

## TABLE OF CONTENTS – SECTION 8

8. ESTIMATION OF THE IMPACT ON THE AUSTRALIAN ECONOMY OF THE COST OF ACHIEVING HIGHER FUEL STANDARDS	1
8.1 Introduction	1
8.2 The modelling framework	1
8.3 Results Of The Illustrative Simulation Of The Costs Of Achieving Higher Fuel Standards	2
8.4 Estimation Of The Impact Of The Estimated Fuel Price Increases For Each Scenario On The Australian Economy	4
8.5 conclusions	6

### TABLES

- 1: Impact on selected industries of a one per cent decline in the productivity of the Petroleum and Coal Products Industry

### FIGURES

- 1: Macro economic impact of a one per cent productivity decline in the Petroleum Products Industry (per cent change)
- 2: Impact on national output of a decline in one per cent productivity in the Petroleum and Coal Products Industry (\$million, 1994–95 prices)

### Attachment 8-A: Overview of the STATE Model

A1. The Economic Environment

Table A1: Industries/commodities of the STATE Model

## **8. ESTIMATION OF THE IMPACT ON THE AUSTRALIAN ECONOMY OF THE COST OF ACHIEVING HIGHER FUEL STANDARDS**

### **8.1 INTRODUCTION**

This chapter provides an assessment of the impact of the higher fuel prices on the Australian economy. A simulation was undertaken, involving a reduction in the productivity of refining in Australia such that costs of the industry rose, initially, by one per cent. Such a simulation would lead to an initial one per cent rise in the cost of refined petroleum products to industry. The results of this illustrative simulation were then assessed in relation to the estimated costs of the scenarios to the petroleum industry, as outlined in Chapter 7 of this report.

It must be stressed that the simulation is illustrative of the effects of higher costs. The simulation does not fully capture the differential impact on the refining industry of introducing higher fuel standards. Perhaps more importantly, *the simulation is not meant to measure the net effects on the economy of higher fuel standards as it focuses on the costs of achieving these standards and does not quantify the benefits.*

### **8.2 THE MODELLING FRAMEWORK**

#### **8.2.1 The Economic Environment**

Higher fuel standards would raise refining costs leading to higher fuel prices for industry and consumers. But the initial effects of higher fuel prices provide only a partial picture of the impact higher fuel prices would have on the economy. Because higher fuel prices raise industry costs, their imposition would initially decrease the competitiveness of industry leading to decreased sales, decreased exports and decreased employment. There would also be further changes in the economy as it adjusts to the reduced market opportunities brought about by the increase in fuel prices.

Of course, higher quality fuel may provide environmental benefits and these would need to be taken into account in any overall assessment of the net benefits from higher quality fuel.

To analyse the economic effects of higher quality fuel, a model of the economy is required which captures both the direct and indirect effects of introducing higher fuel standards. The State Model of the Australian economy is a model which has been extensively used to examine policy issues. It is a General Equilibrium Model with an economic structure very similar to the ORANI Model of the Australian economy. The version of the State Model used in this analysis has a 1994–95 database with 109 industries (see Attachment 8-A).

An important aspect of the State Model analysis of the introduction of higher fuel standards is the specification of the economic environment in which the change is to be assessed. In this analysis a long-run environment is specified in which industry has a reasonable degree of flexibility to adjust to higher fuel prices. The key assumptions in the long-run environment are:

- wage rates adjust to equate labour supply to the increased demand for labour;
- industry and economy-wide stocks of capital adjust to maintain given rates of return;
- tax rates adjust uniformly to maintain a real public sector borrowing requirement; and
- nominal household savings are a fixed proportion of nominal household consumption.

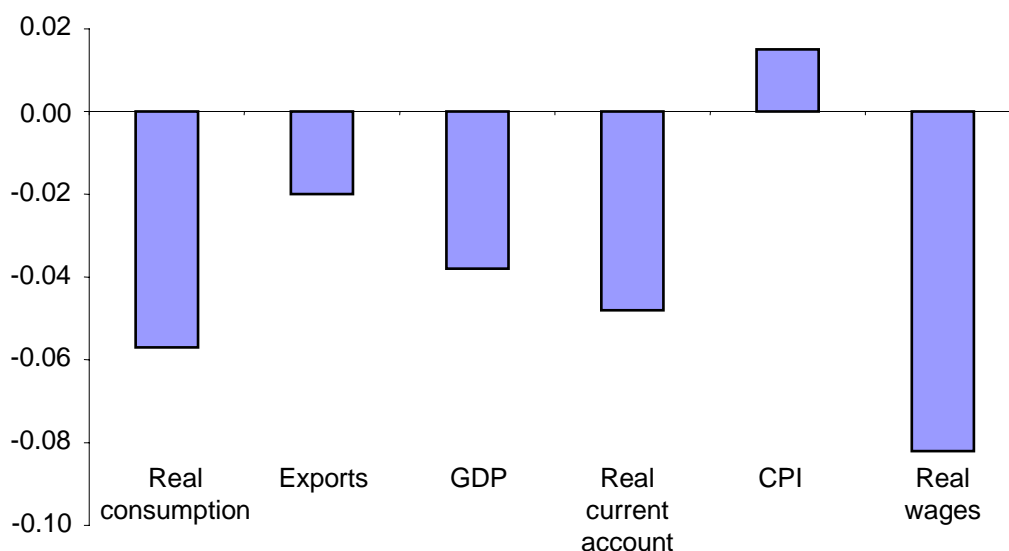
### 8.2.2 The shock imposed on the model

The simulation consisted of a non-uniform reduction in productivity of refining. Productivity declines were imposed on capital, labour and key inputs such that industry refining costs rose, initially, by one per cent.

## 8.3 RESULTS OF THE ILLUSTRATIVE SIMULATION OF THE COSTS OF ACHIEVING HIGHER FUEL STANDARDS

A simulated decline in the refining productivity would lead initially to a one per cent increase in fuel prices (ex-refinery). The higher fuel prices induced by higher fuel standards is found to have a small negative impact on the economy (Figure 8-1).

**Figure 8-1: Macro economic impact of a one per cent increase in the ex-refinery price of fuel (percentage change)**

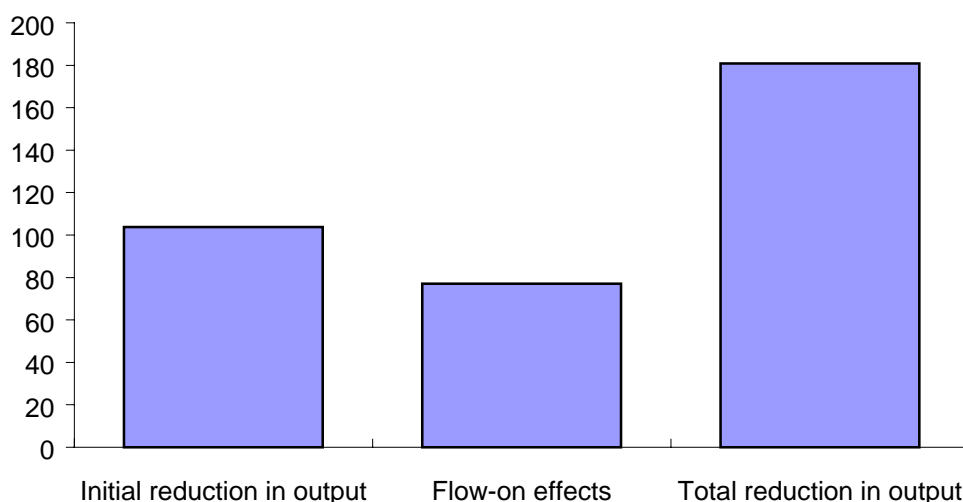


The magnitude and sign of this result was to be expected. First, a relatively small impact on the economy was expected, as the initial shock imposed on the model was equivalent to approximately 0.02 per cent of national output. A small initial impact on the economy generates small overall impacts.

A negative overall impact was also expected as previous work has established that higher fuel prices tend to reduce the competitiveness of the economy leading to reduced output. These effects can be seen to be operating in the macro-economic results given in Figure 8-1. The higher fuel prices increase the cost structure of the economy as indicated by a rise in the CPI. A higher cost structure reduces exports. In addition, as the competitiveness of the economy declines, wage rates adjust downwards in real terms to maintain employment levels. This drives down labour income, which is a major contributor to decreased consumption. With real consumption and exports falling, it is not surprising that GDP falls also (Figure 8-1).

The detrimental effects on national output of higher fuel prices can be seen when the total effect on national output of the decline in productivity is compared to the initial effect of the productivity decline (Figure 8-2).

**Figure 8-2: Impact on national output of a one per cent decline in the productivity of refinery operations (\$million, 1994–95 prices)**



The flow-on effects of the higher fuel prices are relatively strong (Figure 8-2) because they fall disproportionately on some of Australia's more efficient export industries. Thus, as shown in Table 8-1, some of Australia's major export-orientated industries are the most affected by the decline in productivity. As these industries are amongst Australia's most efficient industries, a decline in the output of these industries reduces economic efficiency adding to the initial effect of the decline in productivity.

**Table 8-1: Impact on the output of selected industries of a one per cent increase in ex-refinery fuel prices (percentage change)**

Sheep	-0.02
Grains	-0.01
Beef cattle	-0.02
Coal, oil & gas	0.04
Iron ore	-0.05
Petroleum & Coal Products	-0.09
Non-ferrous metal ores	-0.16
Other food products	-0.02
Basic non-ferrous metals & products	-0.01

Note that the coal, oil and gas industry expands output in the simulation (Table 8-1). In the model, coal is included along with oil and gas in the model industry coal, oil and gas.

In the simulation, the Petroleum Products Industry is assumed to initially require a small amount of additional crude oil to produce the same quantity of fuel to meet the new specifications. Thus, even though the output of the petroleum and Coal Products Industry falls by 0.09 per cent in the simulation (Table 8-1), the demand for crude oil is still higher because more crude oil is required per unit of output. Thus overall the demand for crude oil rises in the simulation and this is reflected in the Coal, oil and gas industry which expands output by 0.04 per cent.

#### **8.4 ESTIMATION OF THE IMPACT OF THE ESTIMATED FUEL PRICE INCREASES FOR EACH SCENARIO ON THE AUSTRALIAN ECONOMY**

Section 8.3 outlined the impact of a 1 per cent increase in fuel prices on the Australian economy. The following table summarises the impact of the estimated fuel price increase for each scenario (from Chapter 7) on the Australian economy, based on the information provided in Section 8.3. The base price for petrol was taken as 26c/L (the average price for petrol in November, 1999, based on information provided by the oil industry). The base ex-refinery price for diesel was taken as 25.5 c/L half a cent lower than the ex-refinery petrol price. This differential was assessed from based on the difference between terminal gate prices for unleaded petrol and diesel. Production cost increases were assessed for conditions anticipated for 2008 by which time significant change to fuel quality would be required under each of the scenarios (Scenarios 2 to 6) which depart from business as usual.

Fuel prices at the bowser is made up of cost contributions from crude price, refining costs, distribution costs, distributors margins and taxes. In 1999 federal excise on unleaded petrol and diesel was 43.485 c/L. Subsidies are provided by some states. The value of these subsidies ranges from nil for most of New South Wales and metropolitan South Australia to 8.2 c/L in Queensland. The assessment of economic impact is based on the change which would apply at the refinery gate prior to imposition of taxes. For the purposes of this work October 1999 prices are used as these were the latest available at the time of reporting.

**Table 8-2: Macro economic impact increased cost of fuel production (percentage change)**

Scenario	Percentage increase in ex-refinery price	Percentage Change					
		Real Consumption	Exports	GDP	Real current account	CPI	Real wages
2	3.6	-0.20	-0.07	-0.14	-0.17	0.06	-0.30
3	4.5	-0.26	-0.09	-0.17	-0.22	0.07	-0.37
4	4.9	-0.28	-0.10	-0.19	-0.23	0.08	-0.45
5	5.5	-0.31	-0.11	-0.21	-0.26	0.08	-0.45
6	5.8	-0.33	-0.12	-0.22	-0.28	0.09	-0.48

The economic impacts set out in Tables 8-2, 8-3 and 8-4 show significant effects on the Australian economy. The effects represent the change from the Scenario 1 outlook. The impacts were developed by extrapolation of the results of a simulation of a one percent increase in production cost compared with business as usual (Scenario 1).

**Table 8-3: Impact on national output of increased cost of fuel production (\$million, 1994–95 prices)**

Scenario	Percentage increase in ex-refinery price	Initial reduction in output	Flow on effects	Total reduction in output
2	3.6	373	278	651
3	4.5	467	347	814
4	4.9	508	378	886
5	5.5	571	424	994
6	5.8	602	447	1049

**Table 8-4: Impact on the output of selected industries to increased fuel production costs (percentage change)**

	<i>Model</i>	<i>Scenario</i>				
		<i>Scenario 2</i>	<i>Scenario 3</i>	<i>Scenario 4</i>	<i>Scenario 5</i>	<i>Scenario 6</i>
Percentage increase in fuel production cost	1.00	3.6	4.5	4.9	5.5	5.8
Sheep	-0.02	-0.06	-0.07	-0.08	-0.09	-0.10
Grains	-0.01	-0.03	-0.04	-0.04	-0.04	-0.05
Beef cattle	-0.02	-0.07	-0.08	-0.09	-0.10	-0.11
Coal, oil & gas	0.04	0.13	0.16	0.18	0.20	0.21
Iron ore	-0.05	-0.19	-0.23	-0.26	-0.29	-0.30
Petroleum & Coal Products	-0.09	-0.33	-0.42	-0.45	-0.51	-0.54
Non-ferrous metal ores	-0.16	-0.59	-0.73	-0.80	-0.90	-0.95
Other food products	-0.02	-0.06	-0.07	-0.08	-0.09	-0.09
Basic non-ferrous metals & products	-0.10	-0.35	-0.44	-0.48	-0.54	-0.57

## 8.5 CONCLUSIONS

A simple simulation has been undertaken to illustrate the effects of the costs of achieving higher fuel standards on the Australian economy. If higher fuel standards were to raise refining costs and these cost increases were passed on to industry and consumers, then it would be expected that these effects would reduce national output. This does not mean that higher fuel standards would necessarily be detrimental to the economy overall. This is because any benefits of higher fuel standards would need to be factored into the analysis before the net effects of higher fuel standards could be assessed.

The results presented here must be considered preliminary. They do not differentiate between petrol and diesel fuel rises. Nevertheless, the broad conclusion from the analysis, that higher fuel prices driven by the new fuel specifications would have a negative impact on the economy, will most likely stand if further refinements to the simulation were undertaken.

Further work could be undertaken to examine the economic implications of improving fuel standards in Australia. This could involve:

- Examination of the effects of higher standards for diesel and petroleum;
- More in depth specification and modelling of the cost implications for refineries of the higher fuel standards; and
- Incorporation of the benefits of higher fuel standards into the analysis.

If these refinements were undertaken a comprehensive analysis could be undertaken of the net benefits to the Australian economy of introducing higher fuel standards in Australia.

## **Attachment 8-A: Overview of the STATE Model**

STATE is a multi-region, multi-sector, and computable general equilibrium model of the Australian economy. It has been designed as a tool for exploring the macroeconomic and sectoral impact of economic policies and development projects. A model simulation provides estimates of the impact of policy change or a project on a range of economic variables including industry output and price, employment and investment, trade flows, government revenue and expenditure, gross regional product and regional income.

The STATE model used in this analysis identifies Australia and a composite Rest of the World. Australia has a fully modelled economic structure while a simpler structure is employed to explain the Rest of the World. The latter is treated as a very large trading block providing a source of demand for Australian exports and a source of imports.

The model consists of numerous equations that explain the behaviour of consumers, firms and governments. In brief —

- Australia comprises various producers and a single representative household. Producers combine factors (ie. labour, capital and land) with material inputs, pay taxes and a miscellaneous other cost item. Material inputs can be produced within the region or imported from one of the two other regions.
- Both the revenues and expenditures of a composite government sector are described, leading to the calculation of the budget balance.
- Australia imports from and exports to the Rest of the World based on the relative prices and the level of demand. Producers, the representative household and the government can choose between domestically produced or imported goods.
- A number of ‘final’ demands are identified. They comprise household demands, government demands, demand for investment purposes and demand for exports. The representative household in Australia allocates disposable income between savings and consumption and chooses among goods and services based on preferences and relative prices.
- The model allows for changes in the economy-wide level of investment and industry specific investment. For most industries the level of investment is determined by profitability. Investment can be funded by householders, government or the Rest of the World.
- Other macro-economic variables are also defined by aggregating industry and household activities. Changes to the capital stock and the level of gross and net liabilities to other regions are defined by a simple dynamic structure. Rental payments to and from each fully modelled region are also identified based on domestic and overseas rates of return and the level of savings flowing into and out of a region. Gross regional product, regional income, and each region's current/capital account balance are identified.

The version of the STATE model used in this analysis identifies 109 industries. The industries comprise: 8 agricultural industries, 7 resource-based industries, 58 manufacturing industries, separate electricity, gas and water industries, 5 transport industries, 2 construction industries and 26 service industries (see Table A1). Each industry produces one commodity, so the industry classification matches the commodity classification.

The model's database relates to the year 1994-95. The core of the database is developed from input-output tables prepared by the Australian Bureau of Statistics. These tables provide data on industry sales and costs for 107 industries. They explain the use of factors and raw materials by each industry and the level of sales by each industry to (as relevant) other industries, consumers, governments, other regions and for use in investment. The database used in this version of the STATE model also identifies two specially created industries that explain the Defence Force's frigate project.

The model's database includes a series of parameters that help explain the responsiveness of industries, households, etc to changes in economic conditions. Most of the parameters are drawn from the database of the ORANI general equilibrium model of the Australian economy.

Further information on the structure of the STATE model is available in Economic Insights and Tasman Asia Pacific (1998).<sup>1</sup>

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<sup>1</sup> Economic Insights and Tasman Asia Pacific, 1998, *Queensland Dairy Industry Act 1993: Public Benefit Test of Restrictions on Competition*, Final Report Prepared for the Queensland Dairy Legislation Review Committee, May

**Table A1: Industries/commodities of the STATE Model**

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1 Sheep	56 Structural metal products
2 Grains	57 Sheet metal products
3 Beef cattle	58 Fabricated metal products
4 Dairy cattle	59 Motor vehicles and parts; other transport equipment
5 Pigs	60 Ships and boats
6 Poultry	61 Railway equipment
7 Other agriculture	62 Aircraft
8 Services to agriculture; hunting and trapping	63 Photographic and scientific equipment
9 Forestry and logging	64 Electronic equipment
10 Commercial fishing	65 Household appliances
11 Coal; oil and gas	66 Other electrical equipment
12 Iron ores	67 Agricultural mining and c
13 Non-ferrous metal ores	68 Other machinery and equipment
14 Other mining	69 Prefabricated buildings
15 Services to mining	70 Furniture
16 Meat and meat products	71 Other manufacturing
17 Dairy products	72 Electricity supply
18 Fruit and vegetable products	73 Gas supply
19 Oils and fats	74 Water supply; sewerage and drainage services
20 Flour mill products and cereal foods	75 Residential building
21 Bakery products	76 Other construction
22 Confectionery	77 Wholesale trade
23 Other food products	78 Retail trade
24 Soft drinks cordials and syrups	79 Mechanical repairs
25 Beer and malt	80 Other repairs
26 Wine and spirits	81 Accommodation cafes and restaurants
27 Tobacco products	82 Road transport
28 Textile fibres yarns and woven fabrics	83 Rail pipeline and other transport
29 Textile products	84 Water transport
30 Knitting mill products	85 Air and space transport
31 Clothing	86 Services to transport; storage
32 Footwear	87 Communication services
33 Leather and leather products	88 Banking
34 Sawmill products	89 Non-bank finance
35 Other wood products	90 Financial asset investors
36 Pulp paper and paperboard	91 Insurance
37 Paper containers and products	92 Services to finance investment and insurance
38 Printing and services to printing	93 Ownership of dwellings
39 Publishing; recorded media and publishing	94 Other property services
40 Petroleum and coal products	95 Scientific research technical and computer services
41 Basic chemicals	96 Legal accounting marketing and business management services
42 Paints	97 Other business services
43 Medicinal and pharmaceutical products pesticides	98 Government administration
44 Soap and other detergents	99 Defence
45 Cosmetics and toiletry preparations	100 Education
46 Other chemical products	101 Health services
47 Rubber products	102 Community services
48 Plastic products	103 Motion picture radio and television services
49 Glass and glass products	104 Libraries museums and the arts
50 Ceramic products	105 Sport gambling and recreational services
51 Cement lime and concrete slurry	106 Personal services
52 Plaster and other concrete products	107 Other services
53 Other non-metallic mineral products	108 ASF Sub contractors
54 Iron and steel	109 ASF Ship building
55 Basic non-ferrous metal and products	

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## **A1. The Economic Environment**

This section discusses the economic environment typically used in operating the STATE model.

Economists argue that the response of an economy to a shock will change over time, with the short run response normally distinguished from the long run response. In the short run there is unemployed labour that can be readily absorbed by economic expansion, but otherwise the economy is fairly rigid. In the long run resources can readily flow among industries and this leads to a more flexible economy.

For this analysis the construction phase is represented by the combination of a short and long run simulation. The short run is normally thought of as lasting one year while the long run is normally thought of as a ten-year period.

The main reason the short run is characterised by a high degree of rigidity in the economy is that industry capital stocks are fixed. This places tight constraints on producer behaviour because changes in output are only possible by changing the level of labour employed. Land is allowed to transfer among the agricultural industries in response to changes in activity and relative factor prices. The model assumes that initially the aggregate labour supply is greater than labour demand (ie. there is unemployment) and the resulting pool of labour can be readily hired at a given wage rate. Only one type of labour is identified in the model, and it is implicitly assumed that labour can readily move to any industry (ie. labour always has the right skills). Wages are either indexed to the consumer price index such that real wages are fixed or the nominal wage is fixed. Given this set-up of the labour market, the rate of unemployment adjusts to reflect movements in the demand for labour.

The normal short run simulation assumes that the household's ratio of income to savings/consumption is fixed. Tax rates are also normally held fixed such that changes can emerge in government deficits and hence the level of government saving. Any change in total regional savings must be offset by a change in net capital inflow. This leads to changes in the capital account and compensating adjustments to the current account (ie. to aggregate exports, imports and/or rental flows).

The long run economic environment is characterised by a higher degree of factor mobility, mainly because industry capital stocks respond to changes in profitability. The standard assumption is that each industry's use of capital adjusts to maintain the original rates of return. That is, an improvement in the rate of return on capital leads to an increase in investment until the rate of return is returned to its original level and vice versa. As for the short run, land moves freely among the agricultural industries.

Like capital and land, labour is freely mobile across industries. We make the standard assumption that wages adjust to 'clear' the labour market, or in other words to ensure a constant level of frictional unemployment. The assumption is important because it means that any change in the demand for labour is reflected in the wage rate and not the aggregate usage of labour (and consequently the unemployment rate). The assumption reflects the view that in Australia the long-run unemployment

rate is not determined by the level of economic activity but by structural features of the economy such as the industrial relations system, the behaviour of unions and the effect of the social security system on the incentive to work.

The standard long-run environment assumes that the government sector maintains transfers to households as a fixed proportion of gross regional income. The budget deficit is also fixed as a fraction of gross regional income so as to ensure a stable level of government debt. Under such an environment, tax rates are altered to meet the budget deficit constraint. A wide range of tax rates can be used to ensure the budget balance. The available taxes include an income tax (levied on labour only) and taxes designed to replicate payroll taxes, stamp duties and property taxes, diesel, petrol and fuel taxes, the financial institutions duty, and alcohol and tobacco taxes. For this analysis, the income tax rate is allowed to vary to ensure budget balance.

The other important features of the long run relate to the determination of savings and the funding of investment. The household average propensity to save (which defines the change in savings as income changes) is held fixed in the standard environment and net capital inflow is left free to adjust to any local savings-investment gap.

In this analysis the standard long run environment is used. A short-run simulation was not prepared.