final report

Project code: PRSET.0046

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Date submitted: June 2006

PUBLISHED BY
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Possible impacts of the CPRS on the Australian red meat and livestock industry

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

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Boxes, charts and tables

Executive summary

Background to the issue

- All points in the red meat production chain, from the farmer to the processor will potentially be affected by the introduction of the proposed Carbon Pollution Reduction Scheme (CPRS).
- Processors will be affected on commencement of the scheme as a number of them are above the inclusion threshold and so will have a requirement to purchase permits. Processors will also be affected by increased energy and other costs as an indirect consequence of the CPRS.
- Farmers will initially be affected through increased energy and other costs as an indirect consequence of the CPRS.
- Farmers will significantly be affected if agriculture is included in the CPRS in 2015 (a decision that will be made in 2013).
- Processors will also be affected if the farm sector is included though increase costs of cattle and sheep.

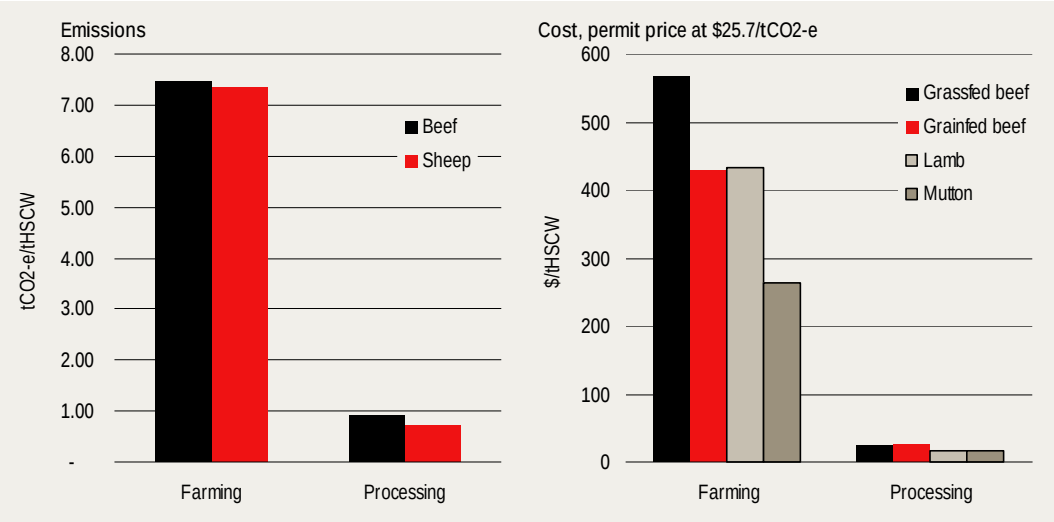
Key factors

- The magnitude of the impacts on farmers and processors depend on a number of factors, none of which is know with certainty.
- In particular, the magnitude of the impact depends on: the exact nature and timing of the inclusion of agriculture; the way in which permits are allocated and; the permit price.
- This report uses a number of scenarios to examine potential impacts on the red meat production chain. The scenarios are not forecasts, but provide a basis for considering the potential magnitude of effects.
- Since the analysis for this report commenced, the Government announced that the start of the CPRS would be delayed until 2011, and that the permit price would be fixed in the first year of the scheme. Given this, results for early years reported here should be viewed as indicative only.

Magnitude of the effects

- Most of the potential impacts of the CPRS on the red meat industry come from the potential inclusion of agriculture (that is, the farm sector) in the scheme.
- Compared to livestock farming, red meat processing generates fewer greenhouse gas emissions (per animal) and faces smaller direct costs associated with them.
- As shown in chart 1, the farming sector emits over 7tCO_2-e/tHSCW (hot standard carcass weight), while the processing sector emits less than 1tCO_2-e/tHSCW.
- As a result, the direct cost impact when the permit price is \$25.7/tCO_2-e (our predicted price in 2020) is between \$16 and \$25/tHSCW for the processing sector, but is between \$260 and \$565/tHSCW for the farming sector.

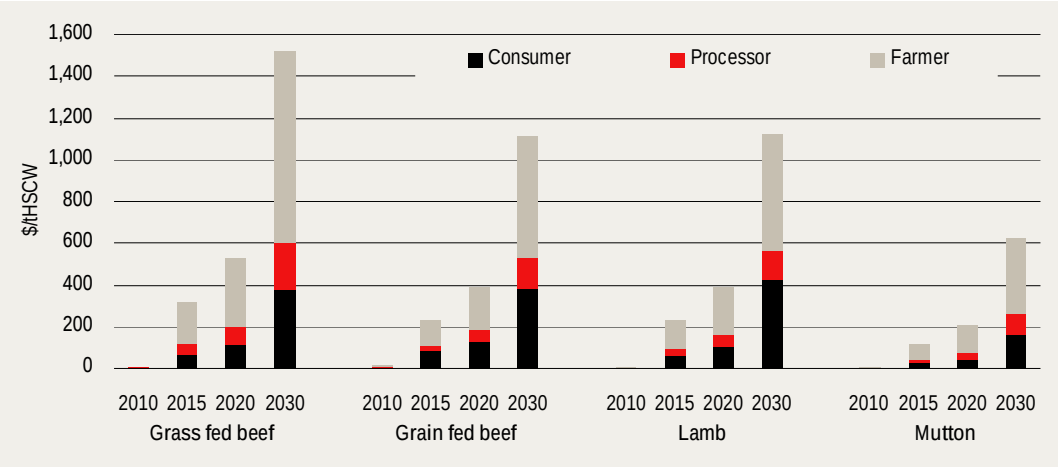
1 **Emissions and CPRS costs from farming and processing assuming both are included in the CPRS**



Data source: DCC, MLA and CIE GMI model simulations

- Chart 2 illustrates how the cost impacts of both processing and farming inclusion in the CPRS is passed throughout the production chain.
- Although farmers will bear most of the emissions costs, the cost burden on processors is also high. For example, the cost burden on processors will be between \$32 and \$82/tHSCW in 2020 when the emissions permit price is projected to be \$25.7/tCO_2-e.

2 **Actual cost burden on consumer, processor and farmer assuming both farming and processing are included in CPRS**



Data source: CIE estimates based on GMI simulations

Exploring some scenarios

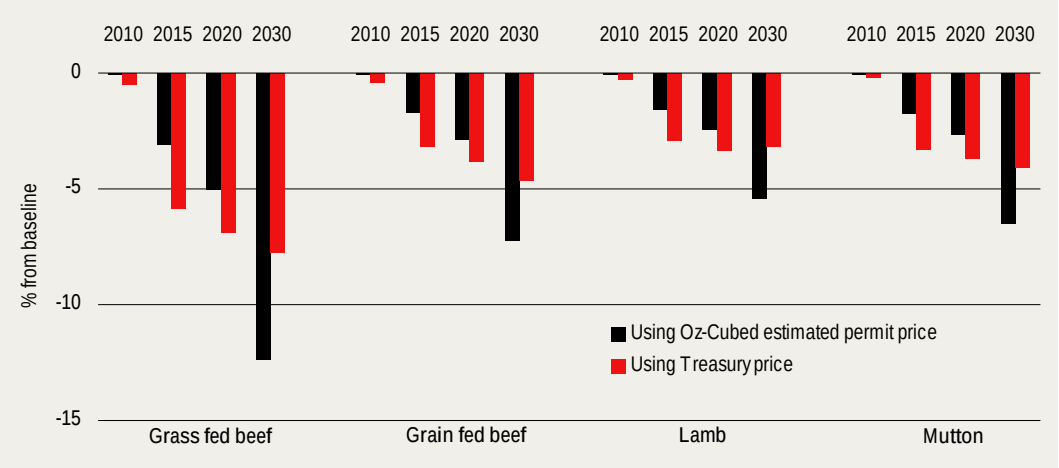
- The impact on the red meat industry could be significant if both farming and processing are included in the CPRS and neither are eligible for free permits (examined as ***Scenario 1*** in this report):
  - By 2030 production may fall by 12 per cent relative to the business as usual (BAU) level for grass fed beef, by 7 per cent for grain fed beef and by 5 to 6 per cent for sheepmeat.
  - By 2030 exports may fall by 12 to 14 per cent relative to the BAU level for beef, and by 8 per cent for sheepmeat.
  - By 2030 the gross operating surplus (GOS, a measure of gross profits) of processors may fall by 62 per cent relative to the BAU level for grass fed beef, and by 27 to 32 per cent for grain fed beef, lamb and mutton.
- Under ***Scenario 2*** (where both farming and processing are included in the CPRS in 2015 and are eligible for free permits which are equivalent to 90 per cent of emissions in 2015 and declining by 1.3 per cent each year), the impacts on the red meat industry by 2030 are:
  - Production may fall by 5.9 per cent relative to the business as usual (BAU) level for grass fed beef, by 3.7 per cent for grain fed beef and by 1.9 to 2.3 per cent for sheepmeat.
  - Exports may fall by 6.6 per cent relative to the BAU level for beef, by 1.8 per cent for lamb and by 3 per cent for mutton.
  - The gross operating surplus of processors may fall by 31 per cent for grass fed beef, by 15 per cent for grain fed beef, by 11 per cent for lamb and by 16 per cent for mutton.

- The impacts on the red meat industry are the smallest under the ***Scenario 3*** where neither farming nor processing are included in the CPRS:
  - By 2030 production may fall by around 1 per cent relative to the business as usual (BAU) level for beef, by 0.1 per cent for lamb and by 0.6 per cent for mutton.
  - By 2030 exports may fall by 1 to 2 per cent for beef and mutton, and rise by 1.8 per cent for lamb (due to the assumption of an emissions trading system being implemented in New Zealand) relative to BAU.
  - By 2030 GOS, may fall by 5 per cent for beef and by 3.7 per cent for mutton, and rise by 0.3 per cent for lamb (all relative to BAU)

Effects are sensitive assumptions about permit prices

- The above results are estimated by The CIE GMI model using the carbon emission permit prices estimated by The CIE Oz-Cubed model. The Oz-Cubed model estimated prices are lower than the prices of the CPRS-5 scenario from the Treasury modelling before around 2022. Sensitivity analysis has been conducted using the Treasury prices.
- The sensitivity analysis shows that the impact would be higher in the early years of the CPRS and lower in the later years than the above presented impacts. Chart 3 compares the impact on production under the Scenario 1 assuming different permit prices and associated cost increases.
  - The magnitude of fall in production in 2010, 2015 and 2020 would be 5.6 times, doubles and about 35 per cent higher, respectively, using the Treasury prices than using the Oz-Cubed estimated prices.
  - However the magnitude of fall in production in 2030 would be about 40 per cent lower using the Treasury prices than using the Oz-Cubed estimated prices.

3 **Impact on production assuming different permit prices, Scenario 1**

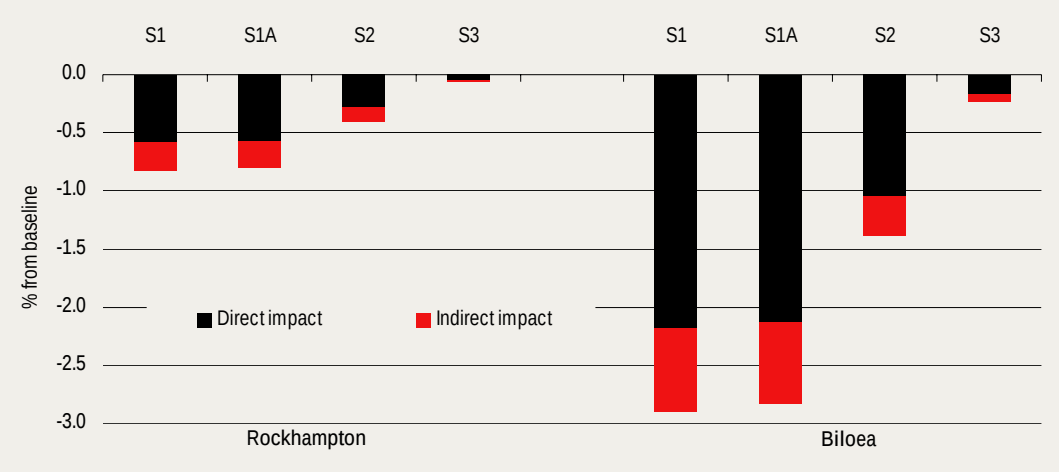


Data source: The CIE GMI simulations

Case studies

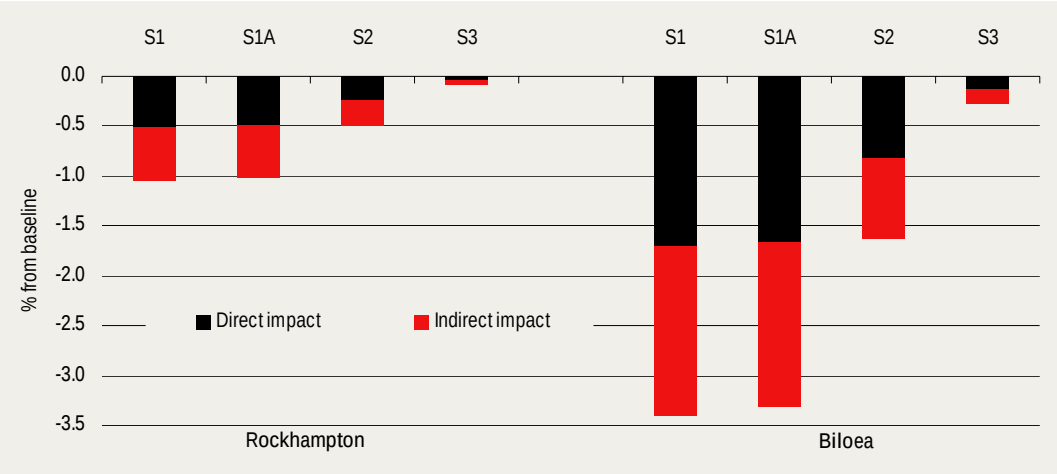
- Both Rockhampton City and Biloela Township have a higher contribution of abattoirs to the local economy than the national average:
  - Nationally, the meat and meat products sector accounts for only 0.4 per cent of gross domestic product.
  - Abattoirs in Rockhampton City and Biloela contribute to over 3 per cent and over 10 per cent, respectively, of gross regional product (GRP).
- Because the red meat sector falls more than the average of all sectors under a CPRS, Rockhampton and Biloela are likely to have more impacts from a CPRS than the national average.

4 **Additional impacts on GRP of lower abattoir throughput 2030**



Note: It is assumed that 30 per cent of non-livestock inputs are sourced locally in calculating the indirect impact of lower inputs.
Data source: The CIE estimates

5 **Direct and indirect impacts on regional employment of lower abattoir throughput, 2030**

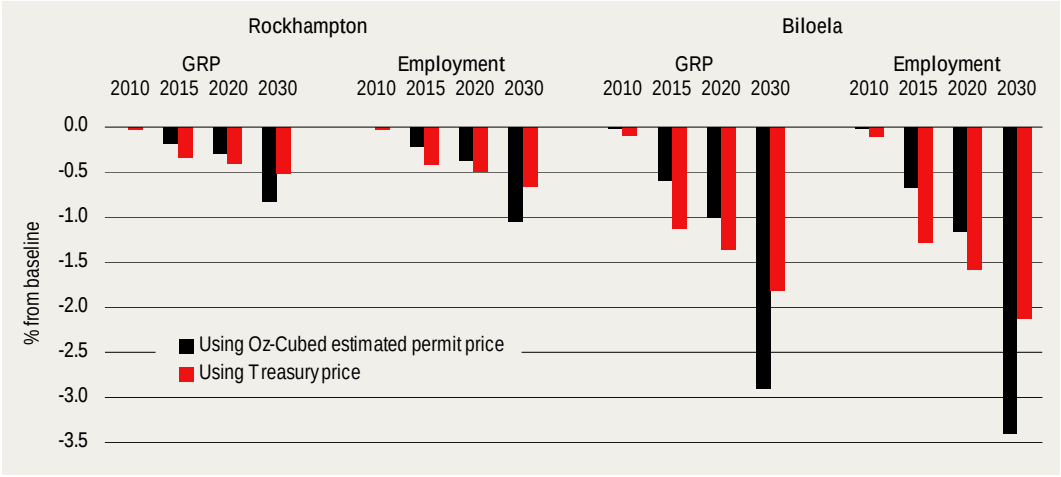


Note: It is assumed that 30 per cent of non-livestock inputs are sourced locally in calculating the indirect impact of lower inputs.
Data source: The CIE estimates

- The additional impacts of a CPRS due to higher proportion of red meat sector in Rockhampton and Biloela are[1]:
  - GRP will be 0.8 per cent lower than the business as usual level in 2030 for Rockhampton and 2.9 per cent lower for Biloela under the Scenario 1 (chart 4).
  - There will be about 429 job losses in Rockhampton City and about 116 job losses in Biloela Township in 2030 under the Scenario 1. These job losses are equivalent to 1 per cent and 3.4 per cent of business as usual employment level in Rockhampton City and Biloela Township, respectively (chart 5).
- The sensitivity analysis result of regional impact using the Treasury's CPRS-5 price displays a similar pattern to the sensitivity analysis result of the sectoral impact. Chart 6 draws the impact on GRP and employment under the Scenario 1 with the Treasury price (red column) alongside the result using the Oz-Cubed estimated price (black column). The former is higher in 2010, 2015 and 2020 and lower in 2030 than the latter.

1 These impacts are the impacts of lower activity of abattoirs and are **additional** to the average impact of CPRS. The macroeconomic analysis suggests that GDP in 2030 will be 1.4 per cent lower than the BAU level if agriculture is included in a CPRS. The total impact of a CPRS on GRP in 2030 will be about 2 per cent lower than BAU for Rockhampton and about 3.6 per cent lower than BAU for Biloela. These estimates do not include the impact of lower spending of beef farmers in the surrounding area.

6 **Overall additional impact of lower abattoir throughput in Rockhampton City and Biloela,** Sensitivity analysis, Scenario 1



a It is assumed that 30 per cent of non-livestock inputs are sourced locally in calculating the indirect impact of lower inputs

Data source: The CIE estimates

Qualifications and interpretation

- Some qualifications for the analysis should be born in mind.
  - First, the analysis assumes New Zealand adopts a similar carbon pollution reduction scheme (that covers agriculture), but does not assume global participation or, in particular, global agricultural coverage. This may overstate the impact in the later years when a global agreement that results in the coverage of agriculture and processing in major producers may actually be reached.
  - Second, the analysis does not include any technological progress which could reduce the emissions intensity in both farming and processing sectors. In other words, the results presented in this report should be interpreted as the *pressure* for change as consequence of the CPRS, rather than a forecast.
  - Third, the fact that the CPRS involves costs for farming and processing is not itself an argument for or against the inclusion of these activities in the CPRS. It is one piece of information to assist the industry in planning and to assist in making future policy decisions.

1 Introduction

This report

Following the release of the White Paper, *Carbon Pollution Reduction Scheme: Australia's Low Pollution Future*, the Commonwealth Government is introducing a bill to Parliament for the implementation of the Carbon Pollution Reduction Scheme (CPRS).

Meat and Livestock Australia Limited (MLA) is interested in knowing the impact of the proposed CPRS on the Australian red meat processing industry, and commissioned the Centre for International Economics (The CIE) to investigate the economic impacts of such a scheme.

The study has two phases. Phase 1 research aims at providing an estimate of the impact of the CPRS on sectoral production, export, employment and farm gate prices. Phase 2 of the research conducts two case studies – one for Rockhampton, a large regional centre containing one big and one medium export beef abattoirs, and one for Biloela, a regional township containing one medium export beef abattoir.

The purpose of this report is to provide input into understanding about the potential effects of the CPRS on the red meat industry. The report in itself does not constitute an argument for or against including the farm sector or red meat processing in the CPRS. Rather, it sets out through a number of scenarios some of the costs that would be faced when the CPRS comes into force.

The scenarios examined assume Australian and New Zealand action only. That is, they assume that Australian and New Zealand agriculture is covered by emissions trading, but that the agricultural sectors of other countries are not. This is an important assumption and used to illustrate one possible set of outcomes.

The scenarios examined here assume limited adjustment on part of farms. That is, the outcomes presented here assume the main adjustment is through reductions in output in response to the CPRS. This provides an estimate of the adjustment pressures facing both farms and processor. These outcomes are not forecasts, but a measure of the sorts of economic pressure farmers and processors will need to respond to.

Which final version of the CPRS?

During the course of the analysis for this report, the Government announced some significant changes to the timing and implementation of the CPRS[2]. In particular, the start date for the scheme was set back by one year (to 1 July 2011) and a fixed permit price of $10/tonne was set for the 2011-12 year. Full market trading is not set to start until 1 July 2012.

The scenarios and analysis set out below all assume a start date of July 2010 and do not implement a fixed price. However, the permit prices derived from the Oz-Cubed model are in fact consistent with an early fixed price.

As the CPRS progresses through the legislative process, there may be other changes. This means that the results presented here, and in particular the implied timing of outcomes, should be treated as illustrative, rather than as predictions.

Scenarios

This study investigates the impacts of a CPRS on the red meat and livestock industry under three main scenarios (and a variant under scenario 1).

- ***Scenario 1***: Meat processing is separate from agriculture (farming). Processors are included in the CPRS from July 2010 and are not eligible for free permits; agriculture is included in the CPRS in 2015 and is not eligible for free permits.
- ***Scenario 1A***: Meat processing is separate from agriculture. Processors are included in the CPRS from July 2010 and are eligible for free permits equivalent to 90 per cent of the level report in the Green Paper in 2015; agriculture is included in the CPRS in 2015 and is not eligible for free permits.
- ***Scenario 2***: Processors are included in the agriculture industry. Agriculture is covered in the CPRS in 2015 and is eligible for free permits. Free permits equivalent to 90 per cent of the level reported in the Green Paper are provided in 2015 and the level of free permits available to decline by 1.3 per cent each year.
- ***Scenario 3***: Processors are included in the agriculture industry. Agriculture is not covered in the CPRS.

Methodology

We use two modelling approaches, one for each of the two phases. In the first phase, we use the Global Meat Industries (GMI) model[3] to evaluate the impacts of the CPRS on the meat processing sector; and in the second phase, we will use an economywide

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[2] The press release for these changes can be found at http://www.environment.gov.au/minister/wong/2009/mr20090504.html

[3] See appendix B for details.

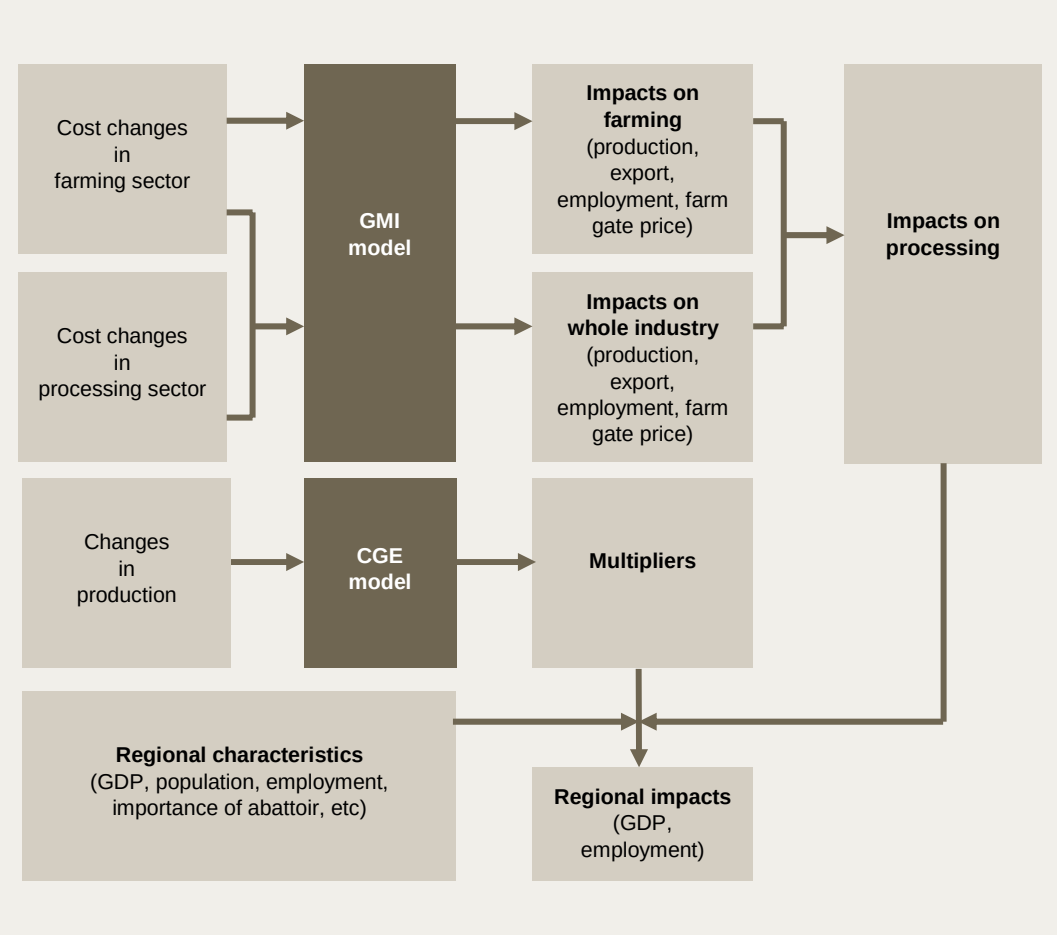
model to assess the impacts on regions containing abattoir. Chart 1.1 illustrates our methodology for the project.

Phase 1 methodology

The GMI model is a multi-country, multi-commodity, Armington style model of the world meat production, consumption and trade. It explains production and consumption of ten commodities including beef and sheepmeat in twenty two regions. It is a suitable model for evaluating the impacts on the meat industry of policy changes, domestically or internationally.

A drawback of the GMI model, however, is that in its standard form it does not distinguish between farming and processing activities. To overcome this problem, we use a general equilibrium model which separates livestock farming and meat processing to work out the ratios of cost incidence on farmers and processors. More details are provided in the following sub-section.

1.1 **Methodology**



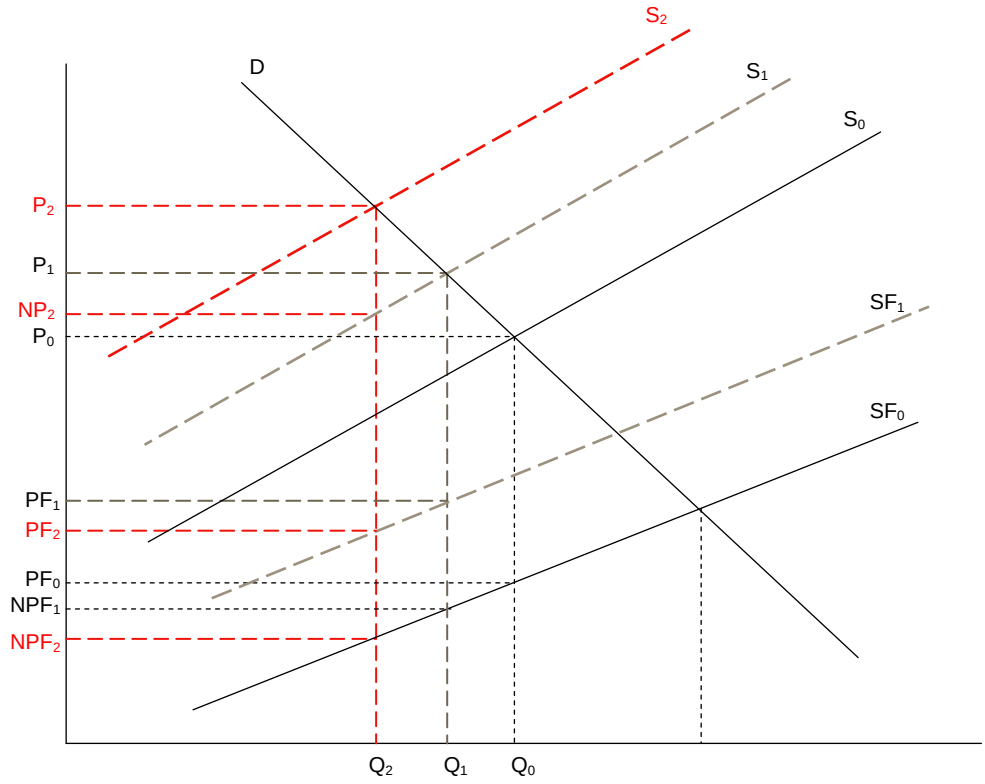
Data source: The CIE

Incidence of emissions costs

Chart 1.2 illustrates the impact of CPRS on the meat demand and supply system. The original equilibrium of the meat market was at the intersection of demand curve (line D) and supply curve (line S_0), with price at P_0 and consumption at Q_0. The meat supply curve is a combination of the livestock supply (line SF_0) and processing. At the original equilibrium, the farm gate price is at PF_0, and the processing margin is the difference between P_0 and PF_0.

Suppose first the farming is subject to CPRS. The livestock supply curve would shift up to SF_1, by the distance of unit emissions cost from farming activities. As a result, the meat supply curve would shift up by the same amount to S_1. Facing the same demand curve, the new market equilibrium would end at price of P_1 and quantity of Q_1.

1.2 **Demand for meat and supply of cattle and meat processing**



Data source: The CIE

Consumers would pay higher prices for meat, implying that they would shoulder $P_1 - P_0$ of the total burden. The farm gate price is now PF_1. However farmers can only receive NPF_1 because they have to pay the emissions costs. Therefore farmers have to absorb $PF_0 - NPF_1$. The new processing margin is now $P_1 - PF_1$, therefore processors'

share of the total burden is the difference between the two processing margins, $(P_0 - PF_0) - (P_1 - PF_1)$.

In sum, moving from the original equilibrium to the equilibrium of farming only shock, the incidence of the farming emissions costs is

- $PF_0 - NPF_1$ on farmers;
- $(P_0 - PF_0) - (P_1 - PF_1)$ on processors; and
- $P_1 - P_0$ on consumers.

Now suppose the processing is also subject to CPRS. The meat supply curve would shift up further to S_2, by the distance of unit cost of emissions from processing. Following the similar logic, we can work out the incidence of the processing emissions costs is

- $NPF_1 - NPF_2$ on farmers;
- $(P_1 - PF_1) - (NP_2 - PF_2)$ on processors; and
- $P_2 - P_1$ on consumers.

Combining the above expressions together gives the incidence of both farming and processing costs:

- $PF_0 - NPF_2$ on farmers;
- $(P_0 - NP_2) + (PF_2 - PF_0)$ on processors; and
- $P_2 - P_0$ on consumers.

We further assume that the processing margin is a fixed proportion (m) of the saleyard price (P), therefore, the farm gate price (PF) is (1-m)P. Furthermore, we have the following identities

$NPF_2 = PF_2 - UECF$ and $NP_2 = P_2 - UECP$,

where $UECF$ and $UECP$ are unit emissions cost from farming and processing, respectively.

Essentially, cost increases are ultimately shared between farmers, processors and wholesale consumers. The distribution of these costs depends on the product. As a detailed model of meat production and consumption, the GMI model can be used to determine the incidence of cost increases on consumers. This turns out to be between 13 and 38 per cent.

While the GMI model can give the changes in wholesale prices of meat products and thus identify the burden on consumers, it cannot by itself determine the distribution of the remaining costs between farmers and processors. In order to calculate this, we use Monash University's TERM model[4].

4 TERM is an economywide model of the Australian economy, similar in part to the MMRF model used by Commonwealth Treasury. Details of the TERM model are available at

TERM model simulations indicate that processors can pass around 80 per cent of the remaining cost increases back to farmers, and that farmers are able to pass around 30 per cent of these remaining costs forward to processors. This amount will clearly vary from region to region and product to product. We use this as a reasonable representation of the incidence of costs along the red meat chain.

Phase 2 methodology

For a region where an abattoir is important, reductions in the processing industry will have a significant impact on the local economy. This has not only direct impacts, but also indirect, flow-on impacts. For example, less turnover of an abattoir means less demand for local business such as suppliers, transport and etc, which in turn means less employment and income. Therefore, it is most appropriate to use an economywide model to analyse the regional impacts.

Unfortunately, there are no existing models with that level of detail. It is beyond this scope of this project to build such a mode. Instead we use a broader region computable general equilibrium model (CGE) to derive the economywide impact multipliers of changes in processing production. We then apply these multipliers to the case study regions to work out regional impacts of the CPRS.

Structure of the report

The following chapter of this report introduces the macroeconomic impacts of the CPRS, chapter 3 gives the detailed results of impacts on the processing sector, and chapter 4 report the results from the two case studies.

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www.monash.edu.au/policy/term.htm. The version of the model we have used is available at www.monash.edu.au/policy/archivep/tpgw0050.zip.

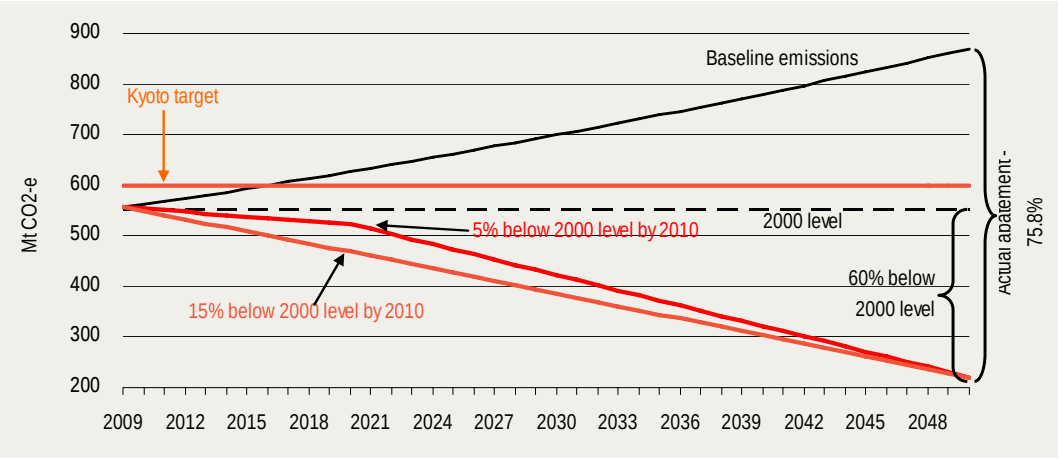
2 *Macroeconomic implications for the red meat industry*

Emissions reduction targets

In the *White Paper*, while maintaining long term target of reducing the greenhouse gas emissions by 60 per cent below the 2000 level by 2050, the Government has softened its position for short- and medium-term targets. Australia will cut emissions by 5 to 15 per cent below the 2000 level, depending on the outcome of international negotiation on climate change policy.

Chart 2.1 illustrates possible greenhouse gas emissions trajectories. The top black line shows the baseline or business-as-usual (BAU) emissions which assumes no policy intervention. The two red lines at the bottom show the possible trajectories to reach the 2050 target. The line with 15 per cent reduction by 2020 seems represent a linear, smooth reduction in emissions over time, while the one with 5 per cent reduction by 2020 allows less reduction in the early years and requires more reduction in later years.

2.1 **Greenhouse gas emissions: baseline, long-term target and possible trajectories**



Data source: CIE estimates

Given the progress in the international policy debate, there is unlikely to be an agreement before 2020 which includes big emitting developing countries like China.

The medium target of 5 per cent reduction below the 2000 level by 2020 is more likely than the 15 per cent reduction target by 2020.

We therefore use the 5 per cent reduction by 2020 trajectory in this analysis. This differs from previous CIE studies (eg CIE 2009) where we assumed a linear progress in reductions to reach the 2050 target because there was then no indication from the Government as per the short- and medium- term targets.

Implications for the red meat processing industry

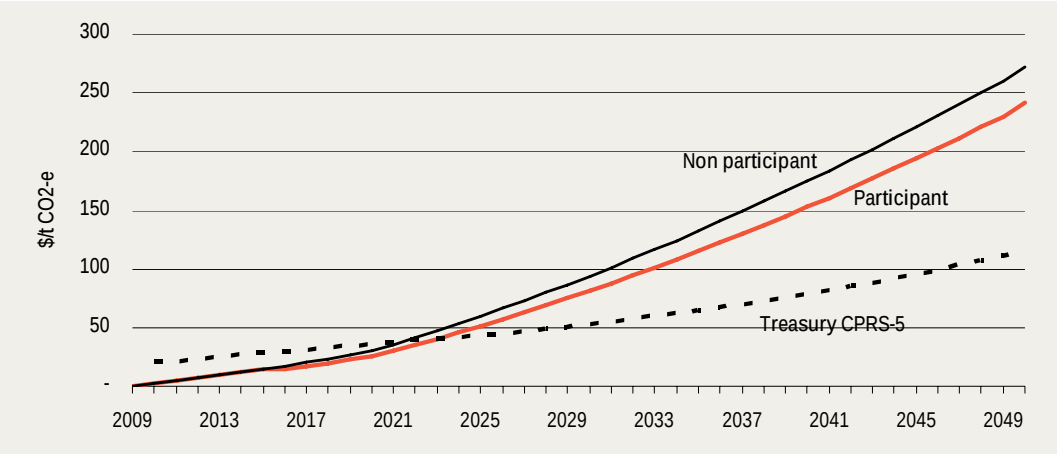
The proposed Carbon Pollution Reduction Scheme has four main impacts on the red meat processing industry.

Requirement to buy permits

First, the red meat processing industry would be subject to an emissions quota. As a recent MLA report (MLA 2009) reveals, emissions from some of the firms in the industry are above the 25 $ktCO_2$-e threshold. Firms will have to abate emissions, or purchase permits from the pollution-permit market to meet their obligations.

According to The CIE Oz-Cubed model[5], permit prices would start from \$2.3/tCO_2-e in 2010, the first year of the CPRS, to \$14.5/tCO_2-e in 2015, to \$26-30/tCO_2-e in 2020 and 81-94/tCO_2-e in 2030 depending on the inclusion or exclusion of agriculture in the scheme (chart 2.2).

2.2 **Emissions permit price**



Data source: The CIE Oz-Cubed simulation, Commonwealth of Australia (2008, Chart 6.3, page 140)

In addition to the Oz-Cubed results of two scenarios (inclusion of agriculture in 2015 – the red line; and exclusion of agriculture – the black line), chart 2.2 also presents the

5 Details of this model are set out in appendix A.

results of CPRS-5 scenario from Commonwealth Treasury modelling. The CPRS-5 scenario has the same medium and long term targets as we assume in this study:

> Australia's long-term emission reduction target in both scenarios is 60 per cent below 2000 levels by 2050. CPRS-5 assumes a slower start to global emission reductions and stabilisation at 550ppm; Australia's medium-term target is 5 per cent below 2000 levels by 2020 (Commonwealth of Australia 2008, page xi).

The Commonwealth Treasury modelling results show higher emissions permit price in the early years and lower price in the latter years than our simulation results. Aside from differences in the underlying model, the higher prices are mainly due to higher baseline emissions in the Treasury modelling, requiring more abatement relative to the 2000 levels, and consequently higher prices. The lower prices are mainly due to the assumption that there is global participation including developing countries by 2025 in the Treasury modelling, while we assume Australian and New Zealand red meat abatement only.[6]

The difference in the emission prices between the Treasury modelling and ours 'highlights the uncertainty around emission prices' as recognised in the Treasury modelling report (Commonwealth of Australia 2008, page 95). To assess the importance of this issue we present sensitivity analysis of emission prices at the end of next chapter.

Increase in input costs

Second, the industry would face higher input prices, which may impose more severe burden on the industry than the direct permit quota and prices do.

The red meat processing is an energy-intensive industry, and energy prices will go up with a CPRS. As shown in charts 2.3 through 2.5, the electricity price is projected to rise by 24-28 per cent by 2030 above the BAU level, petroleum and coal product price by 8-9 per cent, and natural gas price by around 2 per cent.

Electricity has the highest price rise compared to other energy products because the emissions cost of generating electricity has been counted in the price reported here, while for petroleum and coal products and natural gas the price reported here is the market price and does include the permit cost of burning these products.

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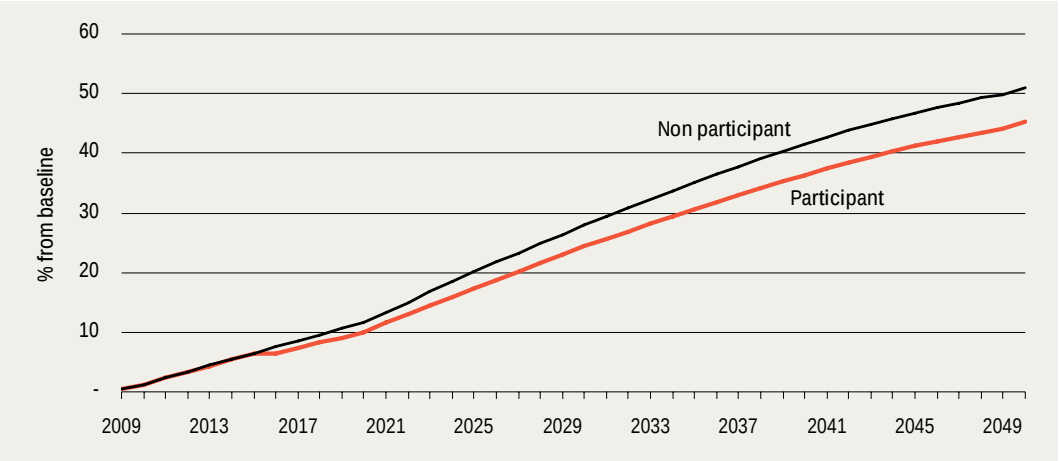
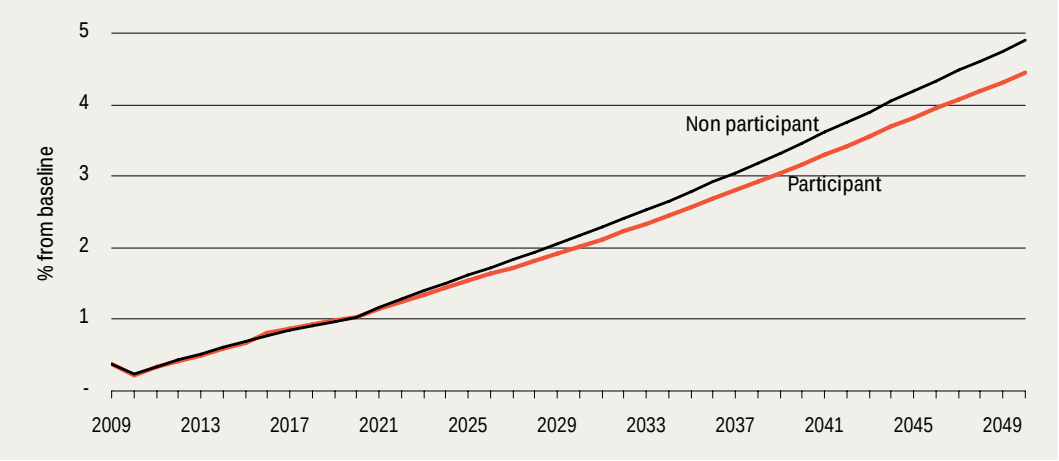
6 As noted further below, our results can be put on roughly the same basis as the Treasury analysis by rescaling the results for the difference in permit prices.

2.3 **Electricity price change** Relative to BAU



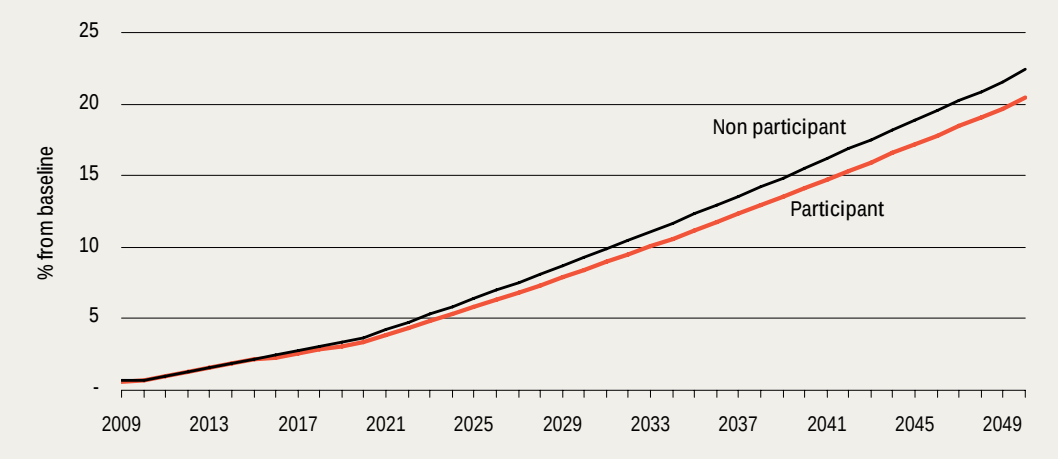
Data source: The CIE Oz-Cubed simulations

2.4 **Gas price change** Relative to BAU



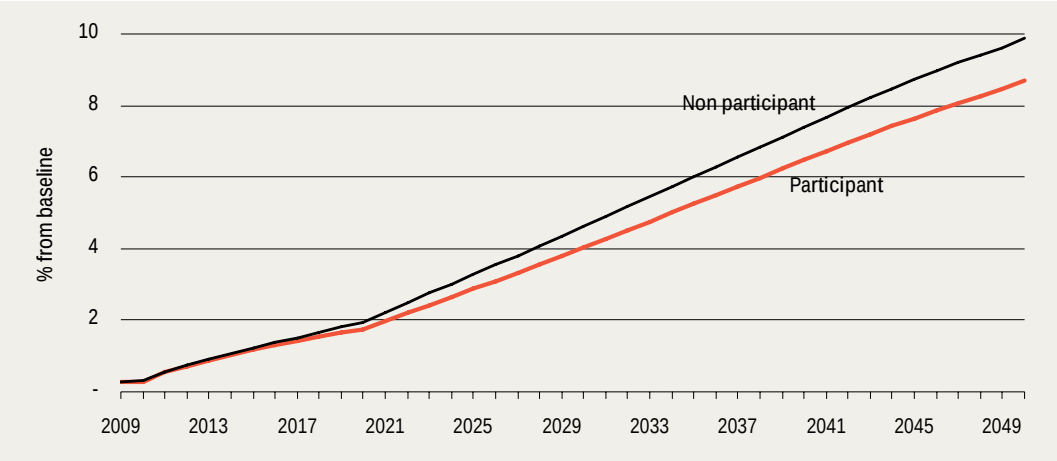
Data source: The CIE Oz-Cubed simulations

2.5 **Petroleum and coal product price change** Relative to BAU



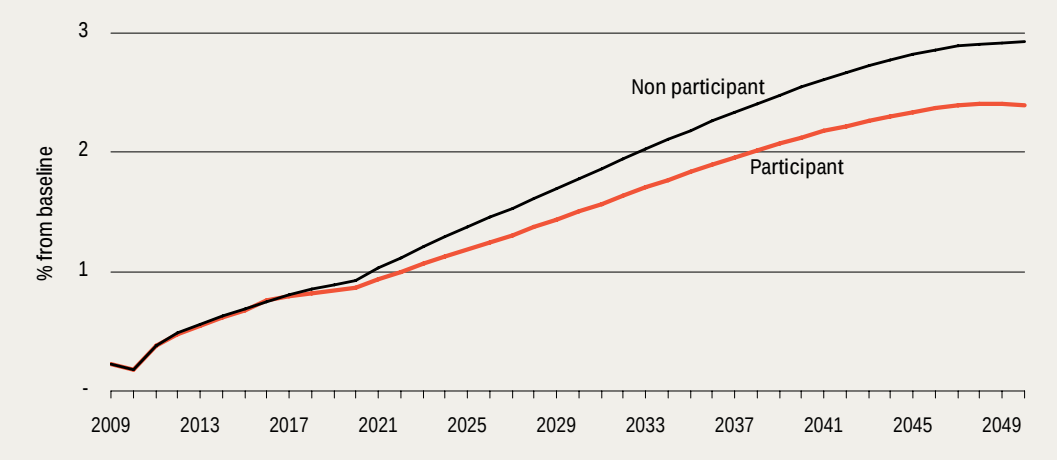
Data source: The CIE Oz-Cubed simulations

2.6 **Transportation price change** Relative to BAU



Data source: The CIE Oz-Cubed simulations

2.7 **Business services price change** Relative to BAU



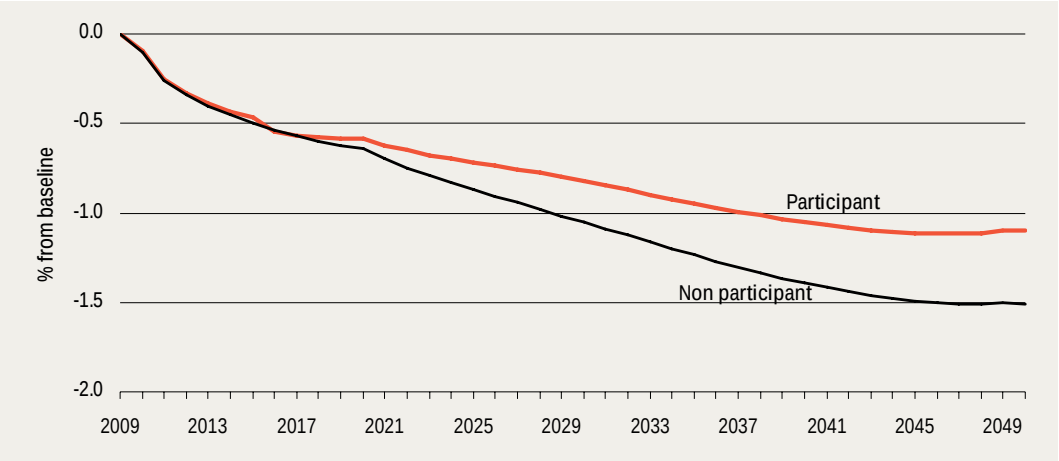
Data source: The CIE Oz-Cubed simulations

Transportation is an important cost component of red meat processing industry, and it is projected the price of transportation will be 4 to 4.6 per cent above the BAU level by 2030 (chart 2.6). Similarly, the price of business cost is projected to be 1.5 to 1.8 per cent above the BAU level by 2030 (chart 2.7).

Lower demand

Third, the industry will have less demand due to lower income after the implementation of a CPRS. It is projected that household disposable income will be 0.8 to 1.1 per cent below the BAU level by 2030 (chart 2.8).

2.8 **Change in household disposable income** Relative to BAU



Data source: The CIE Oz-Cubed simulations

Lower throughput

Finally, not the least, the processing industry will have lower throughput due to less livestock inputs if agriculture is included in the CPRS. This would have far-reaching impact on the industry.

We discuss the detailed impacts of a CPRS on the red meat industry in the following chapter.

3 Detailed impact on red meat industry

Calculating emissions from red meat processing

In order to assess the impact of the CPRS on meat processing, it is necessary to derive emission factors for the sector. Table 3.1 gives some recent emissions estimates derived from three different MLA reports. While these reports do not directly present emissions factors, we derive these from information in the reports as follows.

- First, reported estimates are an average of different plants in the MLA studies. For example, the beef plant Scope 1 emissions of 669.9kgCO_2-e/tHSCW is the average of plants 1 (947kgCO_2-e/tHSCW), 2 (923kgCO_2-e/tHSCW), 3 (454kgCO_2-e/tHSCW) and 4 (356kgCO_2-e/tHSCW).
- Second, individual plant Scope 1 emissions are calculated using information presented in the reports. For example (again from MLA ENV 73), plant 1's total Scope 1 CPRS cost impacts are $1 276 436 (= $964 375 + $312 061) in the base case. With a carbon permit price of $25, the CPRS cost impacts imply the total Scope 1 emissions are 51 057tCO_2-e. For the same plant, the total CPRS cost impacts are $1 585 478, and the total CPRS cost impact per tHSCW is $29.4, implying the throughput is 53 928tHSCW. Dividing the total Scope 1 emissions by the throughput gives the Scope 1 emissions intensity of 946.8kgCO_2-e/tHSCW (= 51 057tCO_2-e /53 928tHSCW).

The MLA ENV 73 estimates (MLA 2009) are the latest and include a broad range of emissions. The Scope 1 emissions include those from wastewater emissions while the previous two reports did not. This is why the emissions in ENV 73 are significantly higher than previous estimates. The MLA ENV 73 derived emissions factors are therefore used in this report.

However, MLA ENV 73 only includes one sheepmeat processing plant, and this is not representative of the sector. To overcome this problem, we use the ratio of scope 1 fuel emissions from sheep and beef processing in the Energy Audit estimates (MLA 2008b, which has more sheepmeat processing plant samples), to work out the total scope 1 emissions and the waste disposal cost for sheepmeat processing, and the ratio of scope 2 (electricity) emissions in the Audit to work out the electricity cost for sheepmeat processing.

The final assumed factors of scope 1 emissions and unit costs for scope 2 and 3 are listed at the bottom of table 3.1.

3.1 Greenhouse gas emissions estimates from red meat processing

	number of plants	*Scope 1 fuel*	*Scope 1 wastewater*	*Scope 2 (electricity)*	*Scope 3*
		Kg CO_2-e/tHSCW [a]			
MLA ENV 63, July 2008					
Beef	1	77.2		201.9	
Sheep	1	135.4		355.3	
Multi species	2	135.7		354.8	
MLA Energy Audit, 2008					
Beef	5	175.0		241.6	
Sheep	4	113.0		299.0	
Multi species	3	125.0		282.0	
MLA ENV 73, February 2009					
Beef	4	669.9		18.6	1.3
Sheep	1	1108.8		34.4	0.0
Multi species	1	158.4		27.2	0.0
Assumption in this study					
Beef		669.9		18.6	1.3
Sheep		432.5		23.0	0.8

[a] HSCW: hot standard carcase weight; numbers of scope 2 and scope 3 in MLA ENV 73 are electricity cost and waste disposal costs respectively (in $/tHSCW).

Source: The CIE calculations based on the reports mentioned in the table.

Other costs of red meat processing

As mentioned in the previous chapter, the CPRS would have significant impact on some of the input costs of red meat processing.

However, without an available benchmark study, we have only been able to estimate some input costs in addition to the electricity and waste disposal costs set out in table 3.1.

Fuel costs

According to the MLA energy audit of 12 plants in 2008 (MLA 2008b), the average fuel consumption index is 2515MJ/tHSCW for beef and 2200MJ/tHSCW for sheepmeat. Assuming the energy cost of $7/GJ as used in MLA 2008b, the fuel cost is $17.6/tHSCW for beef and $15.4/tHSCW for sheepmeat.

Transportation costs

According to the 2004-05 Australian Input-output table (ABS 2008), meat and meat products sector spends about 6.6 cents in transportation for each dollar of production. Applied to wholesale prices, the unit cost of transportation is $368/tHSCW for beef, $53/tHSCW for lamb and $218/tHSCW for mutton.

Services costs

According to the 2004-05 Australian Input-output table (ABS 2008), the meat and meat products sector spends about 4.9 cents in services for each dollar of production. Applying the wholesale prices, the unit cost of transportation is $270/tHSCW for beef, $333/tHSCW for lamb and $161/tHSCW for mutton.

The estimated unit costs are summarised in table 3.2. As seen from the macroeconomic impacts, these costs will be higher under a CPRS.

3.2 **Unit costs of red meat processing, 2007** ($/tHSCW)

	Fuel	*Electricity*	*Waste disposal*	*Transport*	*Services*
Beef	17.61	18.60	1.29	367.56	270.26
Lamb	15.41	23.03	0.83	453.10	333.16
Mutton	15.41	23.03	0.83	218.83	160.91

Source: The CIE estimates

Comparison with livestock farming

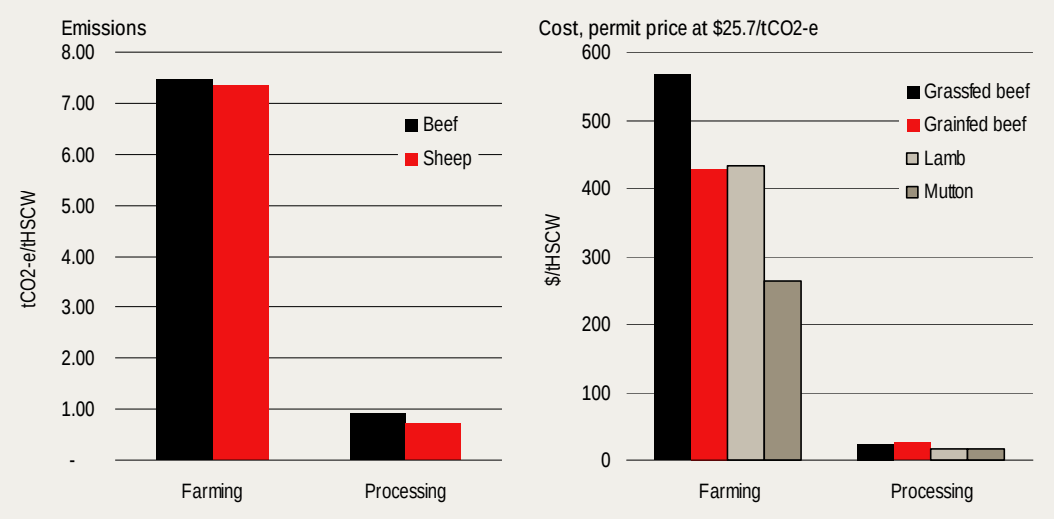
Chart 3.3 compares emissions and CPRS costs (emissions costs and changes in input prices due to the CPRS) of meat processing with those of livestock farming. A striking pattern from the chart is that emissions and CPRS costs of processing sector are significantly less than those of farming sector.

The farm sector generates over 7tCO_2-e per ton of HSCW[7], while processing generates less than 1tCO_2-e. Consequently, farming would face an additional cost of between $260 and $565/tHSCW in 2020 when the permit price is $25.7/t$CO_2$-e (depending on the species), while processing would have additional costs of between $16 and $25/tHSCW.

These simulated additional costs of processing under the CPRS are consistent with the estimates in MLA ENV 73 (MLA 2009). The average total CPRS cost impact of the four beef plants in that report is $20.7/tHSCW when the permit price is assumed to be $25/tCO2-e, which is equivalent to $21.3/tHSCW with a permit price of $25.7/t$CO_2$-e. The simulated cost is $23/tHSCW for grass fed beef and $25/tHSCW for grain fed beef.

[7] According to emissions factors provided by Department of Climate Change, beef cattle and sheep produce greenhouse gas emissions of 2.16tCO_2-e and 0.17tCO_2-e on average, respectively, per animal. Using the conversion ratios of 289.44kgHSCW/animal for beef and of 23.12kgHSCW/animal for sheep, the emissions from farming are 7.48tCO_2-e/tHSCW for beef and 7.34 tCO_2-e/tHSCW for sheep. The conversion ratios are derived from the ENV 73 report ('Total CPRS cost impact per tHSCW' divided by 'Total CPRS cost impact per head').

3.3 Emissions and CPRS costs, Scenario 1



Data source: DCC, MLA and The CIE GMI model simulations

This has important implications for the red meat processing industry. Inclusion of agriculture in the CPRS would have much more severe impact on the processing industry.

- First, farmers will have to reduce livestock production if the agriculture is included in the CPRS. As a result, the throughput of red meat industry would be lower.
- Second, farmers may pass part of the additional costs to processors, squeezing the processing margin.

Impact of the CPRS on production

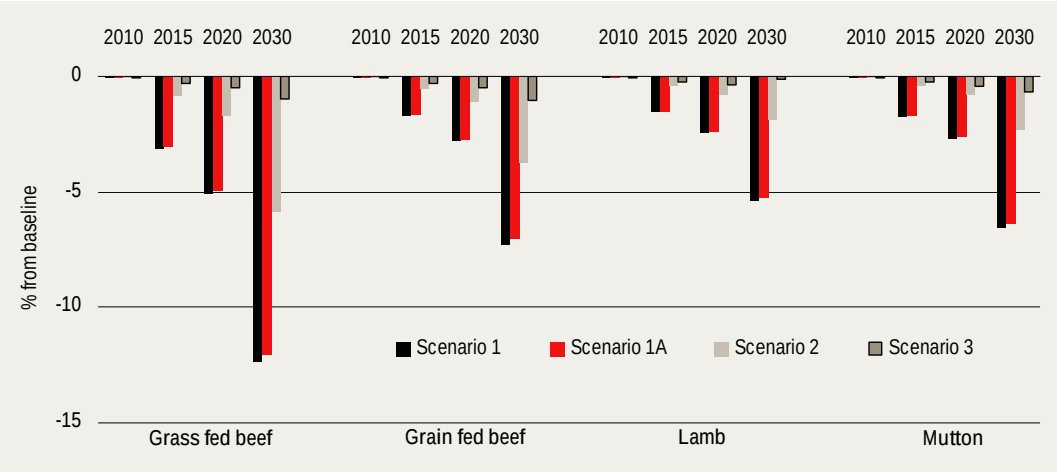
Chart 3.4 summarises impacts on meat production under the four scenarios. It is projected that by 2030 meat production will be 12.4 per cent below the baseline or business as usual (BAU) level for grass fed beef, 7.3 per cent for grain fed beef, 5.4 per cent for lamb and 6.4 per cent for mutton under the ***Scenario 1*** (which assumes inclusion of agriculture in 2015 and red meat processing in 2010 in the CPRS).

The impact on production under the ***Scenario 1A*** is about 97 per cent of the impact under the Scenario 1, despite the fact that processing is allocated 90 per cent free permits under the Scenario 1A.

The impact on production halves under ***Scenario 2***, with production falling by about 2 to 6 per cent from the BAU level by 2030.

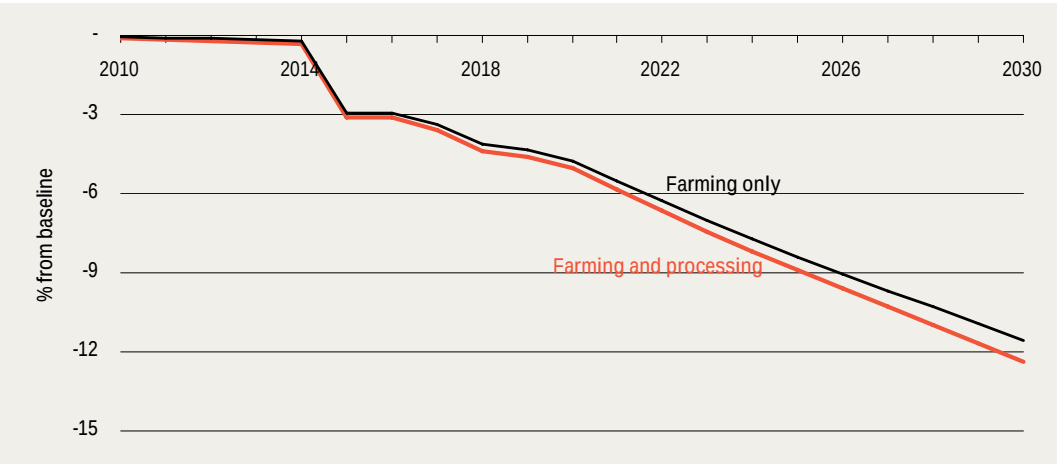
The impact is small, being less than 1 per cent, under **Scenario 3** which assumes exclusion of both agriculture and processing in the CPRS.

3.4 **Changes in meat production** Relative to BAU



Data source: The CIE GMI simulations

3.5 **Changes in grass fed beef production, Scenario 1** Relative to BAU



Data source: The CIE GMI simulations

The simulations reveal that 94 per cent of the impacts are due to inclusion of agriculture in the scheme, which explains the similarity in impacts between the Scenarios 1 and 1A. Chart 3.5 compares the impact on grass beef production of including only farming sector with the impact of including both farming and processing sectors under Scenario 1. It is clear that the reduction in meat production is mainly driven by the inclusion of the farming sector.

Comparison with recent ABARE results

ABARE recently released a report evaluating the impact on Australian agriculture of CPRS (Ford *et al* 2009). According to that report, production of processed meat will fall by 5.8 per cent by 2030 relative to the reference case (Ford *et al* 2009, table 9, page 24). The average fall in beef and sheepmeat production in our analysis is about 10.2 per cent relative BAU levels in 2030. The difference is mainly due to the difference in assumed emissions prices. The permit price in 2030 is assumed to be \$52/tCO_2-e in

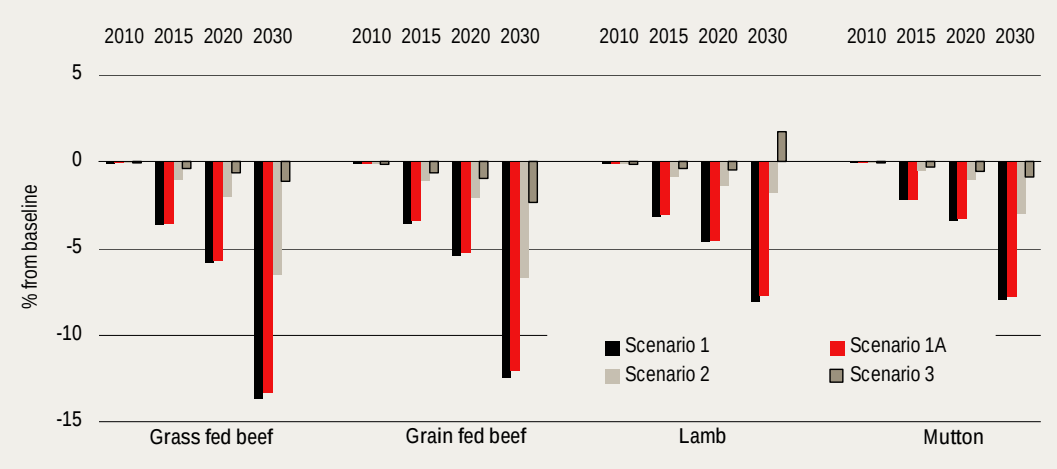
the ABARE report (table 7, page 21) following the price path in the Treasury CPRS-5 scenario, only 64 per cent of our assumed permit price in the same year. If the emissions permit price were scaled down in our study, the simulated reduction in production would be in the similar magnitude to the ABARE result. The assumption of lower price by ABARE is in turn because global participation is assumed and Australian permit price follows the international price.

Lower production may have further impact on the profitability because of downward sloping average cost curve of individual plants due to the existence of fixed costs. We will discuss this impact in more below.

Impact on exports

The impacts on meat exports follow a similar pattern to the impact on production. Under ***Scenario 1***, it is projected that exports will be 13.7 per cent below the baseline (business as usual) level in 2030 for grass fed beef, 12.4 per cent below BAU level for grain fed beef, and about 8 per cent below BAU level for both lamb and mutton. As with the production impacts, ***Scenario 1A*** is very close to ***Scenario 1***.

3.6 **Changes in meat exports** Relative to BAU



Data source: The CIE GMI simulations

Under ***Scenario 3*** (which assumes exclusion of both agriculture and processing in the CPRS), lamb exports are 1.8 per cent higher than the BAU level in 2030. This is mainly due to New Zealand. It is assumed that New Zealand would implement an emissions trading scheme which includes agriculture in 2013. Without including agriculture, Australian lamb becomes relatively more competitive than the New Zealand lamb, leading to higher exports in 2030.

Leakage

It is argued that carbon leakage would occur if Australia acts solely or only few countries act, because other countries would produce and export more to offset the reduction in Australia. The simulation results support this argument. As shown in table 3.7, exports from Australia and New Zealand falls relative to the business as usual levels, while exports from other countries increase. It should also be noted that the fall in Australian and New Zealand exports is not fully offset by the rise in other countries. The leakage ratio (rise in rest of the world relative to the fall in Australia and New Zealand) is about 20 per cent for beef and 30 per cent for sheepmeat.

3.7 **Exports change, kt, Scenario 1** Relative to BAU

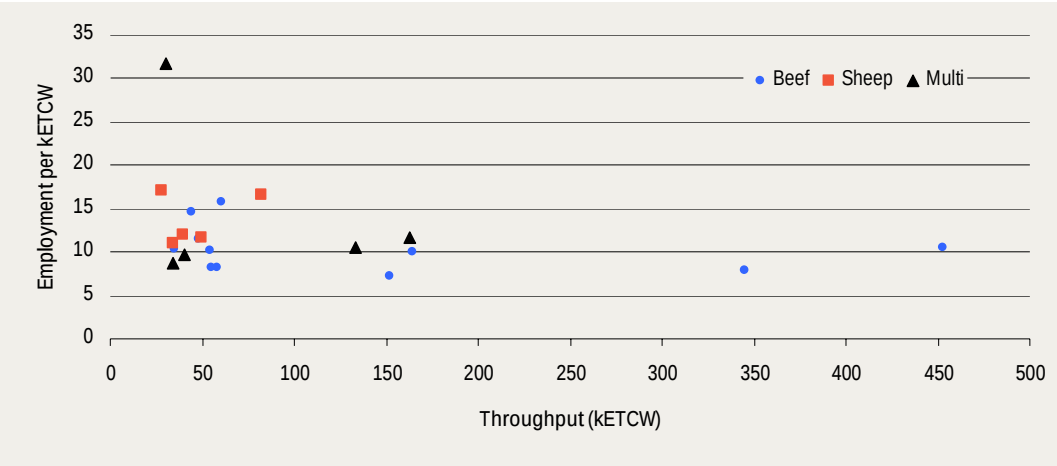
		Australia	*New Zealand*	*Rest of world*
Beef	2010	-2	0	0
	2015	-67	-3	14
	2020	-121	-14	27
	2030	-384	-170	114
Sheepmeat	2010	0	0	0
	2015	-10	1	3
	2020	-16	-2	6
	2030	-38	-58	32

Source: The CIE GMI simulations

Impact on employment

According to MLA's top 25 red meat processors publication (MAL 2008c), the average employment in 2007 was 9.7 persons/ktHSCW for a beef abattoir and 14 persons/ktHSCW for a sheep abattoir (chart 3.8).

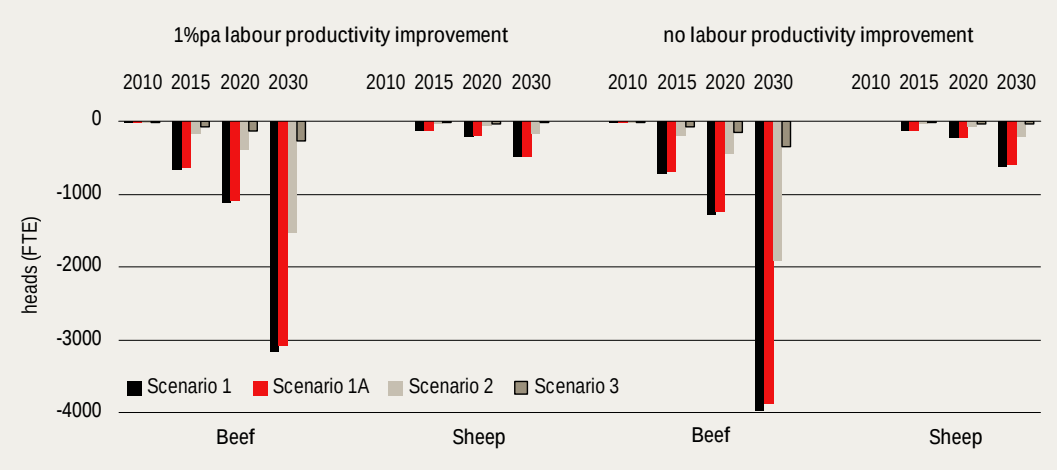
3.8 **Employment in abattoirs**



Data source: MLA (2008c), Figure 1

Using this employment ratio and assuming 1 per cent per annum labour productivity improvement, there would be about 3170 job losses by 2030 compared to the employment level that would have otherwise been for beef processing, and about 493 job losses for sheepmeat processing, under the Scenario 1. If assuming no labour productivity improvement, the job loss in 2030 would be 3985 for beef and 620 for sheepmeat (chart 3.9).

3.9 **Impact on employment; change from business as usual level**

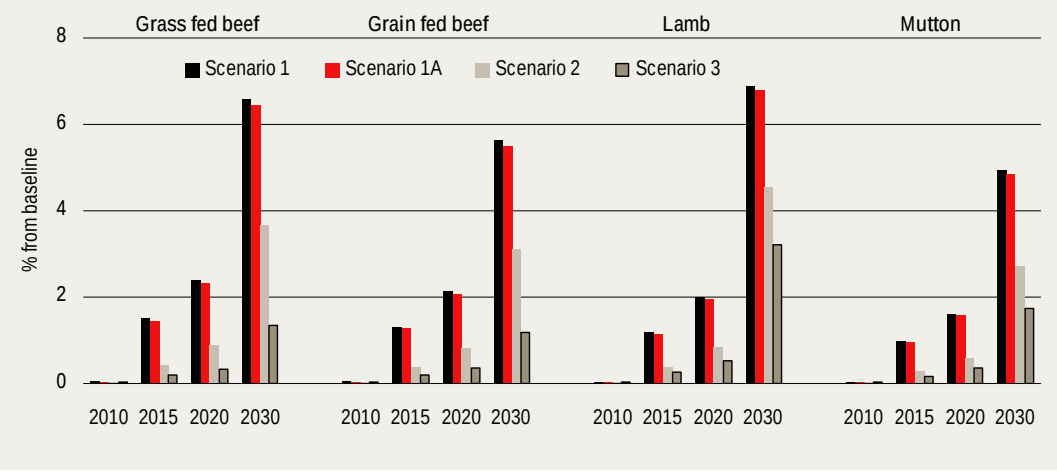


Data source: The CIE estimates

Impact on prices and profit

Wholesale prices will increase modestly under the CPRS. As shown in chart 3.10, under ***Scenario 1*** they will be 6.6 per cent higher than the BAU level in 2030 for grass fed beef, 5.6 per cent higher for grain fed beef, 6.9 per cent higher for lamb and 4.9 per cent higher for mutton.

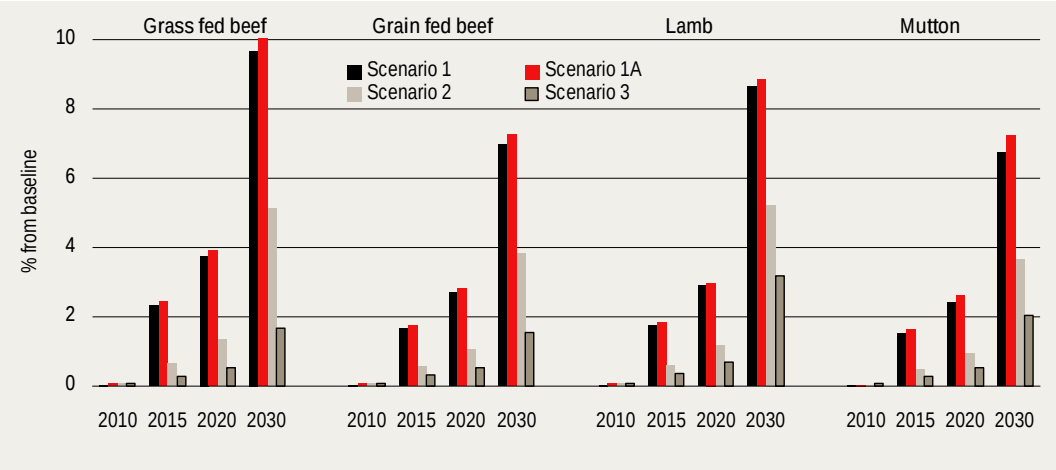
3.10 **Changes in wholesale price** Relative to BAU



Data source: The CIE GMI simulations

The farm gate price will be about 10 per cent higher than the BAU level in 2030 for grass fed beef, 7 per cent for grain fed beef, about 9 per cent for lamb and about 7 per cent for mutton under the Scenarios 1 and 1A (chart 3.11).

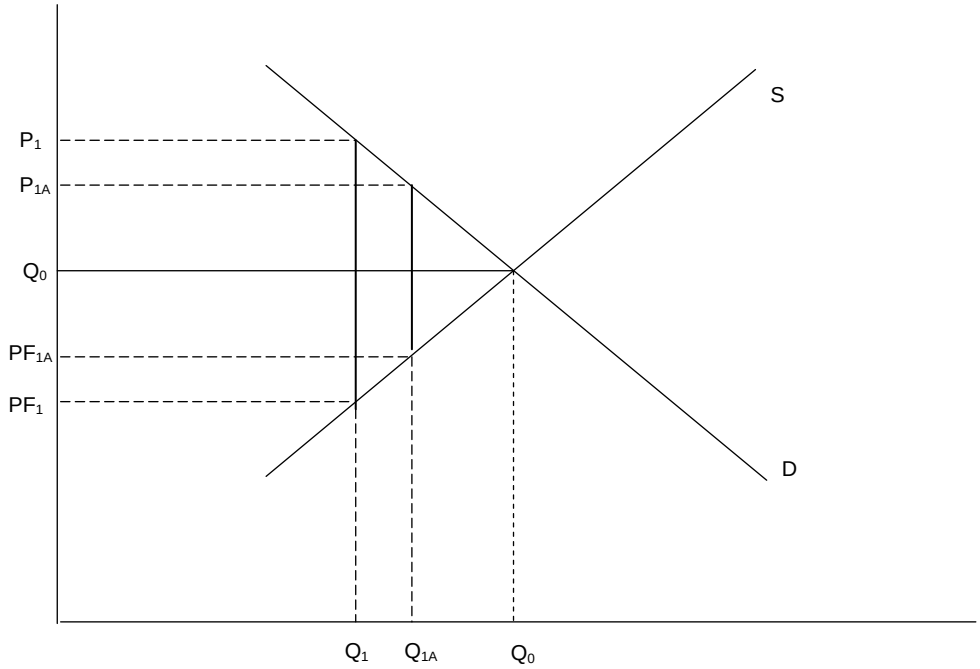
3.11 **Changes in farm gate price** Relative to BAU



Data source: The CIE GMI simulations

The farm gate price under the Scenario 1A is slightly higher than under the Scenario 1. This is because there is less cost incidence passed back to farmers under Scenario 1A. This can be better explained using a diagram like chart 3.12.

3.12 **Higher farm gate price under Scenario 1A than Scenario 1**



Data source: The CIE illustration

The S-curve in the chart is the supply curve of the farming sector and the D-curve is the demand curve for livestock by the processing sector. The farming sector is included in the CPRS and has the same treatment under both Scenarios 1 and 1A, therefore there is no change to the supply curve between the two Scenarios. The only difference between the two scenarios is that processors receive 90 per cent free permits under the Scenario 1A while do not under the Scenario 1. This is equivalent to a lower cost incidence (P_1-PF_1) on processor under Scenario 1A than that (P_{1A}-PF_{1A}) under Scenario 1. The results are higher production (or less reduction), lower wholesale price and higher farm gate price under the Scenario 1A than under the Scenario 1.

Incidence of costs

Table 3.12 shows the incidence of CPRS costs on consumer, processors and farmers under **Scenario 1**.

3.13 **Incidence of costs, Scenario 1, A$/tHSCW**

	Consumer	*Processor*	*Farmer*
Grass fed beef			
2010	2.18	1.27	5.09
2015	69.44	48.98	195.92
2020	116.30	82.30	329.21
2030	375.14	228.34	913.37
Grain fed beef			
2010	3.11	1.57	6.27
2015	80.61	30.63	122.50
2020	131.76	51.56	206.25
2030	386.28	145.18	580.73
Lamb			
2010	2.01	1.35	5.40
2015	59.13	34.32	137.27
2020	104.09	56.67	226.66
2030	421.20	139.98	559.90
Mutton			
2010	0.64	0.88	3.51
2015	25.19	18.67	74.68
2020	43.78	32.09	128.36
2030	165.44	91.25	365.02

Source: The CIE estimates based on GMI simulations

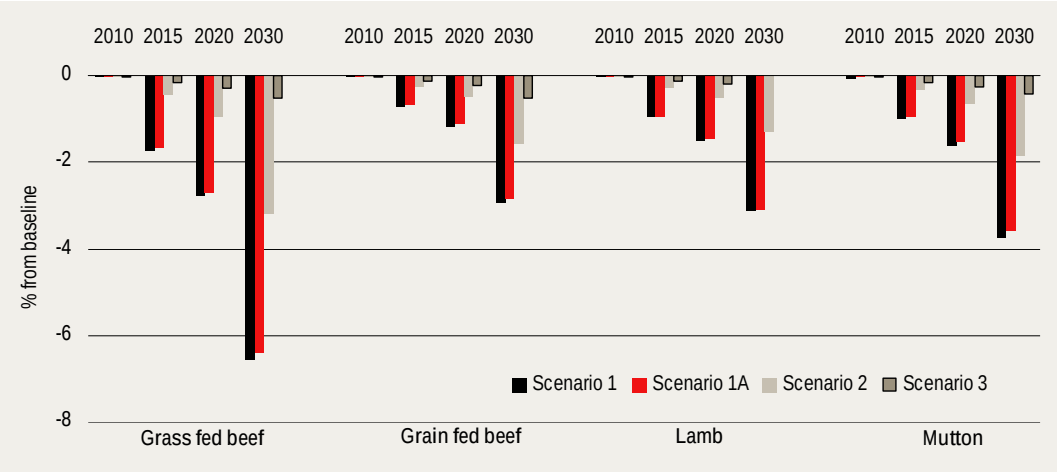
By 2020 when the emissions price is \$25.7/tCO_2-e, processors will have to absorb \$82/tHSCW for grass fed beef, \$52/tHSCW for grain fed beef, \$57/tHSCW for lamb and \$32/tHSCW for mutton. By 2030 processors would have to absorb \$228/tHSCW for grass fed beef, \$145/tHSCW for grain fed beef, \$140/tHSCW for lamb and \$91/tHSCW for mutton.

Comparing to the costs shown in chart 3.3, the actual cost burden on processors is much higher than the additional costs of emissions from the processing sector. This is because processors will face higher livestock prices as farmers are able to pass some of their costs through.

Impact on processing margin

According to the latest input-output table (ABS 2008), livestock inputs account for about 54 per cent of total value of meat products, implying the processing margin is about 46 per cent. Assuming this processing margin holds over the simulation period in the baseline, and using the information on cost burdens derived above, we estimate the change in processing margin under the four scenarios. The results are summarised in chart 3.14.

3.14 **Impact on processing margins** Relative to BAU



Data source: The CIE estimates based on the GMI simulations.

It is estimated that the processing margin would be 6.6 per cent below the business as usual (BAU) level by 2030 for grass fed beef, 3 per cent for grain fed beef, 3.2 per cent for lamb, and 3.8 per cent for mutton under the Scenario 1. Under the Scenario 2, the impact on the processing margin would be between 1 and 3 per cent by 2030, and under the Scenario 3, the impact would be around 0.5 per cent and less by 2030.

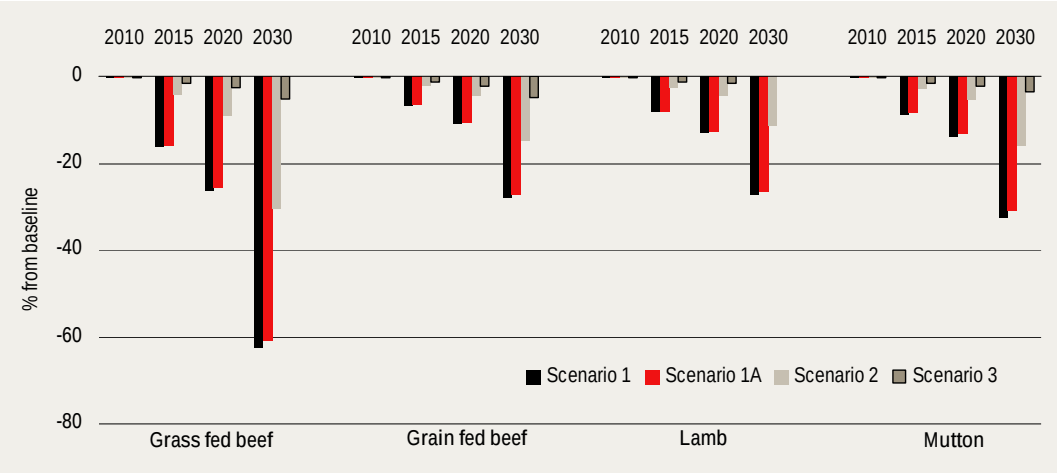
Impact on gross operating surplus

According to the latest input-output table (ABS 2008), gross operating surplus (GOS)[8] is about 5 per cent of total value of meat products. The thin margin implies that the CPRS would have significant impacts on profitability as shown in chart 3.15.

[8] Gross operating surplus measures the surplus accruing from processes of production before deducting any explicit or implicit interest charges, land rent or other property incomes payable on the financial assets, land or other tangible non-produced assets required to

It is estimated that GOS would be 62 per cent below the BAU level by 2030 for grass fed beef, 28 per cent for grain fed beef, 27 per cent for lamb and 32 per cent for mutton under the Scenario 1.

3.15 **Impact on gross operating surplus of processing**



Data source: The CIE estimates based on GMI simulations.

Impact on profits

According to industry estimates, the profit margin of red meat processing is between 1 and 3 per cent. For plants with 1 per cent profit margin, a current profit would turn into loss (profit falls by more than 100 per cent) by 2030 under the Scenario 1. Grass fed beef plants would be the hardest hit. Under Scenario 1 their profits would fall by 300 per cent and 150 per cent in 2030, respectively, if their profit margin is 1 per cent and 2 per cent. They would become just break-even in 2030 if their profit margin is 3 per cent (table 3.16).

Accounting for economies to scale

The above assessment of profitability impacts is based on the assumption that plants have constant average cost, that is, their average cost does not change along with the throughput. However, average cost in general falls along with the throughput because of fixed costs. Chart 3.17 illustrates the impact of throughput on processing profit. For a given processing margin (the flat line), the more throughput, the less average unit cost (the red line), and the higher profitability (distance between the two lines).

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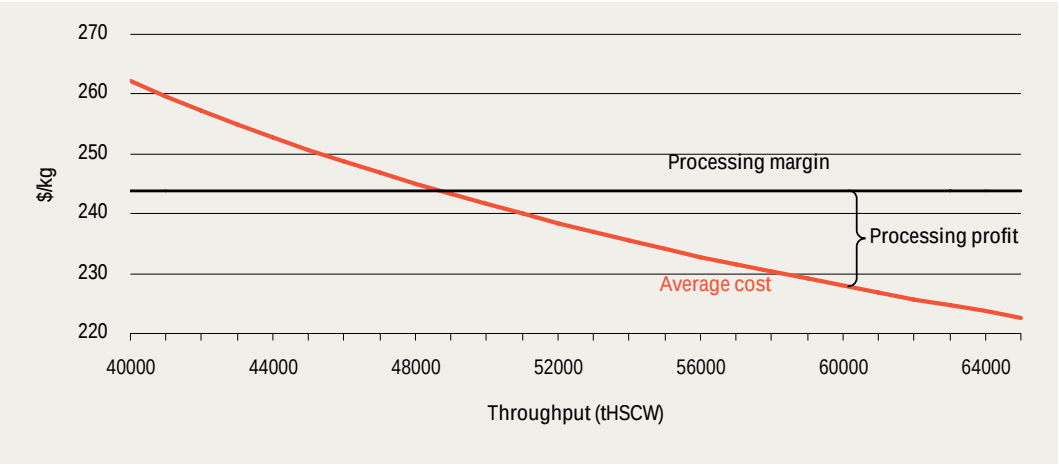
carry on the production. GOS is defined as gross value added minus compensation of employees, minus taxes on production and imports payable plus subsidies receivable.

3.16 **Impact on profit of processing assuming constant average cost**, percentage change from BAU level

	Profit margin @ 1%				*Profit margin @ 2%*				*Profit margin @ 3%*			
	S1	***S1A***	***S2***	***S3***	***S1***	***S1A***	***S2***	***S3***	***S1***	***S1A***	***S2***	***S3***
Grass fed beef												
2010	-2.2	-1.8	-1.8	-1.8	-1.1	-0.9	-0.9	-0.9	-0.7	-0.6	-0.6	-0.6
2015	-79.4	-77.4	-21.2	-8.0	-39.7	-38.7	-10.6	-4.0	-26.5	-25.8	-7.1	-2.7
2020	-128.0	-124.8	-44.1	-13.2	-64.0	-62.4	-22.0	-6.6	-42.7	-41.6	-14.7	-4.4
2030	-302.5	-295.1	-148.0	-24.6	-151.3	-147.6	-74.0	-12.3	-100.8	-98.4	-49.3	-8.2
Grain fed beef												
2010	-2.7	-2.4	-2.4	-2.4	-1.4	-1.2	-1.2	-1.2	-0.9	-0.8	-0.8	-0.8
2015	-49.6	-47.9	-17.6	-10.2	-24.8	-23.9	-8.8	-5.1	-16.5	-16.0	-5.9	-3.4
2020	-80.2	-77.3	-32.7	-16.5	-40.1	-38.7	-16.4	-8.2	-26.7	-25.8	-10.9	-5.5
2030	-192.3	-185.7	-101.3	-33.1	-96.2	-92.9	-50.6	-16.5	-64.1	-61.9	-33.8	-11.0
Lamb												
2010	-2.3	-2.2	-2.1	-2.1	-1.2	-1.1	-1.1	-1.0	-0.8	-0.7	-0.7	-0.7
2015	-55.6	-54.6	-17.3	-8.1	-27.8	-27.3	-8.6	-4.1	-18.5	-18.2	-5.8	-2.7
2020	-88.1	-86.5	-31.4	-11.7	-44.0	-43.2	-15.7	-5.8	-29.4	-28.8	-10.5	-3.9
2030	-185.4	-181.7	-76.6	1.8	-92.7	-90.9	-38.3	0.9	-61.8	-60.6	-25.5	0.6
Mutton												
2010	-1.5	-1.3	-1.2	-1.2	-0.8	-0.6	-0.6	-0.6	-0.5	-0.4	-0.4	-0.4
2015	-30.3	-28.9	-10.1	-5.1	-15.1	-14.5	-5.1	-2.6	-10.1	-9.6	-3.4	-1.7
2020	-49.9	-47.7	-19.6	-8.3	-24.9	-23.9	-9.8	-4.1	-16.6	-15.9	-6.5	-2.8
2030	-120.9	-115.6	-59.7	-13.7	-60.4	-57.8	-29.8	-6.8	-40.3	-38.5	-19.9	-4.6

Source: The CIE estimates based on GMI simulations

3.17 **Processing profit increases along with throughput**



Data source: The CIE estimates

The profit impact is determined by the original processing margin, profit margin, share of fixed costs, and the magnitude of change in throughput. More specifically, the impact on profit is equal to:

$$-S_{fc}\left(\frac{m}{\pi}-1\right)\frac{d}{1-d},$$

where S_{fc} is the share of fixed cost in total non-livestock costs, m is the processing margin expressed as the ratio to the wholesale price, π is the profit margin expressed as the ratio to the wholesale price, and d is the rate of change in throughput.

One of the key parameters is the share of fixed cost. However, we do not have a good, up to date estimate of the share. What we can infer from available information, (Trewin, McLeish and Coleman 1987 and AACM International 1986), is that fixed costs may account for 20 to 40 per cent of non-livestock costs of an abattoir. Table 3.17 lists some estimates of the profit impact of throughput reduction under different assumptions of profit margin and fixed cost share.

3.18 **Profit impact of reduction in throughput, percentage change**

Reduction in throughput	***Profit margin***		
	1%	***2%***	***3%***
Fixed cost rate: 20% of non-livestock cost			
1%	-9.1	-4.5	-2.9
2%	-18.4	-9.0	-5.9
5%	-47.5	-23.2	-15.1
10%	-100.3	-49.0	-32.0
Fixed cost rate: 30% of non-livestock cost			
1%	-13.7	-6.7	-4.4
2%	-27.6	-13.5	-8.8
5%	-71.3	-34.8	-22.7
10%	-150.5	-73.6	-47.9
Fixed cost rate: 40% of non-livestock cost			
1%	-18.2	-8.9	-5.8
2%	-36.9	-18.0	-11.7
5%	-95.0	-46.5	-30.3
10%	-200.6	-98.1	-63.9

Source: The CIE estimates

The profit impact is very sensitive to the assumptions about key parameters. For example, for a 1 per cent reduction in throughput, the fall in profit varies from 2.9 per cent (with profit margin at 3 per cent and fixed cost rate at 20 per cent) to 18.2 per cent (with profit margin at 1 per cent and fixed cost rate at 40 per cent).

The total impact on profit would be the sum of those presented in table 3.16 which assumes constant average cost, and the impact of falling throughput presented in table 3.17.

Sensitivity around permit prices

As discussed in the previous chapter, there is uncertainty about the future path of emission permit prices. Specifically the prices in our modelling results are lower in the early sate and higher in the later stage than those of the Commonwealth

Treasury. To show how sensitively the result is affected by assumed prices, we conducted sensitivity analysis using the emission prices from the Treasury's CPRS-5 scenario. Because the Treasury did not publish the full set of results, in particular the input price changes, we first find the base year when our prices and the Treasury's are the same and then adjust shocks in other years using the growth rate of the Treasury's permit prices.

Impact on production

Chart 3.19 reports the sensitivity analysis of production impact for all four scenarios. The result of using Treasury's emission price (red column) is put alongside our original result (black column).

In general the new impact is higher in the early years and lower in the later years than the original results, mainly due to the fact that Treasury's permit prices are higher in the early years and lower in the later years than the prices estimated by the Oz-Cubed model. For example, grass fed beef production will be 0.5 per cent, 5.9 per cent and 6.9 per cent lower than the business as usual level in 2010, 2015 and 2020, respectively, if using Treasury prices, about 5.6 times, two times and 36 per cent higher than the result using Oz-Cubed estimated prices, respectively. By contrast, the production reduction will be only 7.7 per cent in 2030 if using the Treasury price, about 40 per cent lower than our estimated impact.

The ratios of the two sets of results are similar across meat products and CPRS scenarios and are roughly the ratio of the two permit price series.

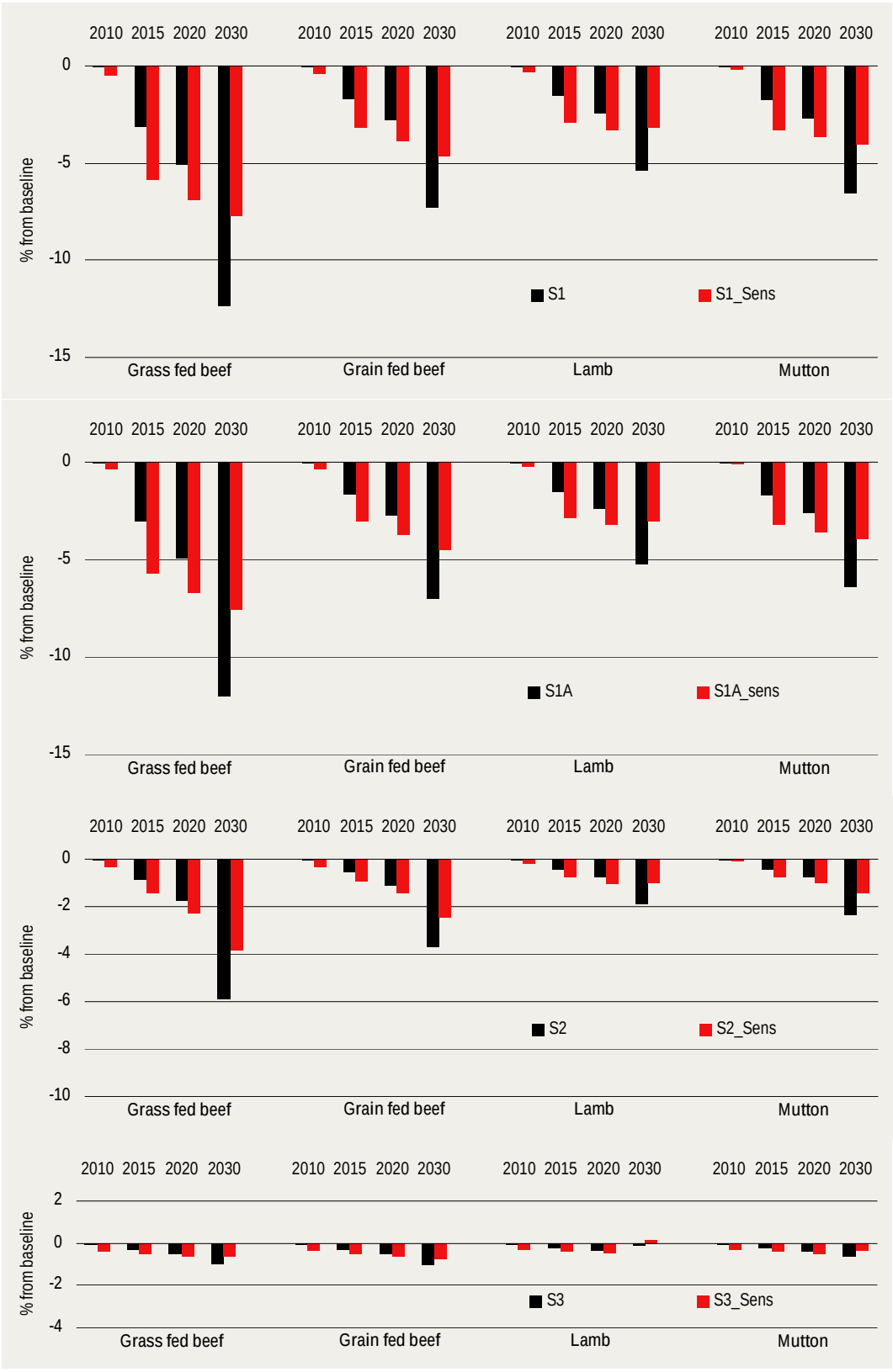
Because Scenario 1 has the most significant impacts among the four scenarios we examined, more detailed sensitivity results for this scenario are presented. The difference in CPRS impact between using the two permit price series is the most significant under the Scenario 1 among the four scenarios.

Impact on exports

Chart 3.20 reports the impacts on export from using the two permit price series under the Scenario 1. Grass fed beef export are projected to fall by 0.6 per cent, 6.9 per cent, 8 per cent and 8.5 per cent from the business as usual level in 2010, 2015, 2020 and 2030, respectively, if using the Treasury price series (the red columns), compared to the fall of 0.1 per cent, 3.7 per cent, 5.9 per cent and 13.7 per cent in relevant years in our previous presented results (the black columns).

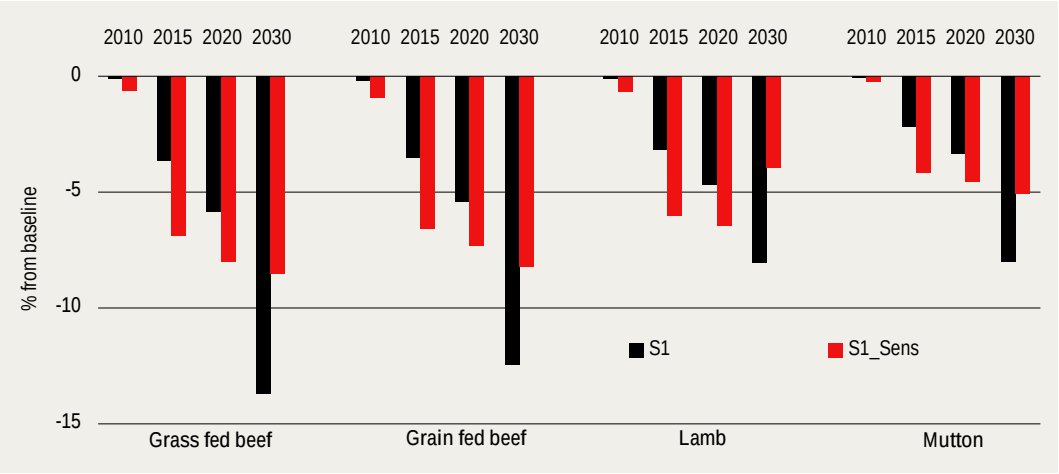
It is projected that grain fed beef exports will fall by 0.9 per cent in 2010, 6.6 per cent in 2015, 7.3 per cent in 2020 and 8.2 per cent in 2030 from the business as usual level, if using the Treasury price series.

3.19 **Changes in meat production** Relative to BAU, sensitivity analysis



Data source: The CIE GMI simulations

3.20 **Changes in meat exports** Relative to BAU, sensitivity analysis, Scenario 1



Data source: The CIE GMI simulations

Using the Treasury price series, it is projected that lamb export will fall by 0.7 per cent in 2010, 6 per cent in 2015, 6.5 per cent in 2020 and 4 per cent in 2030 from the business as usual level.

The fall in 2030 is lower than the fall in 2030 because of the New Zealand factor. By 2030 agriculture is assumed to be fully covered by the emissions trading scheme in New Zealand, and with a relatively lower permit price in Australia, Australian lamb becomes relatively competitive and the exports suffer from less reduction.

Using the Treasury prices, it is projected that mutton export will fall by 0.3 per cent in 2010, 4.2 per cent in 2015, 4.6 per cent in 2020 and 5 per cent in 2020, from the business as usual level.

Impact on employment

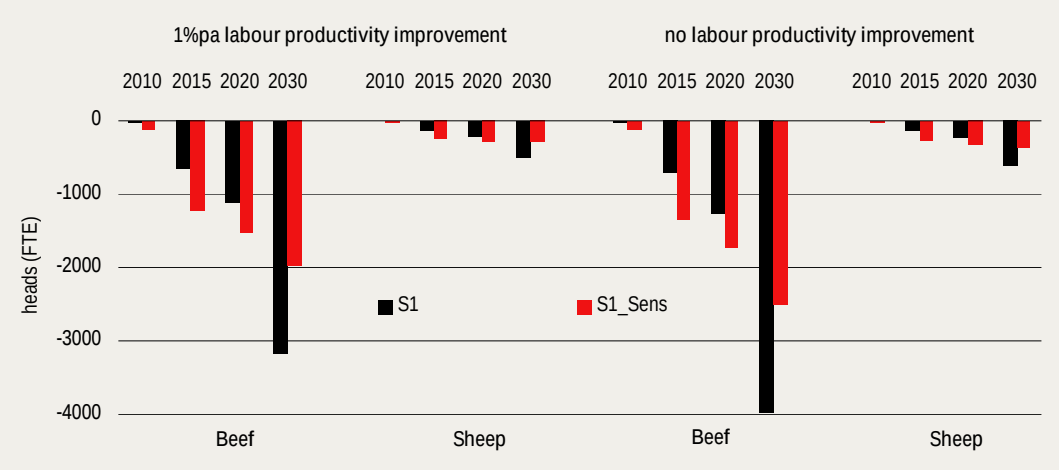
Chart 3.21 reports the sensitivity analysis results of employment impact for Scenario 1.

Using the Treasury prices it is projected that job losses in beef abattoirs will be 107 in 2010, 1235 in 2015, 1526 in 2020 and 1989 in 2030 if the labour productivity growth is 1 per cent per annum, compared to the previous estimates of 19, 656, 1122 and 3170 job losses in relevant years using the Oz-Cubed estimated prices.

Job losses in sheep abattoirs will be 18 in 2010, 247 in 2015, 282 in 2020 and 297 in 2030 if assuming the Treasury prices and 1 per cent annual productivity growth, compared to the previous estimates of 4, 131, 207 and 493 in relevant years.

If assuming no labour productivity, the fall in employment will be bigger and thus the difference between results using the Treasury prices and the Oz-Cubed prices are bigger.

3.21 **Changes in employment** Relative to BAU, sensitivity analysis, Scenario 1

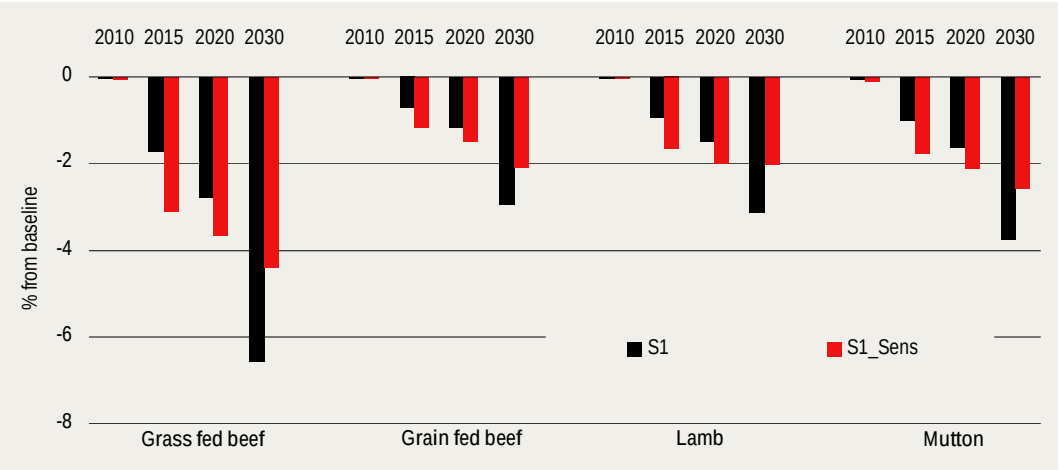


Data source: The CIE estimates based on GMI simulations

Impact on processing margin

Chart 3.22 reports the sensitivity analysis of impacts on processing margin under the Scenario 1. With the same assumption of processing margin ratios as presented on page 36, using the Treasury price will see the processing margin fall by 1.2 to 3.1 per cent in 2015, 1.5 to 3.7 per cent in 2020 and 2 to 4.4 per cent in 2030 from the business as usual level, compared with the previous estimates of 0.7 to 1.7 per cent in 2015, 1.2 to 2.8 per cent in 2020 and 3 to 6.6 per cent in 2030. The impact in 2010 is trivial and so is the difference between the two estimate series.

3.22 **Impact on processing margins** Relative to BAU, sensitivity analysis, Scenario 1



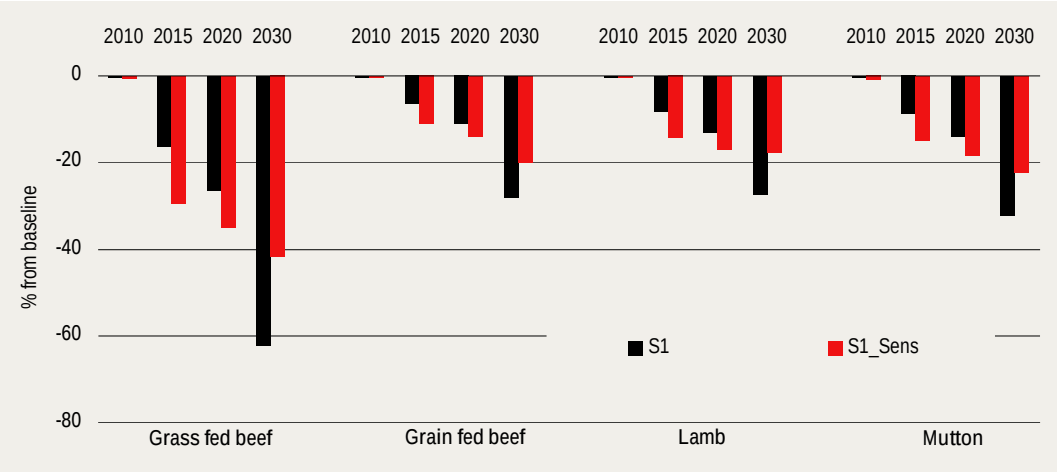
Data source: The CIE estimates based on the GMI simulations.

Impact on gross operating surplus

Chart 3.23 reports the result of sensitivity analysis of impact on gross operating surplus (GOS) under the Scenario 1. Using the Treasury permit prices, it is estimated

that GOS will fall from the business as usual level by 0.3 to 1 per cent in 2010, 11.2 to 29.5 per cent in 2015, 14.2 to 34.9 per cent in 2020 and 17.7 to 41.8 per cent in 2030, compared to the previous estimates of 0.3 to 0.5 per cent in 2010, 6.7 to 16.4 per cent in 2015, 11.1 to 26.4 per cent in 2020 and 27.3 to 62.4 per cent in 2030.

3.23 **Impact on gross operating surplus of processing** Relative to BAU, sensitivity analysis, Scenario 1

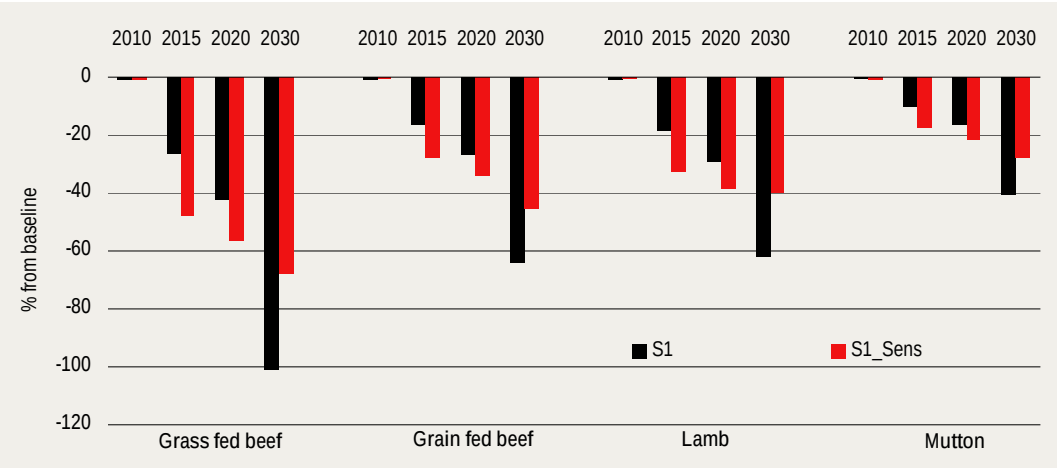


Data source: The CIE estimates based on the GMI simulations.

Impact on processing profit

As noted before, the impact on profitability depends on assumptions about profit margins throughput. We present one set of the sensitivity analysis of impact on profitability of red meat processing in chart 3.24 which assumes 3 per cent of profit margin and constant average cost.

3.24 **Impact on profit of processing** Relative to BAU, sensitivity analysis, Scenario 1



[a] Assuming constant average cost, profit margin is 3 per cent.

Data source: The CIE estimates based on the GMI simulations.

Using the Treasury permit price series, it is estimated that processing profit will fall from the business as usual level by 0.6 to 1.1 per cent in 2010, 17.5 to 47.6 per cent in 2015, 21.6 to 56.4 per cent in 2020 and 27.7 to 67.6 per cent in 2030, compared to the previous estimates of 0.5 to 0.9 per cent in 2010, 10.1 to 26.5 per cent in 2015, 16.6 to 42.7 per cent in 2020 and 40.3 to 100.8 per cent in 2030.

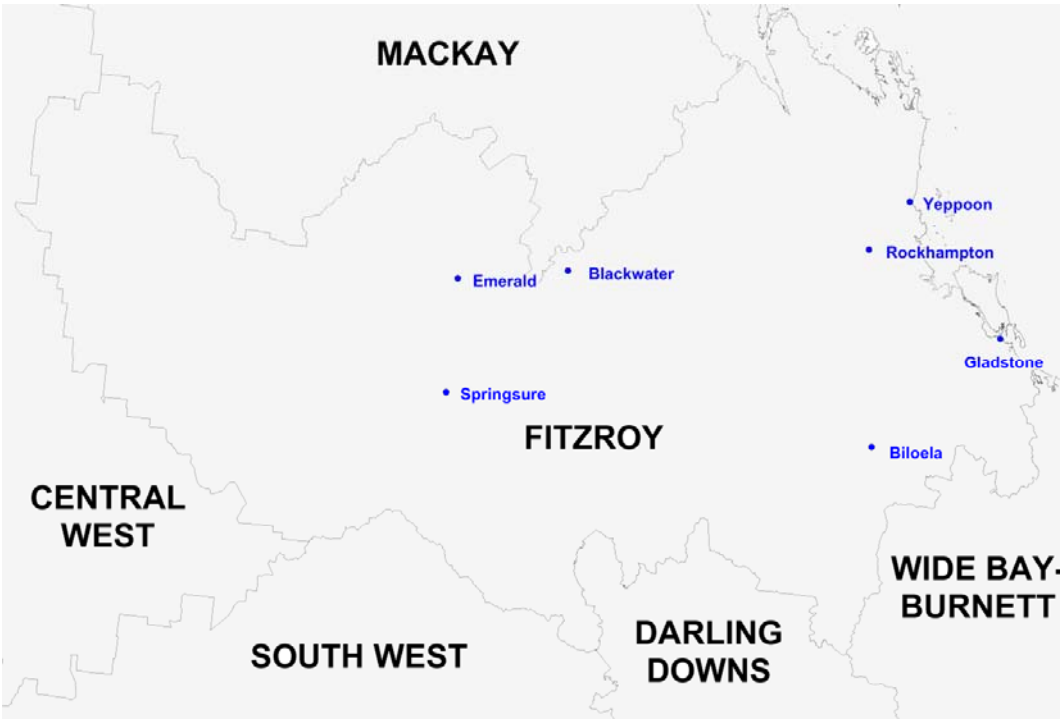
4 Case studies

This chapter presents the results of two case studies – one for Rockhampton, a large regional centre containing one big and one medium export beef abattoir, and one for Biloela, a regional township containing one medium export beef abattoir. The case studies focus on the impact on regional centres of reductions in meat processing activity that may result from the CPRS.

Background information on Rockhampton and Biloela

Both Rockhampton City and Biloela Township are in the statistical division (SD) of Fitzroy of Queensland (chart 4.1).

4.1 **Fitzroy Statistical Division**



Data source: Queensland Department of Education and Training (http://education.qld.gov.au/nextstep/pdfs/map-fitzroy.pdf)

Population

As at 30 June of 2007, the estimated resident population of Rockhampton City and Biloela were 63 125 and 5 658 persons, respectively, accounting for 30.9 and 2.8 per

cent of the total population of Fitzroy statistical division (table 4.2). Both regions share of Fitzroy's population has been declining.

4.2 Regional population

	Fitzroy	*Rockhampton City*		*Biloela*	
	number	*number*	*% of Fitzroy*	*number*	*% of Fitzroy*
1996	178,028	59,857	33.6		
2001	181,747	58,924	32.4	5,531	3.0
2002	184,737	59,346	32.1	5,526	3.0
2003	188,005	59,815	31.8	5,522	2.9
2004	192,227	60,709	31.6	5,529	2.9
2005	195,661	61,544	31.5	5,590	2.9
2006	200,385	62,565	31.2	5,724	2.9
2007p	204,314	63,125	30.9	5,658	2.8

Source: Queensland Government Office of Economic and Statistical Research (http://www.oesr.qld.gov.au/queensland-by-theme/demography/population/index.shtml)

The Queensland Government has produced population projections for each of the SDs (Queensland Government 2008a). According to the medium projection series, the population in Fitzroy will be a little short of 300 000 persons in 2030 (column 2 of table 4.3). Using the growth rate of Rockhampton City and Biloela relative to the growth rate of Fitzroy in the past 5 years and the projected growth rate of Fitzroy in the next two decades, we come up with projected population series for Rockhampton and Biloela (rest of table 4.3). Population in both places is projected to grow at 1.02 per cent and 0.59 per cent per annum, respectively, compared to the growth rate of 1.67 per cent per annum for whole Fitzroy. Consequently, the trend of declining shares in both places will persist. By 2030, Rockhampton City is projected to have 80 152 people (26.7 per cent of Fitzroy population) and Biloela to have 6 598 persons (2.2 per cent of Fitzroy population).

4.3 Regional population projections

	Fitzroy	*Rockhampton City*		*Biloela*	
	number	*number*	*% of Fitzroy*	*number*	*% of Fitzroy*
2010	219,743	66,241	30.1	5,917	2.7
2015	239,552	69,846	29.2	6,099	2.5
2020	258,846	73,247	28.3	6,267	2.4
2030	299,782	80,152	26.7	6,598	2.2

Source: Fitzroy population projections are Queensland Government medium projections (Queensland Government 2008a); Projections for Rockhampton and Biloela are The CIE estimates based on historical trend and Fitzroy projections.

Labour force and employment

According to the Queensland Regional Statistical Information System (QRSIS), the labour force in Rockhampton was 34 184 persons and the unemployment rate was 3.3 per cent in the June Quarter of 2007, implying that employment was 33 056 persons.

The labour force in the June Quarter of 2008 in Rockhampton was 34 999 with an unemployment rate of 6.4 per cent (chart 4.4). These suggest that the ratio of labour force to population was 54.2 per cent in 2007 and 54.4 per cent in 2008.

4.4 Labour force and unemployment in Rockhampton City - smoothed

Data source: The Queensland Regional Statistical Information System (QRSIS)

Applying the labour force to population ratio and unemployment rate to Biloela population, it is estimated that employment in Biloela was 3 021 in 2007 and 2 962 in 2008.

It seems that Rockhampton City has higher unemployment than the national average. As shown in table 4.5, the unemployment rate in Rockhampton is consistently higher except in June and September quarters of 2007. On average the unemployment rate in Rockhampton is 0.6 percentage points higher (excluding March quarter of 2004). We assume this difference will continue in the future.

4.5 Unemployment rate in Rockhampton and Australia, %

Rockhampton City		*Australia*	
Quarter	***Rate***	***Month***	***Rate***
Mar 2004	9.4	Feb 2004	5.6
Mar 2005	6.7	Feb 2005	5.2
Mar 2006	5.5	Feb 2006	4.9
Mar 2007	5.1	Feb 2007	4.5
Jun 2007	3.3	May 2007	4.4
Sep 2007	3.5	Aug 2007	4.4
Dec 2007	4.8	Nov 2007	4.3
Mar 2008	6.0	Feb 2008	4.2
Jun 2008	6.4	May 2008	4.1
Sep 2008	5.3	Aug 2008	4.3
		Nov 2008	4.6
		Feb 2009	4.9

Source: Queensland Regional Statistics Information System and ABS Cat. No. 6105.0

In its *Updated Economic and Fiscal Outlook* released in February 2009, the Commonwealth Treasury projected an unemployment rate of 5.5 per cent in 2008-09 and 7 per cent in 2009-10 (Commonwealth Treasury 2009). Access Economics (2009) recently forecast that the unemployment rate will be beyond 8 per cent by the end of 2010. The International Monetary Fund (IMF) recently projected Australia's unemployment rate will be 6.8 per cent this year and 7.8 per cent next year (IMF 2009, Table 2.1, page 65).

Given the above remarks, we assume that Australia's unemployment rate in 2009 will be 6 per cent and 7.5 per cent in 2010. Accordingly, it is assumed that the unemployment in Rockhampton and Biloela will be 6.6 per cent in 2009 and 8.1 per cent in 2010. We then assume the unemployment rate gradually fall to the long term rate of 5.2 per cent in 2015. The projected labour force and employment are reported in table 4.6.

4.6 **Labour force and employment projection for Rockhampton and Biloela**

	Labour force (person)		*Unemployment*	*Employed person*	
	Rockhampton	*Biloela*	*Rate (%)*	*Rockhampton*	*Biloela*
2010	36,012	3,217	8.1	33,095	2,956
2015	37,972	3,316	5.2	36,006	3,144
2020	39,821	3,407	5.2	37,759	3,231
2030	43,574	3,587	5.2	41,318	3,401

Source: The CIE estimates

Economy

According to the Queensland Government (2008b), Fitzroy's gross regional product (GRP) was $14.1 billion in 2005-06, accounting for 7.7 per cent of the Queensland total. The GRP per capita of Fitzroy was $71 256 in 2005-06, about 50 per cent higher than the Queensland and Australian averages (table 4.7).

There are no official estimates of GRP for Rockhampton and Biloela. We make our own estimates assuming that both places have similar per capita GRP as Fitzroy. We estimate that GRP in 2005-06 was $4 463 million for Rockhampton City and $408 million for Biloela. Assuming the trend of per capita GRP growth extends to 2007-08, it is estimated that GRP in 2008-09 was $4 716 million for Rockhampton City and $426 million for Biloela.

Looking further into the future, we assume a fall of 1 per cent in 2008-09, a gradual recovery between 2009-10 and 2012-13, and back to historical trend beyond 2013, i.e. 3 per cent per annum in Australian GDP growth. These assumptions are in line with the market consensus (table 4.8).

4.7 Regional gross product of Fitzroy, Queensland and rest of Australia

	2000–01	*2005–06*	*Growth rate*
Nominal GRP, current price ($ million)			
Queensland	114,684	183,983	9.9
Fitzroy	7,913	14,126	12.3
Rest of Australia	574,579	783,471	6.4
Real GRP, chain volume measure ($ million, 2005-06)			
Queensland	145,629	183,983	4.8
Fitzroy	12,041	14,126	3.2
Rest of Australia	674,929	783,471	3.0
Real GRP per capita, chain volume measure ($, 2005-06)			
Queensland	40,506	45,495	2.4
Fitzroy	66,499	71,256	1.4
Rest of Australia	44,266	49,118	2.1

Source: Queensland Government (2008b)

4.8 Economic growth forecasts for Australia, %pa

Source	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
IMF World Economic Outlook, April 2009	2.1	-1.4	0.6	1.9	2.8	2.9
ANZ Economic Outlook June Quarter 2009	2.1	-0.9	0.7	2.9		
Economist, 25 March 2009	2.1	-1.2	0.5	1.2	2.4	2.7
Treasury, Updated Economic and Fiscal Outlook, February 2009 [a]	3.7	1.0	0.75			
The CIE assumption		-1.0	0.5	1.5	2.5	3.0

[a] In a recent remark, Federal Treasurer Wayne Swan was reported as saying the recessions and downturns for key trading partners made it 'certain that our own forecasts for growth and revenue in the budget will be substantially worse' than before (http://www.theage.com.au/national/swan-warns-on-china-20090416-a8v1.html).

Source: as noted in the table

4.9 Economic forecast for case studies regions

	Per capita GRP	*GRP*	
	Fitzroy	*Rockhampton*	*Biloela*
	$	*$ million*	*$ million*
2010	69,576.4	4,608.8	411.7
2015	72,512.4	5,064.7	442.3
2020	77,732.4	5,693.6	487.1
2030	89,326.7	7,159.7	589.4

Source: The CIE assumption

Our ultimate assumptions for gross regional product in Rockhampton City and Biloela are summarised in table 4.9. Per capita GRP in both places is the same as that in Fitzroy.

Contribution of abattoirs

Table 4.10 summarises the key information of abattoirs in Rockhampton City and Biloela Township. It should be noted that the numbers in the table are estimated using publicly available information which may differ from the actual (confidential) numbers for any individual abattoir.

Known as the Beef Capital of Australia, Rockhampton has a significant beef industry. Teys Bros has one large abattoir with a daily processing capacity of 1 731 cattle, according to the company's website. The plant employs 900 people and is the city's largest single employer. JBS Swift Australia has a medium size abattoir in the city with a daily processing capacity of 650 beef cattle. It employs about 535 people. The total number of employees in the two abattoirs accounts for 4.3 per cent of total employment in Rockhampton.

Teys Bros' Biloela abattoir has a daily capacity of 703 head and employs about 400 employees, accounting for 13.2 per cent of total employment in Biloela.

4.10 **Abattoirs in Rockhampton and Biloela, 2006-07**

		Rockhampton			*Biloela*	*Sources and notes*
		Teys Bros	*JBS Swift*	*Total*	*Teys Bros*	
Capacity	cattle/day	1731	650	2381	703	Company websites
Employees	number	900	535	1435	400	Company websites
as % of regional total				4.3	13.2	
Throughput	tHSCW	114,978	50,491	165,468	51,101	Applying company average of labour productivity from Top 25 Red Meat Processors
GVP	$ million			745	230	Total inventory price @ $4.5/kg
Value added	$ million			158	49	21% of GVP according to IO table
as % of GRP	%			3.4	11.7	

Source: as noted in the table

According to *Top 25 Red Meat Processors* (MLA 2008c), throughput in 2007 was 453 kt for JBS Swift Australia and 345 kt for Teys Bros. The two companies employed 4 800 and 2 700 people respectively in the year. These imply that the labour productivity was 94.4 tonnes per person in JBS Swift Australia and 127.8 tonnes per person in Teys Bros. Applying these labour productivity ratios to the employment numbers, it is estimated that total throughput in 2006-07 was about 165.5 ktHSCW in Rockhampton and about 51.1 ktHSCW in Biloela.

The gross value of production (GVP) of abattoirs in 2006-07 was $745 million in Rockhampton and $230 million in Biloela, assuming a total inventory price of $4.50 per kg. The value added of meat processing is about 21 per cent of GVP, according to the latest Input-Output table (ABS 2008). It is therefore estimated that value added of abattoirs in 2006-07 was $158 million in Rockhampton and $49 million in Biloela,

accounting for about 3.4 per cent and 11.7 per cent, respectively, of the regional gross product (GRP). The slightly lower GRP share of abattoirs than the employment share indicates that red meat processing is a relatively labour intensive sector.

In addition to the direct contribution to the local economy, abattoirs affect the local economy in several other ways. First, some of their inputs are sourced locally, which would affect the whole supply chain of goods and services in the local economy. Second, employees spend part of their earnings locally, which in turn affects local business. We therefore use an economy-wide model to investigate the complete impact of abattoirs on local economies.

Outlook

Looking into the future, it is assumed that abattoir throughputs in Rockhampton and Biloela grow at the same rate as the business as usual projection by the GMI model. Throughput on average will grow by 1.7 per cent per annum over the next two decades. By 2030, throughput will be about 244 ktHSCW in Rockhampton and 75.3 ktHSCW in Biloela (table 4.11). It should be noted that these throughput projections would by 2030 reach the upper limit of the processing capacity in existing plants – these plants have to be operated seven days a week all year round.

4.11 **Abattoirs outlook in Rockhampton and Biloela**

	2010	*2015*	*2020*	*2030*
Throughput (tHSCW)				
Rockhampton	162,946	175,184	192,686	243,965
Biloela	50,322	54,102	59,507	75,343
GVP ($ million)				
Rockhampton	845.6	964.7	1095.1	1594.6
Biloela	261.2	297.9	338.2	492.4
Value added ($ million)				
Rockhampton	179.2	204.5	232.1	338.0
As of GRP (%)	3.9	4.0	4.1	4.7
Biloela	55.4	63.1	71.7	104.4
As of GRP (%)	13.4	14.3	14.7	17.7
Employment (number)				
Rockhampton	1372	1403	1468	1683
As % of regional total	4.1	3.9	3.9	4.1
Biloela	382	391	409	469
As % of regional total	12.9	12.4	12.7	13.8

Source: The CIE estimates

Because abattoir throughput is projected to grow faster than the local economy, their share in the gross regional product (GRP) will rise over time. By 2030, the value added of abattoirs will account for 4.7 per cent of GRP in Rockhampton and 17.7 per cent in Biloela (table 4.11).

Assuming 1 per cent annual labour productivity growth, it is projected that abattoirs will employ 1683 people in Rockhampton by 2030 and 469 people in Biloela, accounting for 4.1 per cent and 13.8 per cent, respectively, of each region's total employment (table 4.11).

Likely changes in abattoirs under a CPRS

With the projected reduction in production presented in the previous chapter, a specific red meat processor may adjust in two ways:

- By scaling down production proportionately with the overall reduction in output; or
- by restructuring the business, e.g. closing down a plant in one location to concentrate on plants in other locations

The restructuring approach to adjustment is likely to happen when market conditions are very bad. Under the most severe scenario (Scenario 1A), grass fed beef production is projected to fall by 12.4 per cent by 2030 (relative to the baseline, chart 3.4). Given the outlook that throughput in 2030 is projected to be 47.4 per cent higher than today's levels, a 12.4 per cent reduction relative to baseline still means production 29.2 per cent higher than current level. For this reason, we assume processors would adjust in the first way, that is, to scale down individual abattoir's production proportional to the national level.

It is important to note, however, that the structure of the CPRS creates some incentive to restructure production in away that is not necessarily economically rational from the point of view of meat processing. The threshold for emissions accounting under the CPRS creates incentive to reduce the size of processing facilities so they fall under the threshold. While this may be sensible from the perspective of an individual enterprise minimising costs, from an economywide perspective it is not an economically rational way to process meat.

We estimate that, depending on the CPRS scenario, throughput in Rockhampton will be between 213.8 and 241.6 ktHSCW in 2030, down by between 2.3 and 30.1 ktHSCW from the business as usual (that is no CPRS) level. Throughput in Biloela will be between 66 and 74.6 ktHSCW in 2030, down by between 0.7 and 9.3 ktHSCW from the business as usual level (table 4.12).

It is estimated that abattoir value added in Rockhampton in 2030 will be $41.8 million, $40.7 million, $20 million and $3.2 million, respectively, lower than the business as usual level, under Scenario 1, 1A, 2 and 3. Abattoir value added in Biloela in 2030 will be $12.9 million, $12.6 million, $6.2 million and $1 million, respectively, lower than the BAU level under Scenario 1, 1A, 2 and 3 (table

4.13).

It is estimated that, depending on the CPRS scenario, abattoir employment in Rockhampton will be between 1475 and 1667 people in 2030, down by between 16 and 208 people from the business as usual level. Abattoir employment in Biloela will be between 411 and 465 people in 2030, down by 5 to 58 people from the business as usual level (table 4.14).

4.12 **Abattoir throughput and changes under different CPRS scenarios, tHSCW**

Scenario		***2010***	***2015***	***2020***	***2030***
Rockhampton					
S1	Throughput	162,803	169,730	182,933	213,824
	change	-143	-5,454	-9,753	-30,140
S1A	Throughput	162,827	169,869	183,178	214,602
	change	-119	-5,315	-9,508	-29,362
S2	Throughput	162,830	173,728	189,357	229,552
	change	-117	-1,456	-3,329	-14,413
S3	Throughput	162,829	174,629	191,686	241,621
	change	-117	-555	-1,000	-2,344
Biloela					
S1	Throughput	50,278	52,417	56,495	66,035
	change	-44	-1,684	-3,012	-9,308
S1A	Throughput	50,285	52,460	56,570	66,275
	change	-37	-1,641	-2,936	-9,068
S2	Throughput	50,286	53,652	58,479	70,892
	change	-36	-450	-1,028	-4,451
S3	Throughput	50,286	53,930	59,198	74,619
	change	-36	-171	-309	-724

Source: The CIE estimates

4.13 **Abattoir value added and changes under different CPRS scenarios, $million**

Scenario		***2010***	***2015***	***2020***	***2030***
Rockhampton					
S1	Value added	179.07	198.10	220.35	296.21
	change	-0.16	-6.36	-11.75	-41.75
S1A	Value added	179.10	198.26	220.64	297.29
	change	-0.13	-6.20	-11.45	-40.68
S2	Value added	179.10	202.76	228.09	318.00
	change	-0.13	-1.70	-4.01	-19.97
S3	Value added	179.10	203.81	230.89	334.72
	change	-0.13	-0.65	-1.20	-3.25
Biloela					
S1	Value added	55.30	61.18	68.05	91.48
	change	-0.05	-1.97	-3.63	-12.89
S1A	Value added	55.31	61.23	68.14	91.81
	change	-0.04	-1.92	-3.54	-12.56
S2	Value added	55.31	62.62	70.44	98.21
	change	-0.04	-0.52	-1.24	-6.17
S3	Value added	55.31	62.94	71.31	103.37
	change	-0.04	-0.20	-0.37	-1.00

Source: The CIE estimates

4.14 **Abattoir employment and changes under different CPRS scenario, persons**

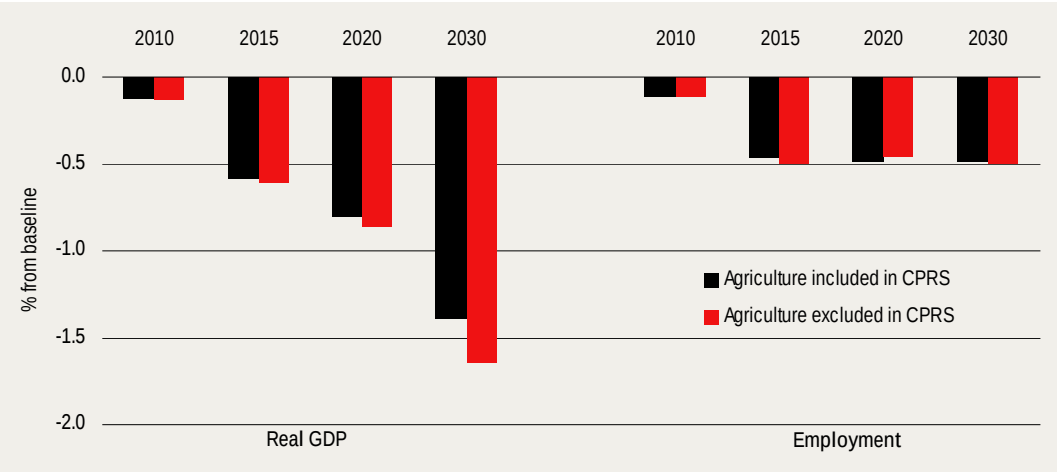
Scenario		***2010***	***2015***	***2020***	***2030***
Rockhampton					
S1	Employment	1,370	1,359	1,394	1,475
	change	-2	-44	-74	-208
S1A	Employment	1,371	1,360	1,396	1,480
	change	-1	-43	-72	-203
S2	Employment	1,371	1,391	1,443	1,584
	change	-1	-12	-25	-99
S3	Employment	1,371	1,399	1,461	1,667
	change	-1	-4	-8	-16
Biloela					
S1	Employment	382	379	389	411
	change	0	-12	-21	-58
S1A	Employment	382	379	389	413
	change	0	-12	-20	-56
S2	Employment	382	388	402	441
	change	0	-3	-7	-28
S3	Employment	382	390	407	465
	change	0	-1	-2	-5

Source: The CIE estimates

Impact on the local economy

A CPRS will have wide spread impact on the economy. According to the Oz-Cubed simulations, real GDP in Australia in 2030 will be 1.4 per cent lower than the business as usual (BAU) level if agriculture is included in the CPRS and 1.6 per cent lower if agriculture is excluded. Employment in 2030 will be about 0.5 per cent lower than the BAU level (chart 4.15).

4.15 **Impact of CPRS on Australia's GDP and employment**



Data source: The CIE Oz-Cubed simulations

The impact of a CPRS on Rockhampton and Biloela is set to be larger than the national average because they have higher proportion of red meat processing than the economywide average. According to the latest Input-Output table (ABS 2008), value added of meat and meat product sector account for 0.4 percent of total value added in Australia, while abattoirs contributed to over 3 per cent of Rockhampton's gross regional product (GRP) and over 11 per cent of Biloela's.

The red meat sector will suffer more reduction under a CPRS than the average of all sectors. The CIE Oz-Cubed simulation reveals that national production will be 0.9 per cent below the business as usual level in 2030 under a CPRS which includes agriculture. By contrast, grass-fed beef production will fall by 12.4 per cent under the Scenario 1 where both farming and processing are included in the CPRS.

The focus of this section is to discuss the additional impact of CPRS on Rockhampton and Biloela due to the lower throughput of abattoirs.

In addition to the direct impacts of lower production as discussed in the previous section, there are indirect, second round, impacts on the local economy.

First, lower production means lower inputs. Some of the abattoirs' inputs are sourced locally. Reduced demand for local inputs would impact the economy further.

Second, lower production means lower employment and lower household income. Reduced income would lead to less spending locally.

In order to catch the indirect impacts, we use the TERM model to estimate the impact of lower intermediate inputs and income on gross regional product (GRP) and employment.

The TERM model simulations suggests that for every million dollars intermediate input in red meat processing, GRP will increase by $590 000 and employment up by 9.6 persons. The household expenditure multipliers are $0.83 in GRP per dollar spending, and 7.47 persons in employment per million dollar spending (table 4.16).

4.16 **Impact multipliers**

	Gross Regional Product	***Employment***
	$/$	person/$mil
Intermediate inputs	0.59	9.61
Household spending	0.83	7.47

Source: TERM model simulations

Impact of lower intermediate inputs

There are no data on the intermediate inputs sourced locally by meat processors. But we can reasonably exclude a big proportion of the inputs, that is, livestock input. Livestock are raised in farms surrounding the city and township, and thus not locally sourced. For the remaining inputs, we have to make an assumption of the local ratio.

According to the latest Input-Output table (ABS 2008), livestock inputs and value added account for about 54 and 21 per cent, respectively, of the total value of meat products. Among the remaining 25 per cent, we assume the local ratio is between 20 and 50 per cent with the 30 per cent as the more likely ratio.

4.17 **Impact of lower non-livestock inputs, change from business as usual level**

Local	*Scenario*	*GRP ($ million)*				*Employment (person)*			
ratio		*2010*	*2015*	*2020*	*2030*	*2010*	*2015*	*2020*	*2030*
20%	Rockhampton								
	S1	-0.02	-0.88	-1.63	-5.80	0	-14	-27	-94
	S1A	-0.02	-0.86	-1.59	-5.65	0	-14	-26	-92
	S2	-0.02	-0.24	-0.56	-2.77	0	-4	-9	-45
	S3	-0.02	-0.09	-0.17	-0.45	0	-1	-3	-7
	Biloela								
	S1	-0.01	-0.27	-0.50	-1.79	0	-4	-8	-29
	S1A	-0.01	-0.27	-0.49	-1.75	0	-4	-8	-28
	S2	-0.01	-0.07	-0.17	-0.86	0	-1	-3	-14
	S3	-0.01	-0.03	-0.05	-0.14	0	0	-1	-2
30%	Rockhampton								
	S1	-0.03	-1.33	-2.45	-8.70	-1	-22	-40	-142
	S1A	-0.03	-1.29	-2.39	-8.48	0	-21	-39	-138
	S2	-0.03	-0.35	-0.84	-4.16	0	-6	-14	-68
	S3	-0.03	-0.14	-0.25	-0.68	0	-2	-4	-11
	Biloela								
	S1	-0.01	-0.41	-0.76	-2.69	0	-7	-12	-44
	S1A	-0.01	-0.40	-0.74	-2.62	0	-6	-12	-43
	S2	-0.01	-0.11	-0.26	-1.29	0	-2	-4	-21
	S3	-0.01	-0.04	-0.08	-0.21	0	-1	-1	-3
50%	Rockhampton								
	S1	-0.05	-2.21	-4.08	-14.50	-1	-36	-66	-236
	S1A	-0.05	-2.15	-3.98	-14.13	-1	-35	-65	-230
	S2	-0.04	-0.59	-1.39	-6.94	-1	-10	-23	-113
	S3	-0.04	-0.23	-0.42	-1.13	-1	-4	-7	-18
	Biloela								
	S1	-0.02	-0.68	-1.26	-4.48	0	-11	-21	-73
	S1A	-0.01	-0.67	-1.23	-4.36	0	-11	-20	-71
	S2	-0.01	-0.18	-0.43	-2.14	0	-3	-7	-35
	S3	-0.01	-0.07	-0.13	-0.35	0	-1	-2	-6

Source: The CIE estimates

If 30 per cent of non-livestock inputs are locally sourced, GRP in Rockhampton City would be further reduced by $8.7 million in 2030 from the business as usual level, and the employment would be down by another 142 persons under the Scenario 1. The impact on Biloela Township would be $2.7 million fall in GRP and 44 job losses in 2030 under the same assumption of local ratio and same CPRS scenario (table

4.17).

Impact of lower household income

There is no public data on abattoir worker earnings and spending in Rockhampton and Biloela, therefore we have to make some assumptions based on available data.

According to the ABS, weekly earnings in meat and meat product manufacturing sector was $762.3 in 2004 and $868.6 in 2006 (ABS Cat. No. 6306.0, Table 2), growing by 4.1 per cent per annum. Applying this growth rate, it is estimated that weekly earning in the sector was $732.2 in 2003 and $860.3 in 2007.

The weekly earnings of $732.2 in 2003 falls between the second and third household income quintiles ($555 and $930 respectively) according to ABS's *Household Expenditure Survey* (Cat. No. 6535.0.55.001, Table 1). These households spent between $603.64 and $859.38 weekly (Cat. No. 6535.0.55.001, Table 2). By interpolation, households with weekly earnings of $732.2 tend to spend $724.5 weekly. This means that 99 per cent of their earnings are spent.

We further assume that abattoir workers in Rockhampton spend 80 per cent of their total spending locally and those in Biloela spent 50 per cent locally because Biloela is relatively small. Applying these assumptions and the income multipliers in table 4.16, we estimate the indirect impact of lower income due to lower employment on local economy and employment and report them in table 4.18.

Under Scenario 1, there will be about $10.7 million less local spending relative to the business as usual level in Rockhampton City in 2030, leading to local GRP down by $8.9 million and 80 job losses. The indirect impact on Biloela GRP is about $1.5 million, and the impact on employment is about 14 job losses in 2030 under Scenario 1.

4.18 **Impact of lower income and spending, change from business as usual level**

Scenario	*GRP ($ million)*				*Employment (person)*			
	2010	*2015*	*2020*	*2030*	*2010*	*2015*	*2020*	*2030*
Rockhampton								
S1	-0.04	-1.57	-2.75	-8.85	0	-14	-25	-80
S1A	-0.03	-1.53	-2.68	-8.62	0	-14	-24	-78
S2	-0.03	-0.42	-0.94	-4.23	0	-4	-8	-38
S3	-0.03	-0.16	-0.28	-0.69	0	-1	-3	-6
Biloela								
S1	-0.01	-0.27	-0.48	-1.54	0	-2	-4	-14
S1A	-0.01	-0.27	-0.47	-1.50	0	-2	-4	-14
S2	-0.01	-0.07	-0.16	-0.74	0	-1	-1	-7
S3	-0.01	-0.03	-0.05	-0.12	0	0	0	-1

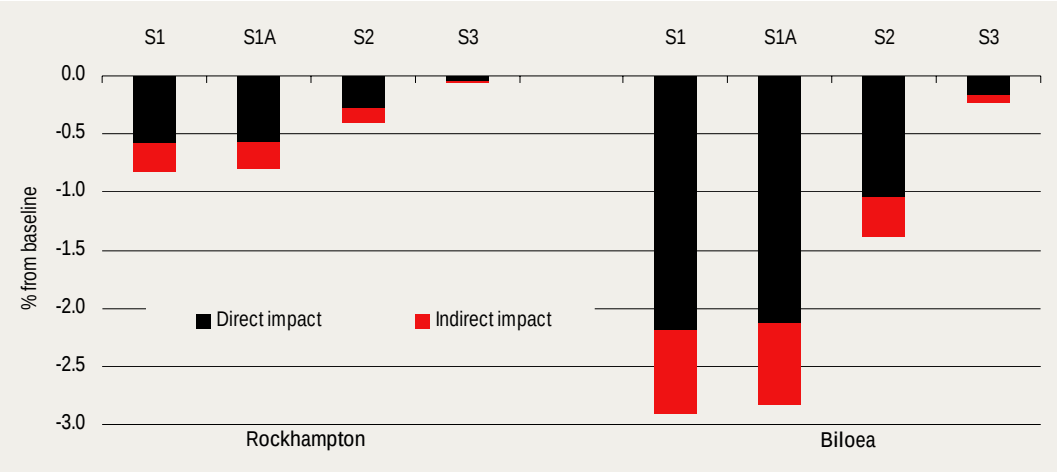
Source: The CIE estimates

Overall impact

Charts 4.19 and 4.20 and table 4.21 summarise the overall impact of lower abattoir throughput on local economies in Rockhampton City and Biloela Township. The indirect impact is calculated assuming 30 per cent of non-livestock inputs are sourced locally.

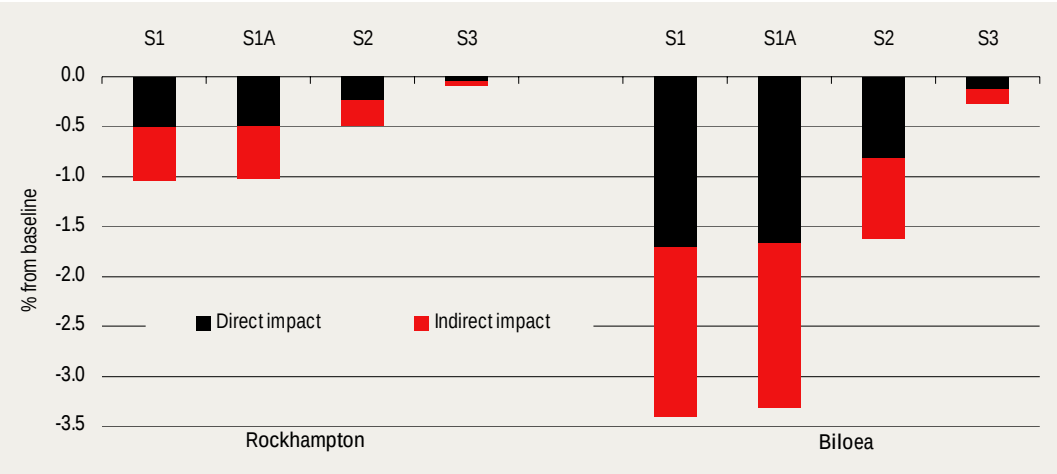
It should be emphasized that these impacts are additional to the average national impacts as presented in chart 4.15 because Rockhampton and Biloela have higher share of red meat processing industry than the national average.

4.19 **Direct and indirect impacts on GRP of lower abattoir throughput, 2030**



Note: It is assumed that 30 per cent of non-livestock inputs are sourced locally in calculating the indirect impact of lower inputs.
Data source: The CIE estimates

4.20 **Direct and indirect impacts on regional employment of lower abattoir throughput, 2030**



Note: It is assumed that 30 per cent of non-livestock inputs are sourced locally in calculating the indirect impact of lower inputs.
Data source: The CIE estimates

4.21 **Overall impact of lower abattoir throughput in Rockhampton City and Biloela Township**

	GRP ($ million)				*Employment (person)*			
	2010	***2015***	***2020***	***2030***	***2010***	***2015***	***2020***	***2030***
Rockhampton								
Scenario 1								
Total	-0.23	-9.26	-16.95	-59.31	-2	-79	-139	-429
Direct	-0.16	-6.36	-11.75	-41.75	-1	-44	-74	-208
Indirect	-0.07	-2.89	-5.20	-17.55	-1	-36	-65	-222
Scenario 1A								
Total	-0.19	-9.02	-16.52	-57.78	-2	-77	-136	-418
Direct	-0.13	-6.20	-11.45	-40.68	-1	-43	-72	-203
Indirect	-0.06	-2.82	-5.07	-17.10	-1	-35	-63	-216
Scenario 2								
Total	-0.19	-2.47	-5.78	-28.36	-2	-21	-47	-205
Direct	-0.13	-1.70	-4.01	-19.97	-1	-12	-25	-99
Indirect	-0.06	-0.77	-1.77	-8.39	-1	-10	-22	-106
Scenario 3								
Total	-0.19	-0.94	-1.74	-4.61	-2	-8	-14	-33
Direct	-0.13	-0.65	-1.20	-3.25	-1	-4	-8	-16
Indirect	-0.06	-0.29	-0.53	-1.36	-1	-4	-7	-17
Biloela								
Scenario 1								
Total	-0.07	-2.65	-4.86	-17.12	-1	-21	-37	-116
Direct	-0.05	-1.97	-3.63	-12.89	0	-12	-21	-58
Indirect	-0.02	-0.68	-1.24	-4.23	0	-9	-17	-58
Scenario 1A								
Total	-0.05	-2.58	-4.74	-16.68	0	-21	-36	-113
Direct	-0.04	-1.92	-3.54	-12.56	0	-12	-20	-56
Indirect	-0.01	-0.67	-1.20	-4.12	0	-9	-16	-56
Scenario 2								
Total	-0.05	-0.71	-1.66	-8.19	0	-6	-13	-55
Direct	-0.04	-0.52	-1.24	-6.17	0	-3	-7	-28
Indirect	-0.01	-0.18	-0.42	-2.02	0	-2	-6	-28
Scenario 3								
Total	-0.05	-0.27	-0.50	-1.33	0	-2	-4	-9
Direct	-0.04	-0.20	-0.37	-1.00	0	-1	-2	-5
Indirect	-0.01	-0.07	-0.13	-0.33	0	-1	-2	-4

Note: It is assumed that 30 per cent of non-livestock inputs are sourced locally in calculating the indirect impact of lower inputs.
Source: The CIE estimate

Moreover the results do not include the impacts of lower activity in the surrounding beef farms. It is likely that farmers buy some of their materials and spend some of their income in Rockhampton and Biloela. As indicated previously, beef farmers would be hit harder under a CPRS, that is, the fall in production would be higher than the average. With lower farming activity, their spending will be smaller and

thus impact the local economy further. However, it is difficult, if not impossible, to account these impacts without detailed regional accounts.

It is estimated that gross regional product (GRP) in Rockhampton in 2030 will be $59.3 million (about 0.8 per cent) lower than the business as usual (BAU) level under Scenario 1. About 70 per cent of the fall is due to the direct impact of lower throughput. There will be 429 job losses (about 1 per cent) in 2030 compared to the BAU level under the Scenario 1. About 48 per cent of the job losses are due to the direct impact of lower throughput in abattoirs.

GRP in Biloela in 2030 will be $17.1 million (2.9 per cent) less than the BAU level under the Scenario 1. About three quarters of the fall is due to the direct impact. There will be about 116 job losses (about 3.4 per cent) in 2030 under the Scenario 1, of which 58 are due to direct impact.

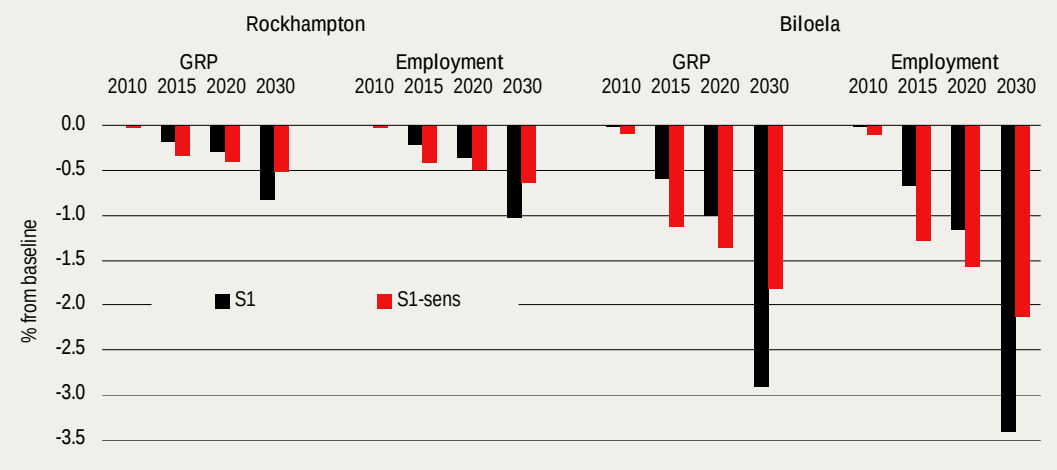
Sensitivity analysis

We conducted sensitivity analysis for the case studies using the GMI results with the Treasury's CPRS-5 price series as presented in the last section of the previous chapter. We also conducted sensitivity analysis assuming the abattoirs in the case study regions are closed.

Applying Treasury's price series

Chart 4.22 draws the sensitivity analysis result of percentage changes in gross regional product (GRP) and regional employment from the business as usual level under the Scenario 1 (red column) alongside the original results using the Oz-Cubed estimated price series (black column).

4.22 **Overall impact of lower abattoir throughput in Rockhampton City and Biloela,** Sensitivity analysis, Scenario 1



[a] It is assumed that 30 per cent of non-livestock inputs are sourced locally in calculating the indirect impact of lower inputs

Data source: The CIE estimates

4.23 **Overall impact of lower abattoir throughput in Rockhampton City and Biloela Township,** Sensitivity analysis

	GRP ($ million)				*Employment (person)*			
	2010	***2015***	***2020***	***2030***	***2010***	***2015***	***2020***	***2030***
Rockhampton								
Scenario 1								
Total	-1.29	-17.48	-23.08	-37.11	-12	-150	-189	-269
Direct	-0.88	-12.02	-16.00	-26.13	-7	-82	-101	-130
Indirect	-0.41	-5.46	-7.08	-10.98	-5	-67	-88	-139
Scenario 1A								
Total	-0.96	-17.01	-22.48	-36.26	-9	-146	-184	-263
Direct	-0.65	-11.69	-15.58	-25.53	-5	-80	-99	-127
Indirect	-0.30	-5.32	-6.90	-10.73	-4	-66	-86	-135
Scenario 2								
Total	-0.93	-4.30	-7.66	-18.46	-8	-37	-63	-134
Direct	-0.63	-2.96	-5.31	-13.00	-5	-20	-34	-65
Indirect	-0.29	-1.34	-2.35	-5.46	-4	-17	-29	-69
Scenario 3								
Total	-1.02	-1.58	-2.19	-2.99	-9	-14	-18	-22
Direct	-0.69	-1.09	-1.52	-2.10	-5	-7	-10	-10
Indirect	-0.32	-0.49	-0.67	-0.88	-4	-6	-8	-11
Biloela								
Scenario 1								
Total	-0.37	-5.00	-6.62	-10.72	-3	-40	-51	-72
Direct	-0.27	-3.71	-4.94	-8.07	-2	-23	-28	-36
Indirect	-0.10	-1.29	-1.68	-2.65	-1	-17	-23	-36
Scenario 1A								
Total	-0.27	-4.87	-6.45	-10.47	-2	-39	-50	-71
Direct	-0.20	-3.61	-4.81	-7.88	-1	-22	-27	-35
Indirect	-0.07	-1.25	-1.64	-2.59	-1	-17	-22	-35
Scenario 2								
Total	-0.26	-1.23	-2.20	-5.33	-2	-10	-17	-36
Direct	-0.19	-0.91	-1.64	-4.01	-1	-6	-9	-18
Indirect	-0.07	-0.32	-0.56	-1.32	-1	-4	-8	-18
Scenario 3								
Total	-0.29	-0.45	-0.63	-0.86	-2	-4	-5	-6
Direct	-0.21	-0.34	-0.47	-0.65	-1	-2	-3	-3
Indirect	-0.08	-0.12	-0.16	-0.21	-1	-2	-2	-3

Note: It is estimated using the throughput change with the Treasury's CPRS-5 permit price. It is assumed that 30 per cent of non-livestock inputs are sourced locally in calculating the indirect impact of lower inputs.
Source: The CIE estimate

As with the pattern of sensitivity analysis of the sectoral impacts, using the Treasury prices will see higher adverse impact on GRP and employment in 2010, 2015 and 2020 and lower impact in 2030 than using the Oz-Cubed estimated prices.

For example, fall in GRP due to lower abattoir throughput in Rockhampton City will be 0.03 per cent, 0.35 per cent, 0.41 per cent and 0.52 per cent in 2010, 2015, 2020 and

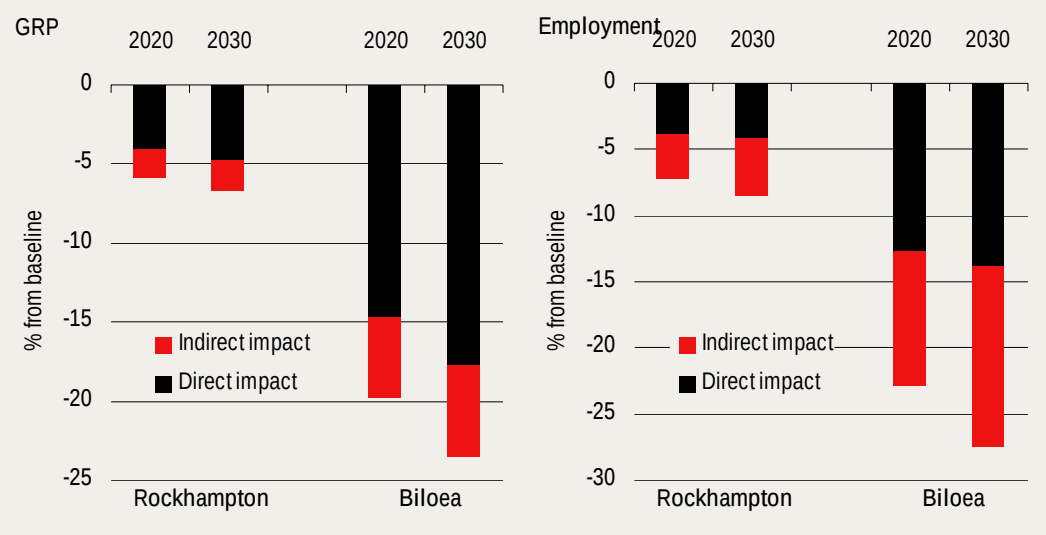
2030, respectively, under the Scenario 1 with the Treasury price, compared to 0.00 per cent, 0.18 per cent, 0.30 per cent and 0.83 per cent in relevant years if using the Oz-Cubed estimated price.

Table 4.23 reports the sensitivity analysis of overall impact for all the four scenarios. It is a replicate of table 4.21 except the different assumption of throughput change due to different permit prices.

What if the abattoirs are closed

As discussed at the beginning of the previous section on page 53, one response to the CRPS may be to close abattoirs. It is not clear how likely this is, the sensitivity of abattoir profits to the level of throughput suggests it is a real possibility. To illustrate the potential impact, chart 4.24 shows the effect of the closure of abattoirs in Rockhampton and Biloela in 2020 and 2030.

4.24 **Impact of abattoir closure on GRP and employment**



Note: It is assumed that 30 per cent of non-livestock inputs are sourced locally in calculating the indirect impact of lower inputs.
Data source: The CIE estimate

Abattoir closure in Rockhampton would see the gross regional product (GRP) down by 6.7 per cent in 2030, including a direct impact of 4.7 per cent from the abattoirs and an indirect impact of 2 per cent from complete loss in spending of the abattoirs and their employees. The employment impact would be 8.4 per cent in Rockhampton, of which only 4.1 per cent is due to the loss in jobs in the abattoirs themselves.

Abattoir closure in Biloela would have much larger impact on the local economy because the abattoir plays a much more important role in the township. GRP would be 23.5 per cent lower than the business as usual level in 2030, directly and indirectly due to the closure of the abattoir. Regional employment would 27.5 per cent lower than the business as usual level in 2030.

5 Conclusions

The CPRS, by putting a price on carbon emissions, will increase costs in both red meat processing (a cost increase that will commence in 2011, when the scheme is scheduled to start at the time of writing this report) and in farming (possibly in 2015 when agriculture may be included in the CPRS — a decision yet to be finally made by Government).

This cost increase will be borne up and down the production chain. Some farm costs will be passed on to processors, some processor costs will be passed back to farmers, and some costs in either case will be passed on to consumers.

By far the most significant cost impost arises from including farming in the CPRS. Under current accounting conventions, farming is considerably more emissions intensive (per unit) than is processing.

With a higher share of beef abattoirs in local economy, the two case study regions – Rockhampton and Biloela – are likely to experience greater income reductions than the national average. In additional to direct impacts such as lower throughput, value added and employment, local economies will also be affected indirectly because of lower demand for intermediate inputs and lower income.

The likely impact of a CPRS on the red meat processing industry is sensitive to the assumption of permit prices. The analysis presented here uses permit prices estimated by the Oz-Cubed model, and compares them with the prices from the Commonwealth Treasury. Future permit prices are not known with any certainty, so the results presented here are based on one set of possible outcomes.

The analysis presented here assumes New Zealand will adopt a similar carbon pollution reduction scheme (covering agriculture) but does not assume global participation. This may overstate the impact in the later years when a global agreement that includes agricultural coverage may actually be reached.

The analysis does not incorporate any technological progress in the future which could reduce the emissions intensity in either farming or processing.

Further, the analysis assumes that farmers and processors respond to the CPRS by reducing output. To the extent that either sector has options for adjustment the impacts may differ to those presented here. The results presented in this report therefore should be interpreted as the *pressure* for change if both are included in the CPRS, rather than an inevitable forecast of consequences.

A The Oz-Cubed model

The Oz-Cubed model has been developed by the CIE from the intertemporal, dynamic general equilibrium model of the global economy, G-Cubed, developed by Warwick McKibbin and Peter Wilcoxen (McKibbin and Wilcoxen 1992, 1999). It tracks the flows of resources within the Australian economy as well as between Australia and the rest of the world. The model in its current form covers 57 sectors (6 energy and 51 non-energy sectors). The model is unique in that it integrates a number of alternative approaches to modelling – macroeconometric models, computable general equilibrium models and real business cycle models into one framework. The Oz-Cubed model distinguishes between financial and physical capital.

Financial capital is perfectly mobile between sectors and from one region to another, and is driven by forward-looking investors who respond to arbitrage opportunities. Physical capital, in contrast, is perfectly immobile once it has been installed: it cannot be moved from one sector to another or from one region to another. In addition, intertemporal budget constraints are imposed on economic decision makers.

Drawing on the general equilibrium literature, Oz-Cubed represents the Australian economy as a multi-sector general equilibrium model. Production is broken down into fifty seven industries and each is represented by a cost function. Unlike many general equilibrium models, however, Oz-Cubed draws on macroeconomic theory by treating saving and investment as the result of forward-looking intertemporal optimisation. Households maximise an intertemporal utility function subject to a lifetime budget constraint, which determines the level of saving, and firms choose investment to maximise the stock market value of their equity.

Finally, Oz-Cubed also draws on the macroeconomic literature by including a transactions-based money demand equation, liquidity-constrained agents, and slow nominal wage adjustment. Unlike typical macro models, however, Oz-Cubed has substantial sector detail.

This combination of features was chosen to make Oz-Cubed versatile. Industry detail allows the model to be used to examine environmental and tax policies which tend to have their largest direct effects on small segments of the economy. Intertemporal modelling of investment and saving allows Oz-Cubed to trace out the transition of the economy between the short run and the long run. Slow wage adjustment and liquidity-constrained agents improves the empirical accuracy with which the model captures the transition. Overall, the model is designed to provide a bridge between

computable general equilibrium models, international trade models and macroeconomic models by combining the best features of each approach.

B The GMI model

The Global Meat Industries (GMI) model is a multicountry, multicommodity, Armington style model of world meat production, consumption and trade. It explains production and consumption in ten commodities in 22 regions, and covers trade in eight commodities between 22 regional groupings. Commodities and regions distinguished in the model are shown in table B.1.

Commodities are distinguished by source, and commodities from different sources are imperfect substitutes. In principle, the model covers all bilateral trade flows of traded commodities (although, in practice, some of these flows are zero) and accounts for all bilateral trade barriers. Its key features are summarised in box B.2 The model is dynamic and produces results on an annual basis.

B.1 **Data and country coverage of the GMI database**

	Beef and veal			***Poultry meat***	***Pig meat***	***Sheep meat***		***Sea-food***	***Live sheep***	***Live cattle***
	Grain	***Grass***	***Diaphragm*** [a]			***Mutton***	***Lamb***			
Australia	X	X	X	X	X	X	X		X	X
USA	X	X	X	X	X	X	X			
Japan	X	X	X	X	X	X	X	X		
Canada	X	X	X	X	X	X	X			
Chinese Taipei		X	X	X	X	X	X	X		
South Korea	X	X	X	X	X	X	X	X		
New Zealand		X	X	X	X	X	X		X	
Mexico		X	X	X	X	X	X			
Argentina		X	X	X	X	X	X		X	
Uruguay		X	X	X	X	X	X			
Paraguay		X	X	X	X	X	X			
Brazil		X	X	X	X	X	X			
China		X	X	X	X	X	X	X		
Malaysia		X	X	X	X	X	X	X		X
Indonesia		X	X	X	X	X	X	X		X
Thailand		X	X	X	X	X	X	X		
Philippines		X	X	X	X	X	X	X		X
European Union		X	X	X	X	X	X			
Hong Kong		X	X	X	X	X	X	X		
Singapore		X	X	X	X	X	X	X		
India		X	X	X	X	X	X			
Other countries		X	X	X	X	X	X			X

a Diaphragm beef comes from the inner lining of the rib cage. It is usually classified as offal. Wee keep it separate because in Japan it receives a special tariff treatment (15 per cent compared with 38.5 per cent for beef in general).

Source: The CIE

B.2 Key features of the GMI model

- For each of 22 regions and ten meat types, it provides annual projections of
  - domestic production of each type of meat
  - consumption of each type of meat
  - price outcomes for each type of meat
  - trade flows (exports and imports) by each region for each type of meat.
- It treats meat commodities produced in different countries as different products – for example, Australian grass fed beef is a different product from South Korean Hanwoo and dairy beef.
- It treats all bilateral trade flows for a particular commodity as trade in different products – for example, South Korean grain fed beef imports from Australia are distinguished from South Korean imports of grain fed beef from the United States.
- It allows importing countries to choose the source of their meat imports on the basis of trade policies, relative prices and their preferences for meat from particular sources.
- It explicitly incorporates the major trade policies affecting world meat trade.
- It is supported by a detailed time series database.

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