.1%	7.4%
		Income change (%)	-11.7%	-10.5%	-9.8%	-9.6%	-9.7%	-9.9%
		Carbon Price	$ 50.83	$ 62.98	$ 75.60	$ 91.00	$ 110.11	$ 134.07
		Cost - Processor ($)	$ 4,575	$ 5,669	$ 6,805	$ 8,191	$ 9,911	$ 12,068
High-CO2-15		Cost - farm ($)	$ 5,949	$ 7,295	$ 8,678	$ 10,345	$ 12,386	$ 14,910
		Cost Total ($)	**$ 10,524**	**$ 12,965**	**$ 15,483**	**$ 18,536**	**$ 22,297**	**$ 26,978**
		Cost change (%)	3.9%	4.8%	5.7%	6.9%	8.3%	10.0%
		Income change (%)	-16.5%	-14.9%	-13.8%	-13.3%	-13.2%	-13.5%

Table 5: Projected change in farm business costs and farm cash income, average Qld beef farm.

Change in total costs and cash income (agriculture uncovered)														
Carbon price scenario			Year 5		Year 10		Year 15		Year 20		Year 25		Year 30	
		Carbon Price	$	23.40	$	28.47	$	34.63	$	42.14	$	51.27	$	62.37
		Cost - Processor ($)	$	2,759	$	3,357	$	4,084	$	4,969	$	6,046	$	7,356
Low $20		Cost - farm ($)	$	3,280	$	3,970	$	4,803	$	5,809	$	7,023	$	8,485
		Cost Total ($)	**$**	**6,040**	**$**	**7,327**	**$**	**8,887**	**$**	**10,778**	**$**	**13,068**	**$**	**15,840**
		Cost change (%)		1.7%		2.1%		2.5%		3.0%		3.7%		4.5%
		Income change (%)		-6.2%		-5.7%		-5.4%		-5.4%		-5.4%		-5.6%
		Carbon Price	$	35.78	$	44.34	$	53.61	$	65.53	$	80.35	$	97.83
		Cost - Processor ($)	$	4,219	$	5,229	$	6,322	$	7,728	$	9,476	$	11,538
Med-CO2-5		Cost - farm ($)	$	4,996	$	6,143	$	7,372	$	8,939	$	10,863	$	13,103
		Cost Total ($)	**$**	**9,215**	**$**	**11,373**	**$**	**13,694**	**$**	**16,667**	**$**	**20,338**	**$**	**24,641**
		Cost change (%)		2.6%		3.2%		3.9%		4.7%		5.7%		6.9%
		Income change (%)		-9.5%		-8.8%		-8.4%		-8.3%		-8.5%		-8.7%
		Carbon Price	$	50.83	$	62.98	$	75.60	$	91.00	$	110.11	$	134.07
		Cost - Processor ($)	$	5,994	$	7,428	$	8,916	$	10,732	$	12,985	$	15,811
High-CO2-15		Cost - farm ($)	$	7,073	$	8,675	$	10,319	$	12,301	$	14,730	$	17,732
		Cost Total ($)	**$**	**13,068**	**$**	**16,103**	**$**	**19,235**	**$**	**23,034**	**$**	**27,715**	**$**	**33,543**
		Cost change (%)		3.7%		4.5%		5.4%		6.5%		7.8%		9.5%
		Income change (%)		-13.5%		-12.5%		-11.8%		-11.5%		-11.6%		-11.9%

Table 6: Projected change in farm business costs and farm cash income, average VIC beef farm.

Change in total costs and cash income (agriculture uncovered)														
Carbon price scenario			Year 5		Year 10		Year 15		Year 20		Year 25		Year 30	
		Carbon Price	$	23.40	$	28.47	$	34.63	$	42.14	$	51.27	$	62.37
		Cost - Processor ($)	$	1,301	$	1,583	$	1,926	$	2,343	$	2,851	$	3,469
Low $20		Cost - farm ($)	$	1,490	$	1,802	$	2,180	$	2,635	$	3,183	$	3,844
		Cost Total ($)	**$**	**2,791**	**$**	**3,386**	**$**	**4,106**	**$**	**4,978**	**$**	**6,035**	**$**	**7,313**
		Cost change (%)		2.1%		2.6%		3.1%		3.8%		4.6%		5.6%
		Income change (%)		-7.0%		-6.5%		-6.3%		-6.3%		-6.5%		-6.7%
		Carbon Price	$	35.78	$	44.34	$	53.61	$	65.53	$	80.35	$	97.83
		Cost - Processor ($)	$	1,990	$	2,466	$	2,981	$	3,645	$	4,469	$	5,441
Med-CO2-5		Cost - farm ($)	$	2,269	$	2,788	$	3,343	$	4,050	$	4,918	$	5,928
		Cost Total ($)	**$**	**4,258**	**$**	**5,254**	**$**	**6,324**	**$**	**7,695**	**$**	**9,387**	**$**	**11,369**
		Cost change (%)		3.3%		4.0%		4.8%		5.9%		7.2%		8.7%
		Income change (%)		-10.7%		-10.1%		-9.8%		-9.8%		-10.0%		-10.4%
		Carbon Price	$	50.83	$	62.98	$	75.60	$	91.00	$	110.11	$	134.07
		Cost - Processor ($)	$	2,827	$	3,503	$	4,205	$	5,061	$	6,124	$	7,457
High-CO2-15		Cost - farm ($)	$	3,211	$	3,934	$	4,676	$	5,570	$	6,664	$	8,014
		Cost Total ($)	**$**	**6,038**	**$**	**7,437**	**$**	**8,881**	**$**	**10,631**	**$**	**12,787**	**$**	**15,471**
		Cost change (%)		4.6%		5.7%		6.8%		8.1%		9.8%		11.8%
		Income change (%)		-15.2%		-14.4%		-13.7%		-13.5%		-13.7%		-14.1%

For all three model farms, the introduction of a carbon price, even at relatively low levels, is projected to have a significant impact on input costs, which rise by between 1.7 and 4.6% by year 5. Input costs increase most for the Qld beef farm in dollar terms, however in percentage terms the VIC farm is projected to experience the biggest percentage increase in input costs of all the model farms. This is related to the fact that the VIC farm sells a greater proportion of cattle each year which are assumed to be processed domestically (57% of the total herd) compared to the Qld farm (27% of the total herd), and therefore incurs larger increases in processor costs.

Processor costs are linked to the carbon price, and it is assumed that 100% of the additional processor cost was passed back to the farm business. This is a realistic assumption, given the export-dependent nature of the beef industry (and hence an inability to recoup additional costs by increasing prices), and the relative concentration in the meat processing sector in Australia. As a result, a change in carbon price will have a large affect on the processor costs, and for a farm which sells more of its stock, this will have a bigger impact on total business costs than for a farm which doesn't sell as many stock each year.

It is likely that the carbon policy will further disadvantage domestic beef processing relative to live exports, although detailed analysis of this issue has not been carried out.

The impact of a carbon price on farm businesses can also be expressed in terms of the changes in farm cash income (gross farm cash revenue minus farm cash costs) as the price of carbon changes. Farm cash income is an important measure for a farm business, as it reflects the cash surplus generated each year that is available for owner/operators expenses and/or to retire debt.

The projections in the three tables highlight that the 'bottom-line' impact of increases in farm input costs are significant when considered from a perspective of the effect on farm profitability, with a 2.1% increase in farm input costs for the VIC farm, for example, translating to a 7.0% reduction in farm cash income.

In relative terms, the impact of the carbon price on farm profitability is greatest for the Australian farm in comparison with the VIC farm and the Qld farm. It is interesting that the VIC farm has the highest increase in input costs of all three farms, but farm cash income is projected to reduce by a proportionally greater amount in the case of the Australian farm. The reason for the different impacts of rising input costs on the model farms is shown best by the amount of revenue each farm generates from inputs. In the base year, before a carbon price is imposed, the VIC farm generates $1.22 revenue per one dollar of input cost. The Qld farm generates $1.19 per dollar input cost. The Australian average farm generates $1.16 per dollar input cost. This means that as the input costs go up, the VIC farm generates proportionally more revenue than the Australian farm, and this is reflected in the percentage change in farm cash incomes for the two model farms.

The above results are expressed in terms of changes from the business-as-usual scenario, under which no carbon price is introduced into the economy, and assumes the beef industry maintains current productivity growth rates of approximately 1.5% per annum. In all cases, the imposition of a price on carbon slows the rate of growth in future farm cash income, (in $2009-10 terms) but farm cash income continues to grow under all scenarios examined, as Figures 2, 3 and 4 (below) highlight.
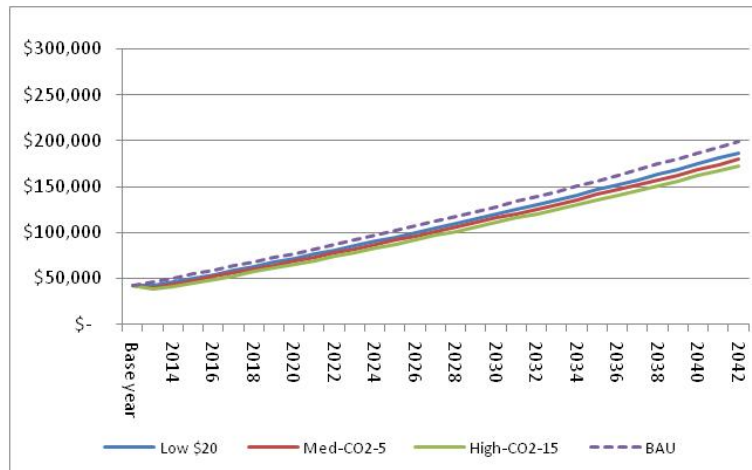
Figure 2: Projected future farm cash income under different carbon price scenarios, Australian average beef farm.
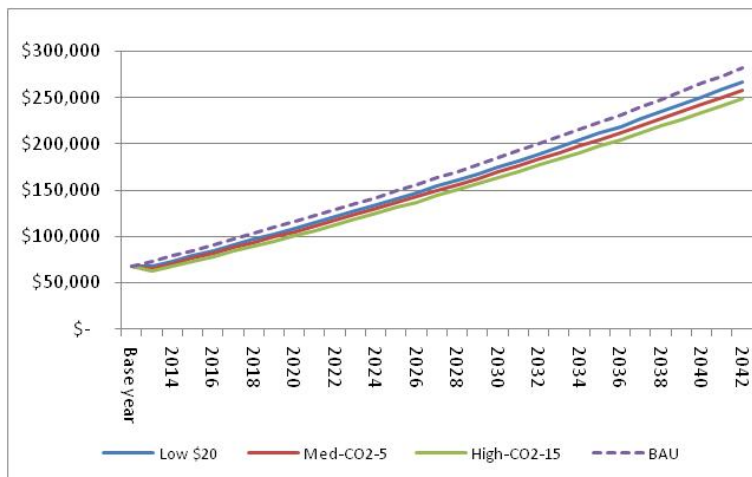

**Figure 3:** Projected future farm cash income under different carbon price scenarios, Qld beef farm.
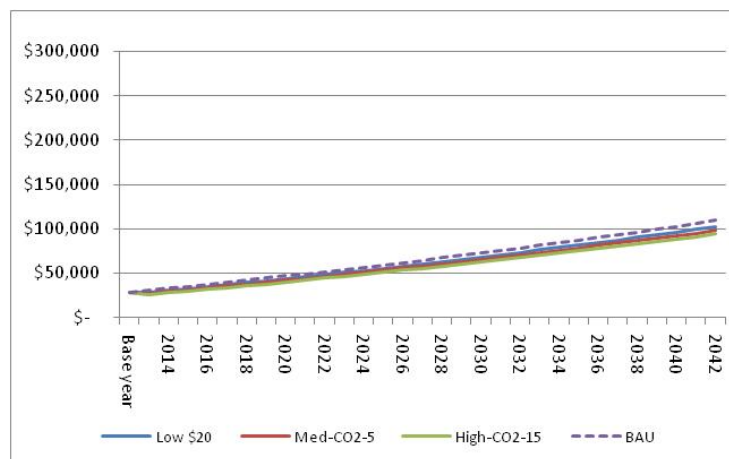
Figure 4: Projected future farm cash income under different carbon price scenarios, VIC beef farm.

The analysis provided an opportunity to develop a "carbon price/farm cost" curve for each of the farms, which provides a picture of how farm input costs are projected to increase at different carbon prices. These results are displayed in Figures 5, 6 and 7 below.
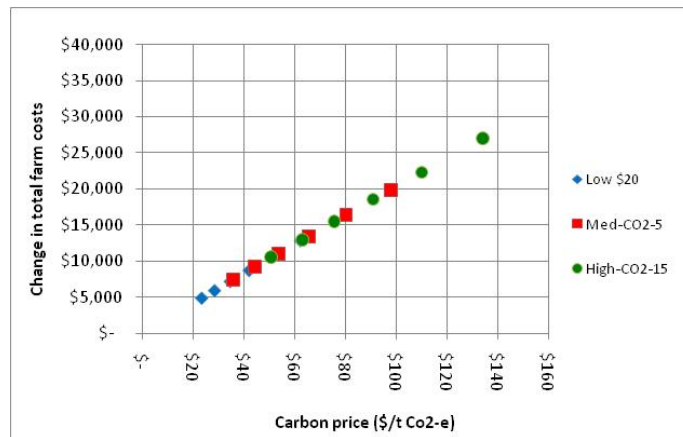
Figure 5: Relationship between carbon price and overall cost increases for the Australian average beef farm.
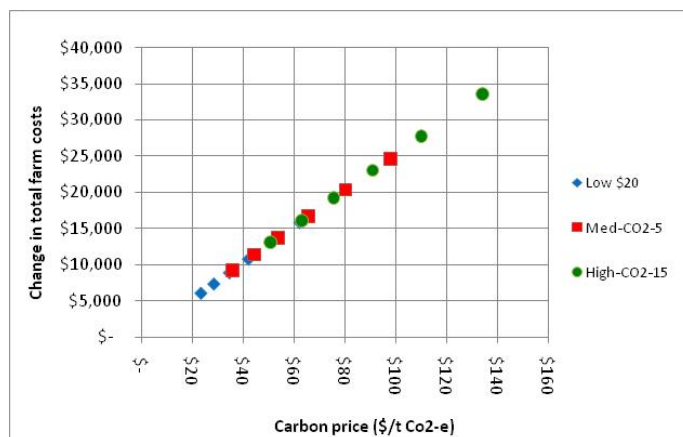
Figure 6: Relationship between carbon price and overall cost increases for the Qld beef farm.
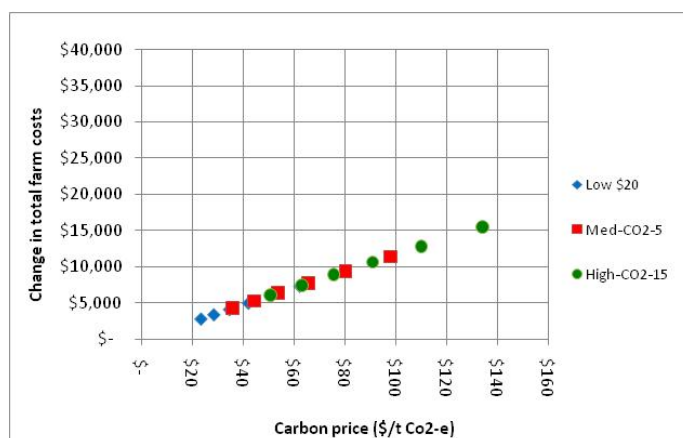
Figure 7: Relationship between carbon price and overall cost increases for the VIC beef farm.

At a carbon price of approximately $20 per tonne CO_2-e, the additional costs are approximately $4.66 per head of cattle for the Australian average beef farm, approximately $3.82 per head of cattle for the Qld farm, and $8.03 per head of cattle for the VIC farm. The difference between costs per head of cattle for the VIC farm is related to the size of the VIC farm, which has a much smaller cattle herd.

Agriculture as a covered sector

The Australian Government has stated that agricultural emissions will not attract a liability under a carbon price mechanism for the 'foreseeable future', and this might lead to the conclusion that the sector therefore does not need to consider the implications of a carbon cost being imposed on farm emissions. However, it is pertinent to note that the New Zealand emissions trading scheme which has already commenced includes a proposal to impose a cost on at least some farm emissions from 2015, by making downstream processors and input suppliers liable for emissions that are generated on farm. This, in combination with the fact that agriculture sector emissions will become more prominent in future in the national inventory as other sectors emissions decline (and therefore more likely to attract the attention of policymakers) suggests that it is prudent to also examine the implications for farm businesses of a liability for a proportion of direct farm emissions.

A scenario was therefore modelled under which a carbon price mechanism was introduced in the economy such that a carbon price trajectory equivalent to the Treasury modelling of the CPRS-5 scenario was experienced. The agriculture sector, from year five, was then assumed to be required to pay a carbon price for 10% of farm emissions (in accordance with the 'Emissions-Intensive Trade Exposed' sector proposal included with the CPRS), with the level of liability increasing by 1.5% per annum from year 6. This would mean that a farm business would be liable to pay a cost for 10% of estimated farm emissions in year 5, 11.5% in year six and so on. Figures 8, 9 and 10 below show the change in farm cash income for beef farms under this scenario, comparing the results with the projected income under a carbon pricing mechanism with carbon prices equivalent to the CPRS-5 Treasury carbon price series.

The resulting projections indicate that the imposition of a cost for farm emissions from year 5, even at an initial 10% level, would result in a significant additional decrease in farm cash incomes for the three farms included in this modelling. The impact would be relatively greater for the Qld farm, because its greenhouse gas emissions are so much higher than the VIC farm and the Australian average model farm, as shown in Table 3 above. For the Qld beef farm, productivity growth over time is projected to steadily reduce the impact of the carbon price under the 'Uncovered' scenario, however productivity is not accelerating fast enough to negate the impact of an emissions liability under a 'Covered' scenario.

For the national average beef farm (Australia) by year 30 farm cash income is reduced by 9.9% and if the farm has an emission liability, farm cash income is 43.9% lower than business as usual. For the VIC farm, by year 30 farm cash income is reduced by 10.4% when the agriculture sector is uncovered, and if agriculture is covered and the farm had an emission liability, farm cash income is 32.5% lower. The Qld farm is projected to experience the largest reduction in farm cash income by year 30; under the uncovered scenario the projected reduction is 8.7% while under a covered scenario farm cash income is projected to be 51.5% lower than business as usual. This is because the Qld farm has nearly double the estimated greenhouse gas emissions than the Australia farm, and nearly five times the emissions estimated for the VIC farm. It should

be noted that this impact is projected to occur under a model whereby it is assumed historical beef industry productivity growth of 1.5% per annum is able to be maintained for the duration of the period under investigation.
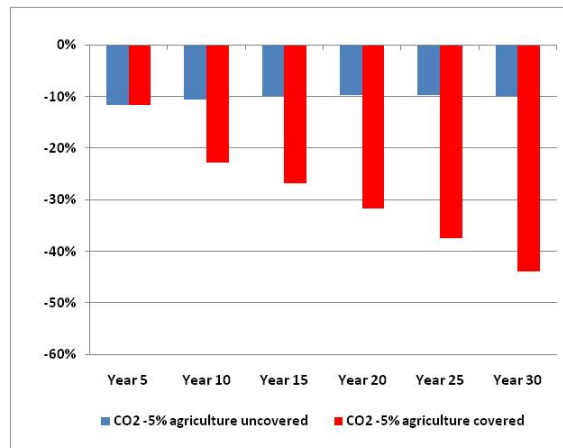
Figure 8: Change in farm cash income for the Australia beef farm business, under a scenario where agriculture becomes a covered sector after 5 years, and incurs a liability for 10% of emissions, escalating by 1.5% per annum.
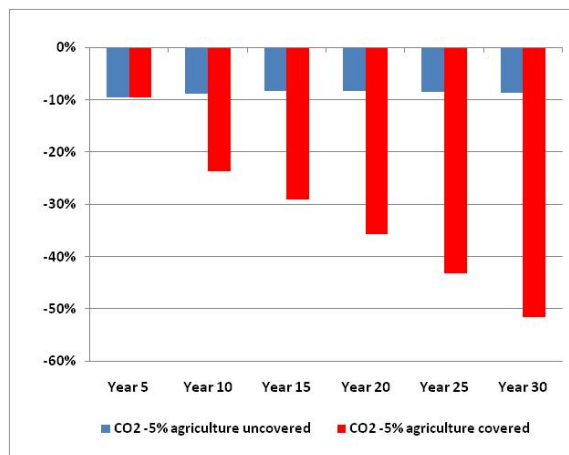
Figure 9: Change in farm cash income for the Qld beef farm business, under a scenario where agriculture becomes a covered sector after 5 years, and incurs a liability for 10% of emissions, escalating by 1.5% per annum.
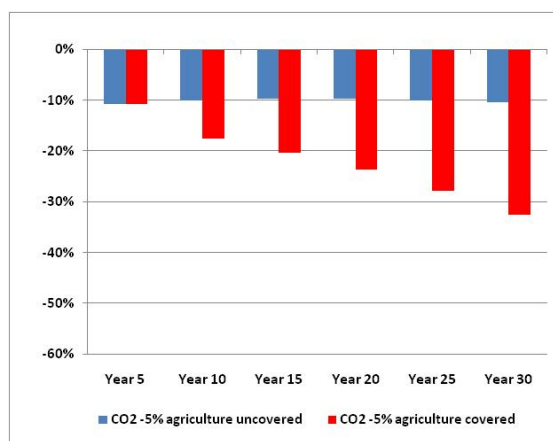
Figure 10: Change in farm cash income for the VIC beef farm business, under a scenario where agriculture becomes a covered sector after 5 years, and incurs a liability for 10% of emissions, escalating by 1.5% per annum.

No fuel scenario

A carbon price policy scenario that has been the subject of some discussion is one under which no carbon price is implemented for emissions arising from liquid fuel, and under which agricultural emissions are excluded from a carbon price. The scenario modelled here attempts to provide an estimate of the impact of such a policy for Australian farm businesses.

For farm-sector costs detailed in the models developed for this analysis, it is a relatively straightforward process to remove any linkage between the carbon price and fuel-related farm input costs such as fuel and freight, in order to calculate the direct impact of a 'no-fuel' policy on farm businesses.

However, for the post farm processing sector, calculating the impact of a carbon price that excludes fuel is much less straightforward, because of the limited availability of relevant data. The approach used in this analysis was to use the increased processor costs identified by ABARE (Tulloh et. al, 2009) as a starting point, and then to discount those to account for the fact that fuel emissions would not incur a cost under the carbon policy. To do this requires identification of the significance of fuel and fuel-related inputs in the total input costs of processors. It is also important to recognise that many processing facilities produce direct emissions in excess of the previously announced threshold level for participation in a carbon scheme (25,000 tonnes CO_2-e per annum) and it is assumed that this same threshold will be applied to a future carbon scheme, and that processors will therefore incur a direct liability for these factory emissions, irrespective of the inclusion or exclusion of fuel.

The potential impact of a carbon scheme on meat, milk and grain processors is assumed to depend on two main variables, which are;

1. The total amount of electricity inputs utilised by the processor and key input providers, and
2. The direct emissions produced by the processor, for which it is likely that a carbon price will be applied.

ABS Input/Output tables, (ABS, 2010) (Table 7 below) provide a breakup of the energy and energy-related inputs used by relevant agricultural processing sectors in Australia. The table

indicates that fuel and transport costs dominate the energy-related costs of these sectors, with dairy processors seemingly less reliant on fuel (and therefore more reliant on electricity) than either of the other two sectors. The extent to which the entire meat processing supply chain is incorporated under the ABS "Meat and Meat Processing" category is unclear, and is also complicated by the different vertical arrangements that exist in the meat industry. Some processors are fully integrated and include operations such as smallgoods manufacture and rendering, whereas in other cases these are activities carried out by organisations that are separate to the meat processor. It may well be that the approach used here underestimates additional costs likely to be passed back to processors, although very detailed plant-by-plant data would be needed to clarify this issue.

The amount of direct greenhouse emissions produced by the various processing sectors is not available, although some information is available from published data associated with the National Greenhouse and Energy Reporting Scheme (NGERS), which lists reporting companies and various categories of emissions they produce (NGERS, 2009). There has also been some research carried out into emissions associated with red meat processing (The CIE, 2009). Based on that data and assuming an emission price of $25/t CO_2-e, direct emission costs of approximately $45 million would be added to the costs incurred by meat processors, and this portion of the added costs would not change if fuel was excluded from coverage.

Table 7: Energy and energy-related inputs utilized by agricultural processors.

Supply sector	User sector ($ millions)		
	Meat and Meat product Manufacturing	Dairy Product Manufacturing	Grain Mill and Cereal Product Manufacturing
Oil and gas extraction	$ 27	$ 60	$ 4
Petroleum and Coal Product Manufacturing	$ 11	$ 23	$ 16
Electricity Generation	$ 67	$ 92	$ 28
Electricity Transmission, Distribution, On Selling and Electricity Market	$ 55	$ 77	$ 23
Gas Supply	$ 2	$ 35	$ 6
Road Transport	$ 1,546	$ 375	$ 298
Rail Transport	$ 21	$ 12	$ 36
Total (Energy related)	**$ 1,730**	**$ 673**	**$ 411**
Fuel related	$ 1,606	$ 470	$ 355
Electricity related	$ 124	$ 203	$ 56
Fuel related (%)	93%	70%	86%
Non-fuel (Electricity/gas) %	7%	30%	14%

Based on the above and on consideration of factors such as pass-through rates of fuel costs into transport costs, the fact that many processors will incur a cost for their factory emissions and not receive any concessional treatment, and that there will likely be indirect cost increases passed on to processors by input suppliers, it seems reasonable to assume that the removal of fuel emissions from coverage under a carbon price policy will substantially reduce the additional costs faced by processors. Based on the above, for the purpose of this modelling it is assumed that additional meat processor costs under a no-fuel scenario would be only 20% of the additional costs estimated by ABARE (Tulloh et. al 2009) under a scenario where fuel was included, and for

dairy and grain processors the additional costs would only be 35% and 25% respectively of the additional costs estimated by ABARE under a scenario where fuel emissions are included.

The resulting 'no-fuel carbon scheme' cost estimates are displayed in Table 1. These unit costs were then multiplied by farm outputs (tonnes of grain, numbers of livestock sold etc.), to estimate processor costs incurred by the farm business, assuming that 100% of processor costs are passed on to the farm business. The processor cost is applied to the number of stock sold each year as estimated by ABARES, and adjusted to account for the percentage of stock sold for live export. It should be noted that these estimates represent little more than a 'best guess' in the absence of the detailed plant-by-plant data that would be required to estimate these costs more accurately.

Modelling was carried out of the projected impacts of such a policy, assuming that all other factors (including the carbon price) remained the same as in earlier modelling. The results are displayed in Tables 8, 9 and 10 below.

Table 8: Projected change in farm business costs and farm cash income, No-fuel scenario, Australian average beef farm.

Change in total costs and cash income (agriculture uncovered)							
Carbon price scenario			Year 5	Year 10	Year 15	Year 20	Year 25	Year 30
		Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
		Cost - Processor ($)	$ 425	$ 517	$ 629	$ 766	$ 932	$ 1,133
Low $20		Cost - farm ($)	$ 900	$ 1,082	$ 1,300	$ 1,562	$ 1,875	$ 2,248
		Cost Total ($)	**$ 1,325**	**$ 1,599**	**$ 1,929**	**$ 2,327**	**$ 2,806**	**$ 3,382**
		Cost change (%)	0.5%	0.6%	0.7%	0.9%	1.0%	1.3%
		Income change (%)	-2.1%	-1.8%	-1.7%	-1.7%	-1.7%	-1.7%
		Carbon Price	$ 35.78	$ 44.34	$ 53.61	$ 65.53	$ 80.35	$ 97.83
		Cost - Processor ($)	$ 650	$ 806	$ 974	$ 1,191	$ 1,460	$ 1,778
Med-CO2-5		Cost - farm ($)	$ 1,363	$ 1,661	$ 1,977	$ 2,377	$ 2,863	$ 3,423
		Cost Total ($)	**$ 2,013**	**$ 2,467**	**$ 2,951**	**$ 3,568**	**$ 4,323**	**$ 5,201**
		Cost change (%)	0.7%	0.9%	1.1%	1.3%	1.6%	1.9%
		Income change (%)	-3.2%	-2.8%	-2.6%	-2.6%	-2.6%	-2.6%
		Carbon Price	$ 50.83	$ 62.98	$ 75.60	$ 91.00	$ 110.11	$ 134.07
		Cost - Processor ($)	$ 924	$ 1,144	$ 1,374	$ 1,654	$ 2,001	$ 2,436
High-CO2-15		Cost - farm ($)	$ 1,923	$ 2,333	$ 2,749	$ 3,246	$ 3,850	$ 4,590
		Cost Total ($)	**$ 2,847**	**$ 3,477**	**$ 4,122**	**$ 4,900**	**$ 5,851**	**$ 7,027**
		Cost change (%)	1.1%	1.3%	1.5%	1.8%	2.2%	2.6%
		Income change (%)	-4.5%	-4.0%	-3.7%	-3.5%	-3.5%	-3.5%

Table 9: Projected change in farm business costs and farm cash income, No-fuel scenario, Qld beef farm.

Change in total costs and cash income (agriculture uncovered)								
Carbon price scenario			Year 5	Year 10	Year 15	Year 20	Year 25	Year 30
		Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
		Cost - Processor ($)	$ 556	$ 676	$ 822	$ 1,000	$ 1,217	$ 1,481
Low $20		Cost - farm ($)	$ 1,084	$ 1,304	$ 1,567	$ 1,882	$ 2,259	$ 2,710
		Cost Total ($)	**$ 1,640**	**$ 1,980**	**$ 2,389**	**$ 2,883**	**$ 3,477**	**$ 4,191**
		Cost change (%)	0.5%	0.6%	0.7%	0.8%	1.0%	1.2%
		Income change (%)	-1.7%	-1.5%	-1.5%	-1.4%	-1.4%	-1.5%
		Carbon Price	35.78	44.34	53.61	65.53	80.35	97.83
		Cost - Processor ($)	$ 849	$ 1,053	$ 1,273	$ 1,556	$ 1,908	$ 2,323
Med-CO2-5		Cost - farm ($)	$ 1,643	$ 2,002	$ 2,383	$ 2,865	$ 3,450	$ 4,125
		Cost Total ($)	**$ 2,493**	**$ 3,055**	**$ 3,656**	**$ 4,421**	**$ 5,358**	**$ 6,448**
		Cost change (%)	0.7%	0.9%	1.0%	1.2%	1.5%	1.8%
		Income change (%)	-2.6%	-2.4%	-2.2%	-2.2%	-2.2%	-2.3%
		Carbon Price	50.83	62.98	75.60	91.00	110.11	134.07
		Cost - Processor ($)	$ 1,207	$ 1,495	$ 1,795	$ 2,161	$ 2,614	$ 3,183
High-CO2-15		Cost - farm ($)	$ 2,318	$ 2,811	$ 3,313	$ 3,912	$ 4,640	$ 5,532
		Cost Total ($)	**$ 3,525**	**$ 4,307**	**$ 5,108**	**$ 6,073**	**$ 7,255**	**$ 8,716**
		Cost change (%)	1.0%	1.2%	1.4%	1.7%	2.0%	2.5%
		Income change (%)	-3.6%	-3.3%	-3.1%	-3.0%	-3.0%	-3.1%

Table 10: Projected change in farm business costs and farm cash income, No-fuel scenario, VIC beef farm.

Change in total costs and cash income (agriculture uncovered)								
Carbon price scenario			Year 5	Year 10	Year 15	Year 20	Year 25	Year 30
		Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
		Cost - Processor ($)	$ 263	$ 320	$ 389	$ 474	$ 576	$ 701
Low $20		Cost - farm ($)	$ 519	$ 623	$ 749	$ 899	$ 1,078	$ 1,291
		Cost Total ($)	**$ 782**	**$ 943**	**$ 1,138**	**$ 1,372**	**$ 1,654**	**$ 1,992**
		Cost change (%)	0.6%	0.7%	0.9%	1.1%	1.3%	1.5%
		Income change (%)	-2.0%	-1.8%	-1.8%	-1.7%	-1.8%	-1.8%
		Carbon Price	35.78	44.34	53.61	65.53	80.35	97.83
		Cost - Processor ($)	$ 402	$ 498	$ 602	$ 737	$ 903	$ 1,100
Med-CO2-5		Cost - farm ($)	$ 786	$ 956	$ 1,137	$ 1,366	$ 1,643	$ 1,962
		Cost Total ($)	**$ 1,188**	**$ 1,455**	**$ 1,740**	**$ 2,102**	**$ 2,546**	**$ 3,062**
		Cost change (%)	0.9%	1.1%	1.3%	1.6%	1.9%	2.3%
		Income change (%)	-3.0%	-2.8%	-2.7%	-2.7%	-2.7%	-2.8%
		Carbon Price	50.83	62.98	75.60	91.00	110.11	134.07
		Cost - Processor ($)	$ 571	$ 708	$ 850	$ 1,023	$ 1,238	$ 1,507
High-CO2-15		Cost - farm ($)	$ 1,108	$ 1,342	$ 1,580	$ 1,863	$ 2,207	$ 2,628
		Cost Total ($)	**$ 1,679**	**$ 2,050**	**$ 2,429**	**$ 2,886**	**$ 3,445**	**$ 4,135**
		Cost change (%)	1.3%	1.6%	1.9%	2.2%	2.6%	3.2%
		Income change (%)	-4.2%	-4.0%	-3.8%	-3.7%	-3.7%	-3.8%

A comparison of these results with the results displayed in Tables 4, 5 and 6 shows that the cost impacts for farm businesses of a carbon policy that excludes fuel emissions would be considerably less. For instance, under the Medium carbon price scenario, input costs for the Australian average beef farm were projected to increase by 2.8% in year 5 under the fuel included scenario, and by 0.7% under the no-fuel scenario. For the VIC farm under the Medium emission price scenario, input costs in year 5 were projected to increase by 3.3% under the fuel-included scenario, and by 0.9% under the no-fuel scenario. Finally for the Qld farm, by year 5 costs were projected to increase by 2.6% under the fuel-included scenario, but only by 0.7% under the fuel-excluded scenario.

It should be noted that, in the event the Australian Government remains committed to an emission reduction target by 2020 that involves emission reductions of either 5% or 15% and also decides to exclude fuel emissions from the carbon price, the carbon price that would be required to achieve that emission reduction target would be considerably higher. No attempt has been made in this modelling to estimate how much higher the carbon price would need to be under the No-fuel scenario, in order for Australia to meet the emission-reduction targets that have been announced.

Conclusions

The introduction of a carbon price has the potential to have a significant impact on profitability of beef farms in Australia, regardless of whether the agriculture sector is included and farm businesses are liable for emissions generated at the farm level. The scenarios modelled here and the assumptions underlying the modelling are as realistic as possible, but are still subject to a large degree of uncertainty at both a policy and also at a farm operation level. Faced with additional costs, farm business managers would respond in a variety of different ways that are not foreseeable or predictable, and technologies may emerge over time that enable adaptation to occur and the negative impacts of a carbon price on farm businesses to be reduced.

From the analysis conducted, however, it is clear that the introduction of a price on carbon presents a significant challenge to beef farm business managers, particularly smaller-scale farms. The ability of beef farms to maintain or increase rates of productivity growth is going to become increasingly important if a carbon price is introduced, as the modelling has shown.

As outlined in the modelling, the impact of a carbon price on processor costs is potentially significant. The challenge of this cost for farm business managers is that there is very little which can be done to reduce it. There is little opportunity to change behavior to cope with this additional cost burden, as it is largely determined at the processor level and passed back to the producer.

The exclusion of emissions from fuel would reduce the impact of a carbon price policy on Australian beef farm businesses by a very large amount in comparison with a policy that included fuel emissions (at the same carbon price), although no attempt has been made to estimate how much the carbon price would need to be increased under a 'no-fuel' scenario in order to achieve a specific future emission reduction target.

If agriculture is a covered sector and farm businesses required to pay for on-farm emissions, farm cash income can be expected to fall significantly relative to that projected under a business-as-usual scenario without a carbon tax being introduced. This analysis assumed that the agriculture sector was afforded EITE status and therefore only had to pay a fraction of emission costs. If this concession was not provided to the agriculture sector and farm businesses were liable for 100% of emissions generated on-farm, the reduction in farm cash income shown above could be expected to be increase by a magnitude of ten. Research and development to discover viable ways to reduce enteric methane emissions in broadacre beef production systems will be very important in future, particularly if the agriculture sector is being considered for inclusion in an emission trading scheme.

However, even if agriculture is not included in a carbon price mechanism, the introduction of a carbon price in the Australian economy has the potential to have a significant negative impact on the profitability of beef production in Australia.

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