IPART
New South Wales

Independent Pricing and Regulatory Tribunal

Review of a maximum price for wholesale ethanol in automotive fuel blends

Other — Issues Paper
June 2016

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Invitation for submissions

IPART invites written comment on this document and encourages all interested parties to provide submissions addressing the matters discussed.

Submissions are due by 18 July 2016.

We would prefer to receive them electronically via our online submission form www.ipart.nsw.gov.au/Home/Consumer_Information/Lodge_a_submission.

You can also send comments by mail to:

Investigation of maximum price for wholesale ethanol
Independent Pricing and Regulatory Tribunal
PO Box K35
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Late submissions may not be accepted at the discretion of the Tribunal. Our normal practice is to make submissions publicly available on our website <www.ipart.nsw.gov.au> as soon as possible after the closing date for submissions. If you wish to view copies of submissions but do not have access to the website, you can make alternative arrangements by telephoning one of the staff members listed on the previous page.

We may choose not to publish a submission—for example, if it contains confidential or commercially sensitive information. If your submission contains information that you do not wish to be publicly disclosed, please indicate this clearly at the time of making the submission. IPART will then make every effort to protect that information, but it could be disclosed under the *Government Information (Public Access) Act 2009* (NSW) or the *Independent Pricing and Regulatory Tribunal Act 1992* (NSW), or where otherwise required by law.

If you would like further information on making a submission, IPART's submission policy is available on our website.

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1 Introduction

The Independent Pricing and Regulatory Tribunal of NSW (IPART) is reviewing the price of wholesale ethanol for use in automotive fuel blends. This paper explains the review, outlines how we propose to approach it and the issues we will consider, and seeks stakeholder comments.

1.1 Why are we conducting this review?

Since 2011, major fuel sellers have been required by the *Biofuels Act 2007* (NSW) (the Act) to ensure that ethanol accounts for at least 6% of the total volume of petrol they sell per quarter. However, this 6% ethanol mandate has not been met. Ethanol sold as a proportion of petrol sold has declined in recent years and is currently around 3%.[1]

In December 2015, the NSW Government announced a range of measures to improve the state's performance against the ethanol mandate. These include amending the Act to extend the ethanol mandate to a wider range of fuel retailers and to provide for IPART to determine the maximum price of wholesale ethanol. The amendments also provide for IPART to monitor the retail market for petrol-ethanol blended fuel.[2]

1.2 What have we been asked to do?

While the provisions related to IPART's role have not yet come into effect, the Premier has asked us to investigate and report on a maximum price for wholesale ethanol by the end of 2016.[3] The terms of reference for this investigation ask us to recommend:

- a maximum price for wholesale ethanol for use in automotive fuel blends, and/or

1 NSW Fair Trading, *Biofuels marketplace data – Progress charts*, Available from: http://www.fairtrading.nsw.gov.au/ftw/Businesses/Specific_industries_and_businesses/Biofuels_industry/Biofuels_marketplace_data.page, Accessed 10 June 2016.

2 We will consult separately on IPART's function to monitor the retail market for petrol-ethanol blended fuels once this section of the Act commences.

3 We also note that Part 6 section 7 of the Act states that if the Minister has asked IPART to report on the wholesale price of ethanol and IPART has made such a report, the price set out in the report is to be taken as a price determined under section 17A (1) (a) of the Act.

- a price methodology that ethanol suppliers must apply to determine a maximum price when selling wholesale ethanol for the purposes of complying with the Act and regulation.

In deciding the maximum price and/or price methodology, the terms of reference require us to review prices in the biofuels industry and have regard to:

- protecting consumers from potential abuses in monopoly power relating to prices
- the efficient costs of supplying ethanol, and
- any other matters we consider relevant.

Recent amendments to the Act also require IPART to,

> …consider the price at which ethanol would need to be sold by wholesale for use in the production of petrol-ethanol blend for the wholesale market for ethanol and petrol-ethanol blend and the retail market for petrol-ethanol blend to be economically viable.[4]

For the full Terms of Reference, see Appendix A.

1.3 How can stakeholders provide input to the review?

For this review, we will conduct a public consultation process and our own research and analysis. We will also consult individually with key stakeholders such as ethanol producers, petrol companies, industry bodies and government agencies.

This Issues Paper is the first step in our public consultation. We invite all interested stakeholders to make submissions in response to the paper by 18 July 2016. Details on how to make a submission is provided on page iii at the front of the paper.

We will also release a Draft Report that outlines our draft recommendations and the analysis that supports them, and invites further submissions. We will consider all submissions in making our final recommendations to the Premier in December 2016.

Table 1.1 provides an indicative timetable for the review. We will update this timetable on our website as the review progresses.

4 *Biofuels Amendment Act 2016*, Schedule 2, section 17A (2) (b).

Table 1.1 Indicative timetable for this review

Milestone	Indicative date
Issues Paper released	20 June 2016
Submissions on this paper due	18 July 2016
Draft Report released	September 2016
Submissions on this report due	October 2016
Final Report released	December 2016

1.4 How is this paper structured?

The rest of this Issues Paper provides more information on the review and our proposed analytical approach, and the key issues we will need to consider:

- Chapter 2 provides contextual information, including the Government's policy objectives for the regulation of wholesale ethanol, and the market for ethanol.
- Chapter 3 outlines our proposed approach for making our recommendations.
- Chapters 4 to 7 sets out the range of options we have identified for setting a maximum wholesale price of ethanol.

1.5 List of issues for stakeholder comment

Throughout this paper, we have identified the issues on which we particularly seek stakeholder comment. Stakeholders may address all or some of these issues, and are also free to raise and discuss any other issues relevant to the terms of reference. For convenience, a full list of the issues we seek comment on is provided below:

1 Do you agree with our proposed approach to the review? Are there any alternative approaches that would better meet the terms of reference, or any other issues we should consider? 18

2 Should we set the price at the 'factory gate' of the ethanol production facility or the fuel wholesaler's terminal? 18

3 How do the costs of producing ethanol vary with different types of feedstocks? What type of feedstock should we use and are these different for different levels of demand? Should we base our cost estimates on a new entrant's costs or an existing facility? How significant is revenue from by-products to the net costs of production? 25

4 How much ethanol can be produced from waste starch? Would the production of starch occur in the same quantities without a market for ethanol? 25

2 Context for the review

In making recommendations on the maximum price for wholesale ethanol, we need to consider the Government's objectives for the measures in the *Biofuels Amendment Act 2016* including the introduction of wholesale price regulation. We also need to take account of the market for ethanol, including the factors that influence supply and demand.

2.1 Government objectives for *Biofuel Amendment Act 2016*

The terms of reference for this review indicate that the Government's main objective for the measures in the *Biofuel Amendment Act 2016* is to improve the state's performance against the ethanol mandate. As Chapter 1 noted, while the mandate aims to ensure that ethanol accounts for at least 6% of the total volume of petrol sold in NSW, it currently accounts for about 3%.[5]

The terms of reference and the readings of the *Biofuels Amendment Bill 2016* also suggest that other objectives are to:

- help ensure ethanol-petrol blends are available at petrol stations at an attractive price to customers,
- promote competitive wholesale pricing that reflects the efficient costs of producing ethanol, and
- protect consumers from potential abuses of monopoly power.

2.2 The market for ethanol

The current market for ethanol in Australia is very small – it accounts for about 1% of total transport fuels nationwide, most of which is sold in NSW.[6] Ethanol is mostly sold as E10, which is regular unleaded petrol containing up to 10% ethanol.

5 NSW Fair Trading, Biofuels marketplace data – Progress charts, Available from: http://www.fairtrading.nsw.gov.au/ftw/Businesses/Specific_industries_and_businesses/Biofuels_industry/Biofuels_marketplace_data.page. Accessed 10 June 2016.

6 ACCC, *Report on the Australian petroleum market – December quarter 2015*, February 2016, Chart 5.1 and Table 5.1, pp 20-21.

2.2.1 Supply of ethanol

Three Australian firms currently produce fuel-grade ethanol:

- Manildra Group (Nowra, NSW), which primarily uses wheat (waste starch)
- Wilmar Sugar (Sarina, Queensland), which uses molasses, and
- Dalby Bio-refinery (Dalby, Queensland), which uses sorghum and other grain.

Manildra Group is the largest producer with capacity of 300 ML a year. In 2014-15, it is likely to have produced the majority of the approximately 170 ML of ethanol consumed in NSW. It is capable of producing about 67% of Australia's total production capacity of 450 ML. [7]

Several factors influence the supply of ethanol in Australia. One is Australian Government subsidies, which are a major driver of ethanol production. Others include the price of the feedstock used in production and the price of petrol.

Australian government subsidies

The production of fuel-grade ethanol in Australia has been influenced by the Australian Government's Ethanol Production Grants (EPG) program, which was established in 2002.[8] This subsidy program effectively exempted ethanol producers from paying fuel excises and duties. It increased the price they received per ML of ethanol by around 70% relative to what they would have received without the subsidy.[9]

The Australian Government closed the EPG program in June 2015, and replaced it with an equivalent subsidy, as well as a schedule to reduce this subsidy each year until 2020. By this time, the subsidy will be equal to slightly more than 50% of the energy equivalent fuel excise for ethanol.[10]

This reduction in the subsidy will potentially affect future levels of supply. Even with a higher fuel excise subsidy, current ethanol production is significantly lower than producers' full capacity.

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7 IPART, *Ethanol mandate: Options to increase the uptake of ethanol blended fuel - Final Report*; May 2015, p 23.

8 Australian National Audit Office, *The Ethanol Production Grants Program*, 2015, p 11.

9 Based on BREE 2014, *An assessment of key costs and benefits associated with the Ethanol Production Grants Program,* February, p 11.

10 The energy content of ethanol is 68% of that of petrol, and ethanol producers would pay 32.5% of the excise applicable to petrol.

The price and availability of feedstock

In Australia the cost of ethanol production is heavily dependent on the cost of the feedstock used (eg, wheat, molasses or sorghum). Feedstock generally accounts for around 75% of total production costs.[11] The remaining costs are capital (which account for around 15%) and other inputs and labour (around 10%).[12]

As feedstock used to produce ethanol can also be used for human food consumption, ethanol producers compete with food manufacturers for feedstock. The market price of feedstock varies with the supply and demand, including factors that affect their availability, such as drought.[13]

Some ethanol production facilities can use quite low-cost waste or residual material such as waste from starch production as feedstock. Waste starch is a by-product of producing higher quality starch for food processing and other activities. As part of this review, we will seek to analyse the extent to which the supply of this low-cost material is available. In 2003, the Sustainable Energy Development Authority of New South Wales (SEDA) was cited as noting that all financially viable waste starch residues in New South Wales are already being utilised to produce around 55 to 60 ML of ethanol a year.[14] We also note that the extent to which starch production would be viable without the production of ethanol as a co-product is not clear. Starch production uses wheat or flour as an input and is thus also in global competition for its inputs.

Increases in the price of feedstock, and in some instances its limited availability, can act as a constraint on the supply of ethanol as they reduce the economic viability of producing ethanol.

Price of unleaded petrol

The energy content of ethanol is 68% that of unleaded petrol. For E10, which has 10% ethanol, the implied energy content is therefore 96.8% of unleaded petrol. This means that end customers of E10 are generally unwilling to pay more than 96.8% of the unleaded petrol price, regardless of production costs. If the price of petrol falls, as it has since 2013, the economic viability of production of ethanol falls. Thus, the price of petrol also acts as a constraint on the demand for ethanol, thereby impacting on the viability of supply.[15]

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11 Except when low cost waste material is used as the feedstock. For more information see Chapter 4.

12 See Chapter 4 for further details.

13 ABARES, *Agricultural commodities: March quarter 2016,* Table 10, p 211.

14 As reported in ABARE 2003, *Appropriateness of a 350 million litre biofuels target,* p 51.

15 IPART, *Ethanol mandate: Options to increase the uptake of ethanol blended fuel - Final Report,* May 2015, p 100.

2.2.2 Demand for ethanol

As an alternative motor vehicle fuel, ethanol has some advantages over unleaded petrol. Adding ethanol of 10% to regular unleaded petrol (RULP) produces fuel with a Research Octane Number (RON) of around 94 to 95 compared to a minimum RON of 91 for RULP. It also increases the Motor Octane Number (MON) to about 83 to 84 compared to a MON of 81 for RULP (see Box 2.1). However, it has lower energy content than unleaded petrol.

Ethanol is a renewable biofuel, and its use may also provide external benefits such as reduced greenhouse gas emissions and better health outcomes through lower air pollution.[16]

Box 2.1 Australian fuel standards for petrol products

The differentiating parameters between premium and regular grade petrol under the Australian fuel standards are:

- Research Octane Number (RON) and Motor Octane Number (MON) measure a fuel's resistance to auto-ignition, which can cause engine knock and a loss of fuel economy. The RON measures the fuel at low engine speeds, while the MON measures the fuel under load and at higher engine speeds.
- Sulphur content occurs naturally in crude oil and if not removed in the refining process it will contaminate refined fuel. Sulphur has a large impact on vehicle emissions because it forms toxic gases on combustion in the engine and affects the efficiency of vehicles' catalytic converters.

Specifically under the Australian fuel standards:

- PULP: minimum RON of 95, MON of 85, and sulphur content of no more than 50 parts per million (ppm).
- RULP: minimum RON of 91, MON of 81, sulphur of 150 ppm.

Adding ethanol of about 10% to RULP to create E10 produces fuel with RON of about 94 to 95 and MON of about 83 to 84. That is, adding ethanol to petrol affects RON more than it does MON. E10 does not meet the Australian fuel standards for PULP, given its lower MON rating. E10 blended in NSW may sometimes have sulphur levels below 50ppm due to the quality of petrol obtained overseas and imported into NSW, but a sulphur level below 50ppm is not guaranteed.

Source: ACCC, *Monitoring of the Australian petroleum industry*, December 2014, p 96; Fuel Standard (Petrol) Determination 2001, pp 3-4.

16 Bureau of Resource and Energy Economics (BREE), *An assessment of key costs and benefits associated with the Ethanol Production Grants program – Report for the Department of Industry*, February 2014, pp 14-19.

In light of this, the main factors that drive demand for ethanol are government intervention in the market (ie, the 6% ethanol mandate in NSW), the price of ethanol blends relative to unleaded petrol, and customer preferences.

Ethanol mandate

Governments around the world have intervened to promote the production and use of ethanol. As Chapter 1 discussed, in NSW the *Biofuels Act 2007* and recent amendments require all large fuel retailers to ensure the volume of ethanol they sell[17] is not less than 6% of the total volume of all petrol they sell in NSW over each quarter.[18] This ethanol mandate is clearly a major driver of ethanol demand. As Table 2.1 shows, the consumption of ethanol in NSW is much higher than in states where there is no ethanol mandate.

Table 2.1 Composition of petrol sales across Australia, December quarter 2015

	NSW	VIC	QLD	Australia
Premium unleaded petrol	44%	24%	26%	31%
Regular unleaded petrol	31%	74%	64%	59%
Ethanol-blend petrol (E10)	26%	2%	10%	10%

Note: Numbers may not add to 100% due to rounding. Premium unleaded covers 95 & 98 Octane.
Source: ACCC 2016, *Report on the Australian petroleum market — December quarter 2015*, pp 20-21.

Price of ethanol and customer preferences

While the overall demand for motor vehicle fuels tends to be relatively inelastic, the demand for ethanol is likely to be highly sensitive to price.[19] This is because unleaded petrol and E10 are close substitutes. Unless consumers see value for money in their purchase of E10, they don't need to buy it. In our 2015 review, we allowed for an own-price elasticity of E10 of -2 to -5 in our cost-benefit analysis. That is, a 1% decrease in the price of E10 would lead to a 2% to 5% increase in demand for E10.

In addition, motorists may prefer not to use ethanol. For example, there is evidence many choose to use more expensive premium unleaded petrol (+$0.15 per litre) over ethanol-blended fuel when regular unleaded is not available.[20]

17 As ethanol blended petrol.

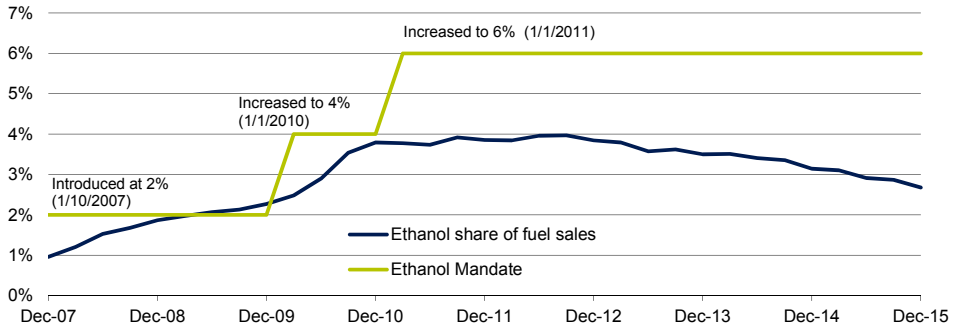
18 *Biofuels Act 2007*, section 6(1) and (2).

19 The price elasticity of demand measures how much quantity changes for a given percentage change in price. For example, an elasticity of -2 would imply that a 10% increase in price would lead to a 20% reduction in quantity demanded.

20 ACCC, *Report on the Australian petroleum market – December quarter 2015*; 2016, p 23, Noel, M. & T. Roach, *Regulated and Unregulated Almost-Perfect Substitutes: Aversion effects from a Selective Ethanol Mandate*, 26 September 2014, Department of Economics (Texas Tech University).

Technically, about 85% of the registered vehicles in NSW can use ethanol blended fuels.[21] If 75% of these vehicles used E10, the 6% ethanol mandate would be met. However, as Figure 2.1 shows, demand has been falling. Demand for ethanol in 2014-15 was only about 3% of total petrol sales.

Figure 2.1 Demand for ethanol as a proportion of total petrol sales by volume fuel sellers in NSW



Data source: IPART 2015, *Ethanol mandate: Options to increase the uptake of ethanol blended fuel - Final Report , p 27* and NSW Office of Biofuels, Market place data, Available from http://www.fairtrading.nsw.gov.au/ftw/Businesses/Specific_industries_and_businesses/Biofuels_industry.page,

[21] IPART, *Ethanol mandate – options to increase the uptake of ethanol blended petrol – Final Report*, May 2015, p 28.

3 Our proposed approach

We have developed a proposed approach for this review that ensures we have regard to all matters specified in our terms of reference (see section 1.2), and take account of the contextual issues discussed in Chapter 2.

The sections below provide an overview of this approach, and outline each of the main steps.

3.1 Overview of our proposed approach

Our proposed approach involves five main steps:

1. Analyse the market for ethanol, particularly the impacts of and the relationship between the maximum wholesale price and the supply and demand for ethanol.
2. Identify the possible methods for calculating the maximum wholesale price, and apply them to develop a range of possible maximum prices.
3. Assess these methods by considering:
   a) the resulting prices and likely impacts on supply and demand
   b) the consistency of these outcomes with the Government's policy objectives for the *Biofuels Amendment Act 2016* and the terms of reference for this review.
4. Decide whether the price should be calculated at the wholesale terminal or the factory gate.
5. Make our recommendation on the maximum price or pricing methodology for wholesale ethanol.

3.2 Analysing the market for ethanol and likely impacts of a maximum price on supply and demand

In the first step of our approach, we will consider the market for ethanol in NSW and Australia and how a maximum wholesale price is likely to affect the outcomes of this market. In general, the market comprises:

- the costs of supply for ethanol (which can be expected to increase as the quantity required increases, as more expensive sources of supply are made available), and
- the demand for ethanol (which can be expected to decrease as the wholesale price increases).

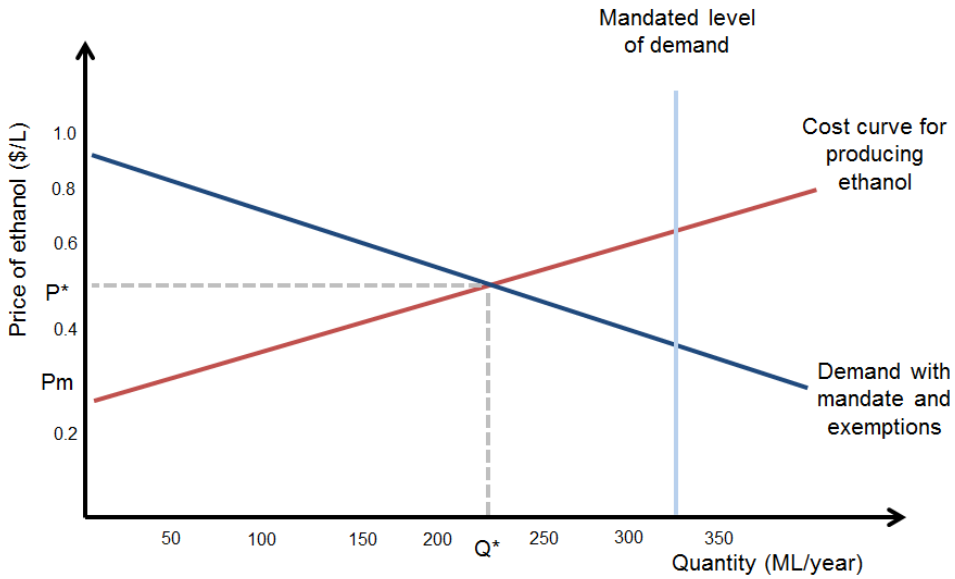
As Chapter 2 discussed, supply and demand for ethanol are affected by:

- the Australian Government's excise subsidy, which acts to reduce the cost of locally produced ethanol, and
- the NSW Government's biofuels policies (including the 6% ethanol mandate), that act to increase ethanol demand relative to what it would otherwise have been.

In addition, the fuel excise applies to ethanol imports, making this source of supply more expensive.

Figure 3.1 sets out a hypothetical framework for the market for ethanol. The outcome in this market is for the supply of ethanol somewhere less than or equal to Q*, with a price greater than or equal to P*. At any point to the right of this, the efficient costs of supplying ethanol would be greater than customers are willing to pay, even under the arrangements where demand is increased by the mandate.

Figure 3.1 Hypothetical framework for the market for ethanol



Note: Some part of the cost curve is likely to be low cost reflecting the lower cost of producing ethanol using waste starch, with a higher cost once this is fully utilised. Numbers shown are for illustrative purposes only.

We note that the mandate does not guarantee ethanol demand at the mandated level. The current market conditions (including current unleaded petrol prices) suggest that the outcome would likely be less ethanol supplied and less consumed than the 6% level.

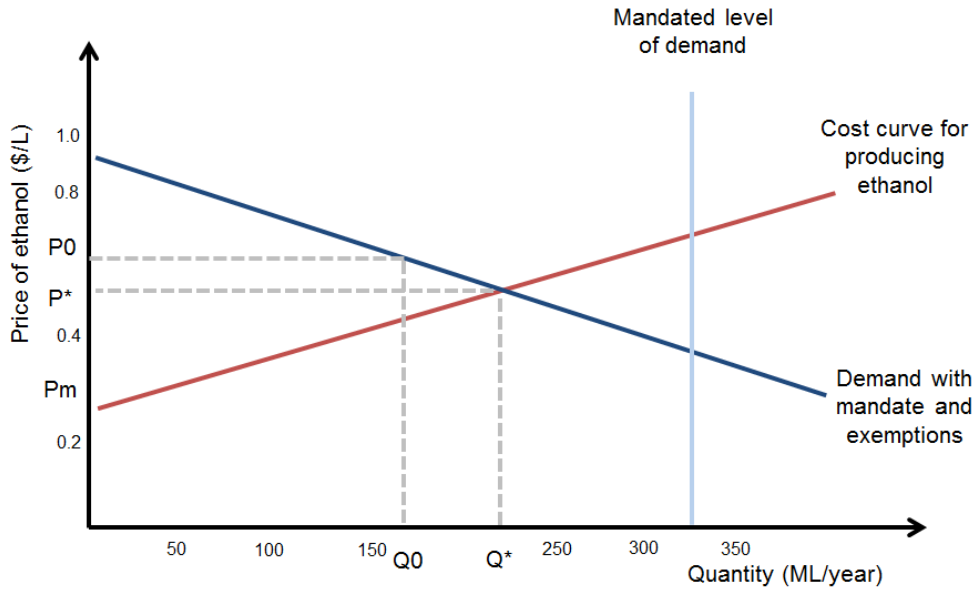
In addition, the demand and supply of ethanol are not constant:

- Demand for ethanol will shift right as unleaded petrol prices increase. This would increase the quantity and price at which ethanol could viably be sold.
- Supply of ethanol will shift up if there are increases in feedstock prices used to produce ethanol. This would increase the price but reduce the quantity at which ethanol could viably be sold.

Within this framework, setting a maximum wholesale ethanol price could have a number of outcomes (Figure 3.2). Suppose the current market price is P0 delivering a quantity of Q0 then:

- a maximum price of P* would reduce the price paid and increase consumption and production of ethanol
- a maximum price above the market price P0 would have no impact on the market
- a maximum price below P* would lead to less supply than Q*, and if the regulated price was sufficiently lower, could lead to a reduction in supply compared to Q0.

Figure 3.2 Impacts of setting a maximum price



Note: Some part of the cost curve is likely to be low cost reflecting the lower cost of producing ethanol using waste starch, with a higher cost once this is fully utilised. Numbers shown are for illustrative purposes only.

As part of our first step, we will need to consider the level of competition in the supply of ethanol, the efficiency of ethanol producers' costs and the extent to which ethanol producers can consistently receive wholesale prices above their costs of production. That is the extent to which the producers could be able to use market power, in conjunction with the mandate, to reduce the quantity of supply to increase the price per ML of ethanol. It might be the case that producers are not able to use market power to restrict supply in this market.

We will also need to consider how the price we set interacts with exemptions for fuel sellers from meeting the mandate. Fuel sellers are exempt from meeting the mandate if the wholesale price of ethanol for use in the production of petrol-ethanol blend exceeded the reasonable wholesale price determined by IPART.

3.3 Identify possible methods for calculating the maximum wholesale price

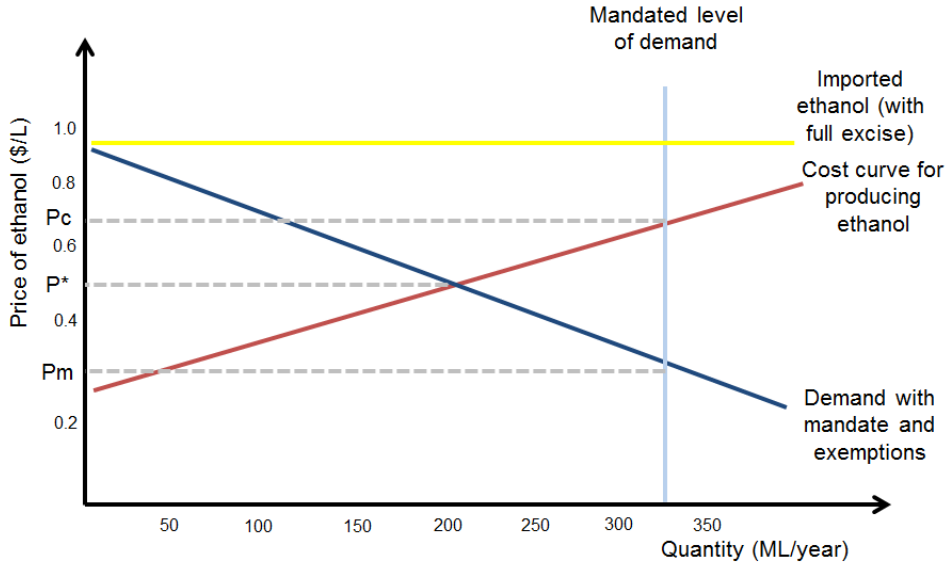
In the second step of our approach, we will identify the possible methods for setting the maximum price of wholesale ethanol. Our preliminary view on the possible methods is set out in Figures 3.3 and 3.4. These methods include:

1. Calculating the price based on the efficient cost of producing ethanol (the red supply curve shown in Figure 3.3) including the cost of producing enough ethanol to meet the mandate (Pc, in Figure 3.3).

2. Calculating the price based on the willingness to pay for ethanol (the blue demand curve shown in Figure 3.3), including the price likely to induce enough demand to meet the ethanol mandate (Pm, in Figure 3.3)
3. Calculating the price to encourage an economically efficient level of production and use of ethanol (Pe in Figure 3.4). The economically efficient level of production reflects the social costs of ethanol, which are likely to be higher than the supply curve because of the excise subsidy for domestically produced ethanol compared to unleaded petrol, offset in part by the external benefits of E10 compared to unleaded petrol (as is drawn in Figure 3.4).
4. Estimating the price based on international ethanol prices (the yellow curve shown in Figure 3.3).

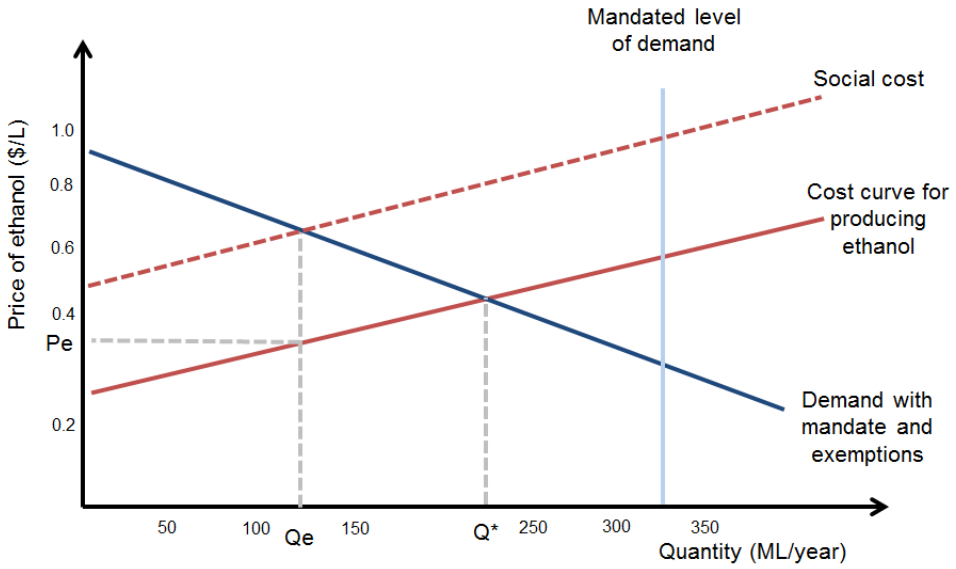
We will then apply each of these methods to calculate a range of possible maximum prices. Chapters 4 to 7 discuss our proposed approach for each method.

Figure 3.3 Methods for setting prices



Note: Some part of the cost curve is likely to be low cost reflecting the lower cost of producing ethanol using waste starch, with a higher cost once this is fully utilised. Numbers shown are for illustrative purposes only.

Figure 3.4 Setting a price to achieve economically efficient production



Note: Some part of the cost curve is likely to be low cost reflecting the lower cost of producing ethanol using waste starch, with a higher cost once this is fully utilised. Numbers shown are for illustrative purposes only.

3.4 Assess methods and set a price or price methodology

Once we have identified the possible methods and calculated the possible maximum prices for ethanol, we will assess them to select the most suitable one. This assessment will take into account:

- The NSW market for ethanol and how the maximum wholesale price resulting from each method is likely to affect the supply and demand outcomes (considered in Step 1).
- The consistency of these likely outcomes with the Government's policy objectives for the *Biofuels Amendment Act 2016*, and the terms of reference for this review. As section 2.1 discussed, these objectives include:
  - improving the state's performance against the 6% ethanol mandate
  - helping to ensure E10 is available at petrol stations at an attractive price to customers
  - promoting competitive wholesale pricing that reflects the efficient costs of producing ethanol, and
  - protecting customers from potential abuses of monopoly power.

It is likely that no one method will perform best against all of these objectives. In addition, each method will have different impacts on supply and demand for ethanol. These impacts depend on how each option changes the price of wholesale ethanol and the market's response to this price change.

These methods are likely to provide boundaries within which the maximum regulated price should lie. We will consider these boundaries and seek to set a price that strikes the best balance between the objectives.

For example, the minimum price that producers would be willing to sell ethanol would be the price that covers the efficient costs of production – method 1. The main factors that are likely to affect this price are the cost of feedstock and revenue from other by-products. If the cost of feedstocks increases or revenue from by-products decreases, then the minimum price would increase.

However, the maximum price that wholesalers would be willing to pay would reflect oil and wholesale petrol prices plus excise, the consumer preference differences between E10 and unleaded petrol and the cost of bringing E10 to market – method 2. If oil and unleaded petrol prices increase, the maximum price of ethanol would increase. However, if oil and petrol prices decrease, the maximum price of ethanol would decrease and may potentially be below the costs of production. Similarly, if consumer preferences mean that the necessary differential between E10 and unleaded petrol is sufficiently high, the maximum price of ethanol could also be below the costs of production. In this case, without further government subsidies, supply of ethanol may be limited and the mandate would not be achieved.

In making our recommendations, we will also need to take into account the inputs required for each method (such as the price of unleaded petrol and the cost of feedstocks), the extent to which the inputs can be estimated with certainty, and the risk associated with estimation error.

3.5 Decide whether the price or price methodology should be calculated at the wholesale terminal or the factory gate

Whichever method we select for calculating the maximum wholesale price for ethanol, we will need to define the location at which the price or price methodology is set. Possible options could include:

- the 'factory gate' of the ethanol production facility, or
- the fuel wholesaler's terminal.

The difference between these options is the transport cost of moving ethanol from the ethanol production facility to the fuel wholesaler's terminal.

The transport costs could differ depending on the particular ethanol production facility and the fuel wholesaler's terminal. For example, transport costs would be smaller from Manildra's terminal in the Shoalhaven to Sydney, than from Queensland ethanol producers' facilities to Sydney.

3.6 Make our recommendation on the maximum wholesale price or pricing methodology

The final step in our proposed approach is to make our recommendations based on the findings from the first four steps and having regard to other matters in our terms of reference. Our preliminary view is that we will recommend a pricing methodology, rather than a single price, because an appropriate price will vary considerably depending on market conditions.

IPART seeks comments on the following

1 Do you agree with our proposed approach to the review? Are there any alternative approaches that would better meet the terms of reference, or any other issues we should consider?

2 Should we set the price at the 'factory gate' of the ethanol production facility or the fuel wholesaler's terminal?

4 Calculating price based on efficient costs of producing ethanol

In many regulated industries, we determine prices based on the efficient costs of providing a good or service. In these industries, regulated businesses provide detailed information on their operating and capital costs. We review this information to assess the level of efficient costs and how these costs vary with expected levels of demand (including estimates of marginal costs). We then determine prices that encourage efficiency while also allowing businesses to earn sufficient revenue to recover their costs.

As part of this review, we will apply a similar approach to those we use in other regulated industries and estimate the efficient costs of supplying ethanol. The sections below outline our proposed approach, and some of the issues we will consider.

4.1 Proposed approach to estimating the efficient costs of producing ethanol

In most industries where we determine prices, we use a building block approach to estimate how much revenue the business needs to generate from prices to recover the total efficient costs of providing the services. We also estimate the efficient costs of producing the next unit of production – known as the marginal cost.

In industries such as water and energy, this approach targets allocative efficiency by setting a variable charge equal to the marginal cost.[22] The approach also targets the recovery of total efficient costs and ensures that the regulated business remains financially viable by setting a fixed access charge equal to the residual of the total efficient costs and marginal costs. In the long run, a business would cease production if it is unable to earn sufficient revenue to cover total efficient costs.

We propose to estimate both the efficient total costs and marginal costs of producing ethanol.

[22] Typically, the long run marginal cost where all factor of production including capital can be varied. Allocative efficiency is maximised when prices are set at the point where the marginal cost curve intersects with the demand curve.

This will involve calculating the following costs and examining how they vary with demand:

- **Operating expenditure:** our estimate of forecast efficient operating, maintenance and administration costs associated with producing ethanol.
- **Feedstock costs:** our estimate of forecast cost of purchasing the feedstock used to produce ethanol (eg, wheat, sorghum or molasses).
- **A return on the assets used to produce ethanol:** our assessment of the opportunity cost of the capital invested by the producer. This allowance ensures the producer can continue to make efficient investments in capital in the future. To calculate it, we need to decide on the value of the assets used to produce ethanol, and the appropriate rate of return.
- **A return of assets (depreciation):** This allowance recognises that the equipment used to produce ethanol would wear out over time and therefore revenue must recover the cost of maintaining the plant. To calculate this allowance, we need to decide on the appropriate asset lives and depreciation method.
- **Taxation:** our estimate of cost of meeting the tax obligations of the producer.
- **Working capital:** our estimate of the holding cost of net current assets.

In many industries, businesses also earn supplementary revenue from some of their assets such as revenue from advertising or property rents. In these industries, we deduct a proportion of this revenue from the total efficient costs to give an estimate of the net efficient costs to be recovered through prices. Many forms of ethanol production generate other by-products and so we will also need to take account of revenue earned from these by-products when estimating the net costs of production.

4.2 Factors affecting the costs of ethanol production

Previous analysis of the costs of ethanol production has found that total production costs vary depending on the type of feedstock that is used. Gross production costs have been found to range from $0.78/L using molasses as a feedstock to $1.10/L using wheat as a feedstock.[23] Feedstock costs are the largest component of ethanol production costs accounting for around 75% of total gross ethanol production costs (see Table 4.1). The remaining costs are capital (which account for around 15%) and other variable costs including labour, energy and other non-feedstock inputs (around 10%).

[23] BREE, *An assessment of key costs and benefits associated with the Ethanol Production Grants Program*, February 2014, Table 5, p 12, ($2012-13).

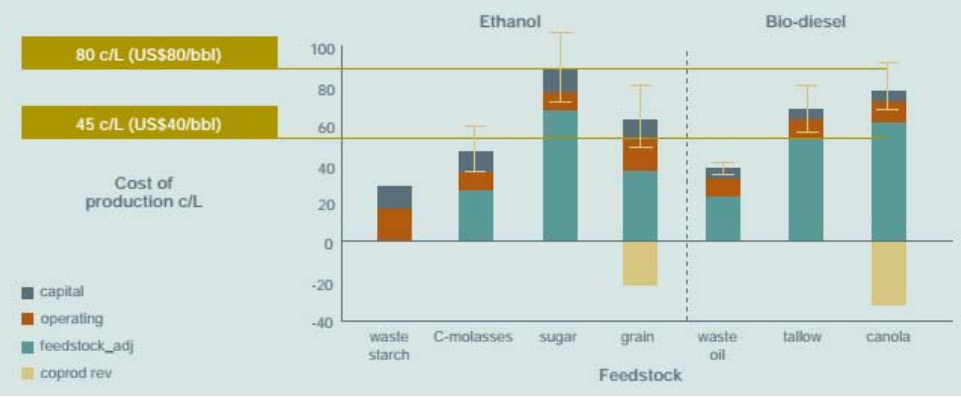
Table 4.1 Cost of production of ethanol ($2012-13)

Year	Unit	Molasses	Wheat	Sorghum
Feedstock price	**$/tonne**	**150**	**306**	**284**
Feedstock transport and storage	$/tonne	22	43	43
Ethanol yield per feedstock tonne	L/tonne	280	382	437
Feedstock cost	$/Litre	0.61	0.92	0.75
Other variable costs	$/Litre	0.08	0.09	0.09
Amortised capital costs	$/Litre	0.10	0.10	0.10
Gross cost of production	**$/Litre**	**0.78**	**1.10**	**0.93**
By product price	$/tonne	178	178	178
By product yield per litre	Kg/Litre	0.9	0.9	0.9
By-product revenue	$/Litre	0.16	0.16	0.16
Net cost of production	**$/Litre**	**0.62**	**0.94**	**0.77**

Source: BREE 2014, *An assessment of key costs and benefits associated with the Ethanol Production Grants Program*, February, Table 5.

However, we note that some ethanol producers can use quite low-cost waste or residual material such as waste from starch production as feedstock, or lower grades of other feedstocks such as wheat. This would lower the average cost of producing ethanol. Previous estimates suggest that producing ethanol using waste starch is considerably cheaper than grain (see Figure 4.1).

Figure 4.1 Indicative costs of producing ethanol in Australia – waste starch compared to other feedstocks

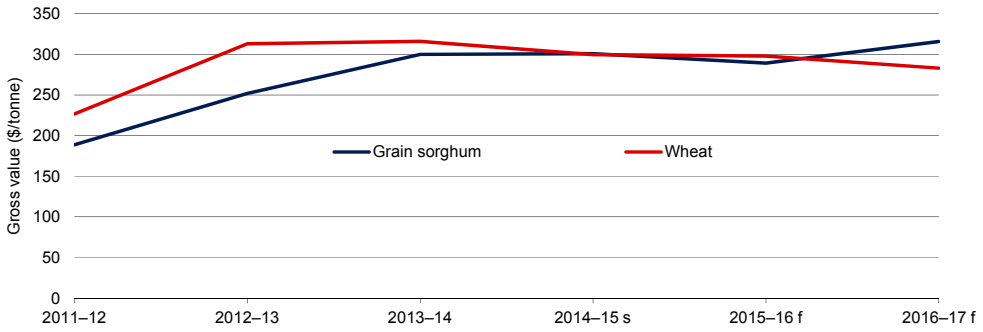


Data source: RIRDC 2007, *Biofuels in Australia an overview of issues and prospects.*

However, as noted in Chapter 2, the supply of waste starch may be limited. It is also unclear whether starch would be produced in the same quantities if there was not a market for ethanol. As part of this review we will investigate the further availability of low cost waste starch as a feedstock and its impact on the efficient costs of producing ethanol.

We also note that feedstock prices are set in a competitive market and typically vary with seasonal conditions and other factors in the world market (see Figure 4.2). In our 2012 ethanol review, we noted that movements in feedstock prices from 2003 to 2011 could make up to 70 cents per litre petrol equivalent difference to production costs for ethanol.[24]

Figure 4.2 Variability in feedstock prices



Data source: ABARES, Agricultural commodities: March quarter 2016 – Statistical tables, March 2016, Table 10, p 251.

Changes in the price of feedstock can increase or decrease the cost of producing ethanol substantially. In estimating the efficient costs of producing ethanol we will need to select which feedstock(s) to base our costs estimates on.

We also note that in the case of ethanol production, there may be significant differences between average costs and marginal costs. This depends on whether low cost waste products are used as feedstock and whether there is excess capacity (as is the case in NSW).

While some producers using molasses or waste starch have lower costs compared to other feedstocks, the continued availability of this feedstock may be limited. In this case, the marginal costs of producing additional ethanol would reflect the costs of using higher-cost feedstocks such as sorghum.

We also note that decisions to expand capacity are also affected by risks including feedstock price variability, uncertainty around continued subsidy of ethanol fuels, technological change and consumer trends. This means that although production could be expanded without sharply increasing costs, it may take a period of sustained higher prices to induce ethanol producers to take on these risks and expand capacity.

24 IPART, *Ethanol supply and demand in NSW - Final Report*, 2012, Figure 3.1, p 24.

4.3 Accounting for by-product revenue when estimating the costs of producing ethanol

Typically, ethanol producers generate multiple products and by-products, not only ethanol. For example, Manildra also grows and mills wheat, and produces starch (in dried and liquid forms), gluten, glucose syrup, and dried distillers' grains (used as stock feed).[25]

Previous analysis of the costs of producing ethanol indicates by-product revenue is significant (see Table 4.1 above). By-product revenue was found to lower gross costs of production by 15% to 20%.[26]

Therefore, in estimating efficient costs, we will need to ensure that the approach takes account of revenue earned from by-products. We could review data we receive from producers to ensure costs are appropriately attributed between different products. In practice, this may be difficult as the costs of production for each of the by-products may not be easily isolated. In addition, as the prices of feedstock and several by-products are set in competitive markets, the net costs of production will fluctuate as both input costs and by-product revenues move. This means that under different market conditions producers may increase or decrease production of different products to maximise profit.

4.4 Estimating the costs of providing different levels of demand

As noted in Chapter 2, ethanol demand was about 170 ML in 2014-15.[27] This level of demand is well below the capacity of Manildra's plant and the mandate. Increasing demand from this level up to Manildra's capacity would mean that Manildra is the marginal producer.

At the mandated level of demand, ethanol sales would be above Manildra's plant capacity. If a 6% mandate had been achieved in 2014-15 this would have amounted to sales of around 320 ML, compared to Manildra's capacity of 300 ML. In this case, a new entrant, Queensland plant or expansion of Manildra would be the marginal producer.

We propose to estimate the costs of producing ethanol for different levels of demand based on both existing facilities and new entrant facilities. As part of this we will look at the efficient costs of supplying ethanol to meet the 6% mandate.

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25 Manildra Group, Our Process, Available from, http://www.manildra.com.au/, Accessed 10 June 2016.

26 BREE, *An assessment of key costs and benefits associated with the Ethanol Production Grants Program,* February 2014, Table 5, p 12.

27 NSW Office of Biofuels, Market place data, Available from http://www.fairtrading.nsw.gov.au/ftw/Businesses/Specific_industries_and_businesses/Biofuels_industry.page , Ethanol production based on E10 sales multiplied by 10%.

4.5 Available data to calculate the costs of production

We will draw on publicly available data, and request information from Australian producers on their costs of producing ethanol.

Table 4.2 outlines possible sources of data for estimating the efficient costs of producing ethanol.

Table 4.2 Data sources for estimating efficient costs

Cost item	Source
Operating costs	▾ Information produced by BREE ▾ Information requested from ethanol producers
Capital costs	▾ Planning documents for major projects include cost estimates ▾ Information requested from ethanol producers
Feedstock costs	▾ ABARES commodity statistics ▾ Information requested from ethanol producers
Transport costs - feedstock and ethanol	▾ Information requested from ethanol producers
Economic life of capital	▾ Planning documents ▾ Engineering assessment ▾ Information requested from ethanol producers
Rate of return	▾ IPART's standard weighted average cost of capital methodology. For the market parameters (risk free rate, debt margin, inflation rate and market risk premium) we have a standard approach for all industries we regulate. The parameters for equity beta and gearing ratio are specific to the ethanol industry and we will estimate these by reviewing comparable parameters for listed businesses or businesses producing similar goods and services.
By product prices	▾ ABARES commodity statistics ▾ Information requested from ethanol producers
Tax allowance	▾ We calculate the tax allowance by applying a 30% statutory corporate tax rate adjusted for gamma to the business' (nominal) taxable income. Interest expenses are based on the parameters used for the WACC

4.6 Dealing with input costs that change over time

The costs of producing ethanol change over time. The most substantial changes reflect unknown changes in feedstock prices and known changes to Australian Government excise arrangements.

For example in our 2012 review, we noted that movements in feedstock prices from 2003 to 2011 could make up to 70 cents per litre petrol equivalent difference to production costs for ethanol.[28]

[28] IPART, *Ethanol supply and demand in NSW - Final Report*, March 2012, Figure 3.1, p 24.

Excise changes will increase costs of production by 13 cents from 2016 to 2020. These changes will be made on the 1 July each year, beginning 1 July 2016 (Table 4.3).

Table 4.3 Excise tax rates for ethanol production

Item	For the financial year starting on:	Percentage of the petroleum excise rate (currently $0.395/litre):
1	1 July 2015	0%
2	1 July 2016	6.554%
3	1 July 2017	13.108%
4	1 July 2018	19.662%
5	1 July 2019	26.216%
6	1 July 2020 or a later 1 July	32.770%

Source: *Excise Tariff Act 1921*, Section 6H.

We will likely recommend a methodology to determine the maximum wholesale price of ethanol, rather than setting a specific maximum price. In doing this we will need to consider:

- how frequently the methodology allows for changes in input prices to flow through into changes to the maximum price, and
- whether significant changes to inputs or market conditions would require a more substantial review of prices.

For example, a methodology could involve setting the price on the last three months average feedstock price, converted to an ethanol equivalent, plus an allowance for capital and operating costs and taxes. The use of a methodology might provide more certainty but we expect that there would still be a need to monitor market outcomes and determine whether there is a need for review.

IPART seeks comment on:

3 How do the costs of producing ethanol vary with different types of feedstocks? What type of feedstock should we use and are these different for different levels of demand? Should we base our cost estimates on a new entrant's costs or an existing facility? How significant is revenue from by-products to the net costs of production?

4 How much ethanol can be produced from waste starch? Would the production of starch occur in the same quantities without a market for ethanol?

5 How often should a maximum wholesale price based on the cost of production be recalculated in response to changes in feedstock prices and changes in other inputs?

6 Over what period should we use feedstock futures contracts to estimate the forward looking expected cost -the next month, six months or year?

7 What are the implications for ethanol producers and fuel wholesalers of more or less frequent changes in the regulated maximum wholesale price of ethanol?

5 Calculating price likely to induce enough demand to meet mandate

One of the policy objectives for introducing a regulated maximum price of wholesale ethanol is to ensure that the price encourages wholesalers and retailers to meet the mandate. One possible method for setting the maximum price is to calculate the price based on willingness to pay for ethanol, in particular the price required to meet the mandate. At the same time, we must also consider the economic viability of the wholesale and retail markets for petrol-ethanol fuels.

The sections below outline our proposed approach for calculating this price, and some of the issues we will consider.

5.1 Approach for calculating price to induce sufficient demand and ensure economic viability

To calculate the maximum wholesale price of ethanol to meet the mandate, while ensuring the wholesale and retail markets remain economically viable, we would need to:

1. Identify the maximum retail price for E10 that could be expected to achieve the mandate, given the lower energy content and potentially lower consumer preferences for E10 versus unleaded petrol.
2. From this maximum retail price for E10, find the corresponding maximum wholesale price for E10, allowing for an appropriate retail margin on E10 (and potentially additional retail costs associated with E10, in particular for retailers required to install new infrastructure).
3. From this maximum wholesale price for E10, find the maximum supply price of ethanol, accounting for relevant wholesale, distribution and transport costs, as well as an appropriate wholesale margin.

5.2 What is the relationship between ethanol price and demand?

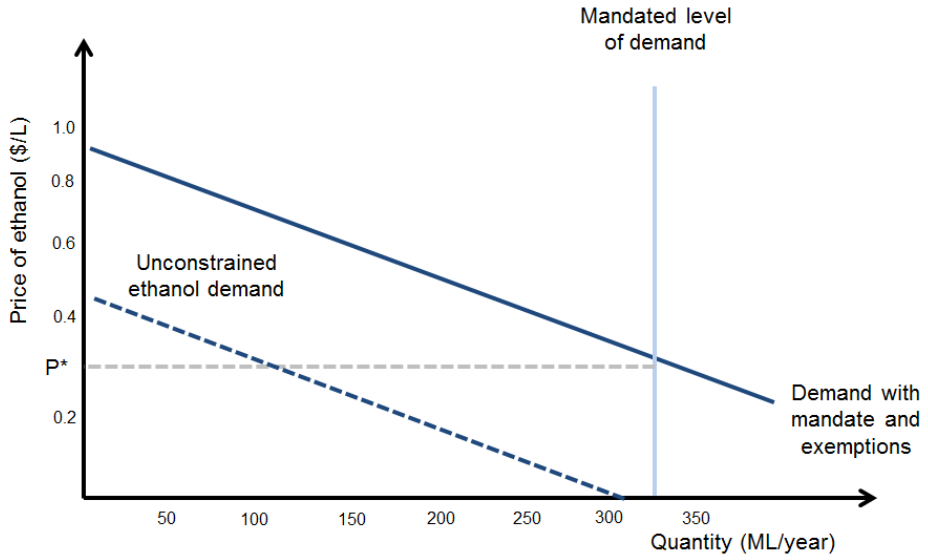
The demand for ethanol reflects the demand from end-customers, which leads to induced demand from retailers, which leads to induced demand from wholesalers. In general, this demand will increase as the price of ethanol decreases, forming a demand curve.

However, the shape of this curve is not likely to be consistent:

- For some end-customers, the demand curve is likely to be very flat, as they are fairly indifferent about the choice between E10 and unleaded petrol.
- For other end-customers it will be steep, as they will require substantial price differences to entice them to switch to an ethanol-blended fuel as they have a preference for unblended petrol.
- For retailers who have storage tanks for E10 and unleaded petrol, the demand curve is likely be very flat, as they, and many of their end-customers, are fairly indifferent about the choice between E10 and unleaded petrol.
- For retailers who do not have storage tanks for E10, the demand curve will be very steep, as they will need a large and ongoing discount on E10 compared to unleaded petrol to entice them to make the necessary investments to store and sell ethanol.
- Retailers demand may also be affected by costs associated with transportation costs and surety of supply across different products.
- For wholesalers, demand from retailers would flow-through to their demand for ethanol after considering issues such as costs/facilities required to store and blend ethanol.

Together, the above interactions generate the overall demand for ethanol. There is likely to be some price point at which demand for ethanol would meet mandated demand (P* on Figure 5.1). The key determinants of this price point are the price of substitutes, such as regular and premium unleaded petrol, and the level of the mandate. Figure 5.1 illustrates the price point where the demand curve with the mandate and exemptions in place would meet mandated demand.

Figure 5.1 The demand curve for ethanol



Note: Numbers are shown for illustrative purposes only.

5.3 What level of discount will induce end-customers to use E10?

Our 2015 review of the ethanol mandate noted that ethanol has 68% of the energy content of unleaded petrol.[29] This implies that an ethanol blend of 10% ethanol has 96.8% of the fuel efficiency of unleaded petroleum.[30] Given this, it is likely end-customers would not buy E10 unless it priced at least 3.2% below regular unleaded.

However, recent evidence indicates that consumers are switching to premium unleaded in response to E10 replacing regular unleaded petrol at service stations.[31] This suggests that many consumers may require additional discounts of up to 15 cents per litre before they would consider using E10.

29 IPART, *Ethanol mandate – Options to increase the uptake of ethanol blended petrol – Final Report*, May 2015, p 100.

30 Calculated as 90% x 100 + 10% x 68% = 96.8%.

31 ACCC 2016, *Report on the Australian petroleum market – December quarter 2015*, February 2016, pp 20-21

5.4 What level of discount will induce wholesalers and retailers to offer E10 (wholesale and retail margins)?

There are additional costs associated with wholesaling and retailing E10 compared to petrol. These include the costs of storing and blending ethanol with petrol, transporting an additional fuel product, and fitting out service stations to handle E10 as well as an appropriate margin on these costs. The wholesale price of E10 and ethanol would need to be discounted compared with that of petrol to induce them to offer E10.

For larger retailers that have already fitted out service stations and are able to offer more products, the additional costs may not be large. However, for other retailers and wholesalers, they are likely to be substantial. For example, the Alliance Against Ethanol Mandates has suggested that the additional infrastructure capital cost per service station to handle E10 is around $500,000 to $900,000.[32] In our 2015 review of options to increase the uptake of ethanol blended petrol, we suggested service station fit-out costs would be around $200,000 for retailers, and $500,000 for wholesalers.

For example, if we use current sales and assume fit out costs of $200,000 at around 500 service stations retailing E10,[33] retailers would need to earn around $0.07 per litre of ethanol sold to recover the fit-out costs.[34] If the additional costs of blending and segregating at the wholesale level were half the fit-out costs, they would need to recover more than $0.10 per litre to recover all these additional costs.

5.5 How is the wholesale price calculated under this method?

To illustrate how the wholesale price is calculated using this method we have done an illustrative calculation (Table 5.1). This involves:

- Working backwards from the unleaded petrol price (in this example 124.4 cents per litre) to the price retailers would pay for E10. This involves subtracting:
  - the GST (10%, equal to 11.3 cents per litre)
  - a standard retail margin (in this example, assumed to be 11.3 cents per litre) and an additional retail margin for providing E10 facilities (in this example assumed to be 0.7 cents per litre), and
  - the discount consumers require for energy equivalence of E10 and unleaded petrol (3.3. cents per litre).

  This gives a price that retailers would pay for E10 of 97.9 c/L.

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32 Alliance Against Ethanol Mandates 2015, *Response to the Queensland Biofuels Mandate discussion* paper, pp 13-14.

33 ACCC, *Monitoring of the Australian petroleum industry*, December 2014, Chart 10.3, p 112.

34 Calculation based on $200,000 capital costs, 7% discount rate and using 2014-15 sales of ethanol (168 ML).

- From the price retailers would pay for E10 (97.9 c/L), working backwards to how much a wholesaler would pay for ethanol, by subtracting:
  - the wholesale margin (in this example 10.7 cents per litre), and
  - costs for the wholesale unleaded petrol component of E10 (82.3 cents per litre of E10, based on an assumed wholesale price of 91.4 cents per litre of ULP multiplied by 90%)[35]

This leaves 4.9 cents to cover the costs of wholesale ethanol, equivalent to 49 cents per litre of ethanol, given that ethanol makes up about 10% of the E10.

In this example, we have assumed that there is no further discount required for end-customers beyond that required for equivalent energy, and no additional wholesaler margin. As part of our review, we will further investigate appropriate levels for these assumptions and are interested in stakeholder views on them.

Since the result of this approach depends on the retail price of petrol, which varies over time, adopting this approach would require developing a methodology that can account for changes in the retail price of petrol.

The approach is sensitive to the price of unleaded petrol and the differential between unleaded and ethanol-blended petrol necessary to induce sufficient demand to meet the mandate (ie, the cross-price elasticity). This is captured in both the energy equivalent discount and the additional consumer discount items in Table 5.1 below. Therefore, if the price of unleaded petrol was low and/or the necessary price differential was large, this approach could result in a maximum wholesale price of ethanol below the cost of supply. In that case, without further ethanol subsidies, supply could be limited and the state's performance against the mandate would not improve.

We will also need to consider how we account for differences between regular unleaded petrol and premium unleaded petrol.

35 ACCC, *Report on the Australian petroleum market – December quarter 2015*, February 2016, p. 3.

Table 5.1 Example of how to calculate a wholesale ethanol price to induce sufficient demand to meet 6% mandate

Year	Unit	Price
Unleaded price	**Cents/L of ULP**	**124.4**
Less GST	Cents/L of ULP	-11.3
Less standard retail margin	Cents/L of ULP	-11.3
Less additional E10 margin	Cents/L of ULP	-0.7
Less energy equivalent discount	Cents/L of ULP	-3.3
Less additional consumer discount	Cents/L of ULP	0
Price retailers pay for E10	**Cents/L of E10**	**97.9**
Less standard wholesale margin	Cents/L of E10	-10.7
Less additional ethanol-related margin	Cents/L of E10	0
Less costs of unleaded fuel inputs to E10	Cents/L of E10	-82.3
Amount left to pay for ethanol	Cents/L of E10	4.9
Implied wholesale price of ethanol	**Cents/L of ethanol**	**49.5**

IPART seeks comment on:

8 What are additional costs faced by wholesalers and retailers in supplying ethanol-blended fuels, compared with regular petrol?

9 How often should a wholesale price of ethanol that induces enough demand to meet the mandate be updated in response to changes in wholesale and retail petrol prices?

10 Should we use regular unleaded petrol or premium unleaded petrol as the relevant comparator?

6 Calculating the price to encourage the economically efficient level of ethanol production and use

In theory, there is a wholesale ethanol price that will encourage the economically efficient level of ethanol production and consumption – that is, the level where the production and use of ethanol has the greatest net benefit to society. This is known as the 'economic price'.

If the maximum wholesale price is higher than the economic price, there is likely to be excess production of ethanol. Society would be made better off by reducing production (and consumption) of ethanol. If the maximum wholesale price is lower than the economic price, there is likely to be insufficient production of ethanol. Society would be made better off by increasing production (and consumption) of ethanol.

The sections below discuss this possible method for maximum wholesale ethanol price, and outline how we could calculate it and some of the issues we would consider.

6.1 What does the 'economic price' measure?

The 'economic price' of ethanol is the maximum wholesale price at which there is a net benefit from the production and consumption of ethanol compared to its closest substitute, unleaded petrol. This economic price will change as the price of unleaded petrol changes.

The economic price for ethanol would be set so that ethanol would be produced up to the point at which its cost was equal to the cost to society of the alternative — unleaded petrol. The cost to society differs from the cost of production, because it includes 'externalities' of petrol versus ethanol – that is, the impacts on others, such as environmental and health impacts and government revenue impacts from the use of ethanol-blended fuels compared to unleaded petrol.

The cost to society of unleaded petrol is equal to the retail price less taxes plus external costs. The retail price can be broken into the wholesale input price of unleaded petrol plus a wholesale margin plus retail costs and a retail margin.

The cost to society of ethanol-blended fuel reflects the same calculation. The cost to society of E10 comprises:

- the wholesale input cost of unleaded petroleum, which makes up ~90% of E10, plus
- the wholesale economic price of ethanol, which makes up ~10% of E10, plus
- the wholesale and retail margin for E10, plus
- the external costs of using E10, less
- excise taxes on the unleaded petroleum, and, once applicable, excise taxes on ethanol.

The economic price of wholesale ethanol is then set so that the cost to society of ethanol-blended fuel is equal to that of unleaded petrol , after adjusting for differences in the products such as fuel efficiency. More specifically:

Cost to society of E10 adjusted for product differences = Cost to society of unleaded petrol

6.2 How would we calculate the economic price?

The economic price takes account of costs incurred by producers, as well as differences between the costs incurred by a producer and the costs to society as a whole. The most important of these costs to society are:

- taxes paid to Government, which are a cost incurred by a producer but are not a cost to society as a whole, and
- externalities from the consumption of ethanol blends compared to unleaded petroleum, such as greenhouse gas emissions.

Box 6.1 sets out the key steps in how we would calculate the economic price of wholesale ethanol. It will be higher when:

- the price for unleaded fuel is higher
- ethanol blended fuels have fewer environment costs relative to unleaded petrol, or
- the excise tax difference between ethanol blended fuels and regular petrol is smaller.

Box 6.1 Worked example of economic price of ethanol

Suppose unleaded petrol costs 91.4 cents per litre wholesale and there is a combined wholesale and retail margin on top of this. Of the wholesale price, 39.5 cents per litre is revenue related to excise taxes. Further assume that external environment costs for unleaded are 0.78 cents per litre greater than for E10, because air and GHG emissions are higher than for E10. Then the total cost to society is 52.7 cents per litre (91.4-39.5+0.78) plus a retail and wholesale margin.

Now consider the price at which ethanol would have to be produced to provide an equal cost to society of unleaded petrol. E10 is 90% petrol and 10% ethanol. No excise is currently paid on ethanol production, and the excise on the 90% petroleum component is 39.5 cents per litre. There is also a wholesale and retail margin on E10. The cost to society of E10 is then:

Social cost of E10 = Economic price of ethanol*10% + 90%*(91.4-39.5) + Margin

Social cost of E10 = Economic price of ethanol*10% + 46.7 + Margin

The economic price is set so that the cost to society of E10 and unleaded are equal. That is:

Social cost of unleaded = Social cost of E10 adjusted for product differences.

One product difference is that each litre of E10 allows for only 96.8% of the travel of unleaded petrol. There may be other product differences related to engine impacts, which we do not include in this example.

Rearranging the above gives:

Economic price of ethanol*10% - 46.7 + E10 margin = 96.8%*(52.7 + Unleaded margin)

If the margins for wholesalers and retailers were equivalent on an energy-adjusted basis (E10 margin = 96.8% of unleaded margin), then these terms cancel out. The resulting economic price of ethanol is:

Economic price of ethanol = (96.8%*52.7-46.7)/10%

This gives an economic price of wholesale ethanol of 43 cents per litre.

In this example, the economic price makes no adjustment for other impacts of different fuel types on a vehicle. Nor does it include a different margin for wholesalers or retailers related to E10 versus unleaded fuels. As part of the review we will consider the need for these other adjustments.

6.3 What values would we need to estimate to use this method?

To use this method to set the maximum wholesale price of ethanol we would need to estimate:

- the fuel efficiency of ethanol-blended petrol compared to unleaded petrol
- the externalities of ethanol compared to petrol
- any other costs to end-customers of using E10 rather than unleaded petrol, and
- the price paid by fuel wholesalers for refined petrol.

6.3.1 Fuel efficiency of ethanol-blended petrol

Our 2015 review noted that ethanol had 68% of the embodied energy of unleaded petroleum. This would imply that a fuel blend of 10% ethanol would have 96.8% of the fuel efficiency of unleaded petroleum.

6.3.2 Externalities of petrol versus ethanol

Our 2015 review noted that the use of ethanol-blended fuels rather than petrol could have some external benefits, including lower greenhouse gas (GHG) emissions and health advantages related to air pollution (Table 6.1). (For more information, see Appendix B.)

However, a study undertaken by the Bureau of Resources and Energy Economics[36] (BREE) found that these benefits may be very small.[37] It also pointed out that the health advantage of ethanol is in decline as technological advances reduce emissions more generally, which would reduce the estimated health benefits shown in Table 6.1 over time.

Table 6.1 Externality measures used in IPART 2015 Final Report on the NSW Ethanol Mandate

	Low	Medium	High
	Cents 2015, per litre ethanol	Cents 2015, per litre ethanol	Cents 2015, per litre ethanol
GHG abatement benefits	0.5	1.1	3.8
Health benefit (from RULP to E10)	1.5	6.7	15.0

Source: IPART 2015, *Ethanol mandate: Options to increase the uptake of ethanol blended fuel - Final Report*, Appendix C, pp 102-104.

36 BREE, *An assessment of key costs and benefits associated with the Ethanol Production Grants Program,* February 2014, pp 18-20.

37 BREE, *An assessment of key costs and benefits associated with the Ethanol Production Grants Program,* February 2014, pp 18-20.

6.3.3 Other costs to end-customers

Ethanol-blended fuels may have other impacts that people place a cost on. For example, the introduction of ethanol-blended fuels led to many consumers switching to premium unleaded, which is substantially more expensive.

There are also potentially different costs for wholesalers from blending of ethanol with unleaded petroleum and transportation of multiple fuel types.

6.3.4 Price paid by fuel wholesalers for petrol

To estimate the economic price of ethanol, we would require information on the price wholesalers pay for unleaded petroleum. To calculate this we could use:

- The price of refined petrol plus excise and transportation costs based on a relevant benchmark for Australia such as the Singapore Mogas 95 Unleaded (Mogas 95).[38] To this we would add transportation costs to Australia and the relevant excise tax rate, currently 39.5 cents per litre.
- The terminal gate price (TGP) for fuel wholesalers and subtracting a wholesale margin. TGPs are posted on a regular basis on the websites of the major wholesalers. We would also have to estimate the wholesale margin.
- Information obtained directly from wholesalers about their prices paid for unleaded petrol.

IPART seeks comment on:

11 Do you support setting the maximum wholesale price of ethanol at the level at which consumption of ethanol has the greatest net benefit to society? How often should the economic price of ethanol be updated in response to changes in wholesale fuel prices and changes in other factors?

12 Should we use wholesale fuel futures contracts to estimate the expected future price of petrol and over what period – 1-month, six months or a year?

13 What are the externalities associated with production and consumption of ethanol and petrol?

14 Should we estimate other costs for consumers of using ethanol-blended fuels? What is the evidence for these costs?

15 Are there other factors we should consider in determining the economic price, such as costs for wholesalers of blending ethanol with unleaded petroleum and transportation of multiple fuel types? What evidence is there on the magnitude of these costs?

38 ACCC, *Report on the Australian petroleum market – December quarter 2015*, February 2016, p 10.

7 Setting the wholesale price based on international ethanol prices

World production of ethanol in 2014 was 94 GL.[39] The USA and Brazil produced around 86% of this. Australia produces around 0.25%. Brazil is the largest ethanol producer, exporting 1,900 ML in 2015.[40]

As ethanol is an internationally traded commodity, a possible method for setting the maximum wholesale price is to base it on international ethanol prices. The sections below discuss this method.

7.1 The role of international ethanol prices

International ethanol prices currently act as a constraint on domestic ethanol production because:

- The price charged for domestic ethanol cannot be greater than the import parity price. The import parity price is equal to the international price plus transport costs plus customs duties.
- The price for purchase of domestic ethanol cannot fall below the international price less transport costs, otherwise domestic producers would be better off exporting their ethanol.

Currently, neither of these constraints has a significant impact on the ethanol market. The customs duties on imported ethanol have meant that importing is currently not a viable supply option. For Australian producers, exporting has been viable from time-to-time at relatively small quantities. For example Australia exported small amounts of ethanol in 2015 (22 ML) and 5 ML in 2014.[41]

39 APAC, Australian Biofuels 215-16, p 37.

40 UN Comtrade data, accessed from http://comtrade.un.org/data/, based on commodity code 2207.

41 UN Comtrade data, accessed from http://comtrade.un.org/data/, based on commodity code 2207.

7.2 What is the international price of ethanol?

The import parity price for ethanol (before duty and excising) landed into Australia was 75 cents per litre from the USA and 77 cents per litre from Brazil as at September 2015.[42] By comparison, the estimated import parity price for petrol in September 2015 was 59.4 cents per litre.[43]

The international price could be used as a benchmark for a maximum wholesale price. The maximum wholesale price would not necessarily have to equal to the international price, but could be linked to it, such as the international price before import duties plus an additional amount for example to cover the costs of additional import storage.

Calculating the maximum wholesale price based on import parity prices including excise would likely result with a price well above what demand would be willing to bear. The price would be higher than petrol. Such a price would have no bearing on the market and domestic producers receiving a subsidy would be able to produce at a lower price.

Calculating the maximum wholesale price based on import parity prices with no excise may constrain the prices charged by Australian producers to be equivalent to international production costs plus transportation.

However, we note that in using an international benchmark to set wholesale ethanol prices we will also need to consider that the international price is itself influenced by a range of policies related to ethanol around the world.

IPART seeks comment on:

16 Do you support setting the maximum wholesale price of ethanol based on international ethanol prices? Why?

42 APAC, Australian Biofuels 215-16, p 34.
43 APAC, Australian Biofuels 215-16, p 34.

Appendices

A Terms of reference

TERMS OF REFERENCE

Maximum price for wholesale ethanol in NSW

I, Michael Baird, Premier of New South Wales, under section 12A of the *Independent Pricing and Regulatory Tribunal Act 1992* (**Act**), request the Independent Pricing and Regulatory Tribunal (**Tribunal**) to investigate and report on a maximum price for wholesale ethanol in accordance with this Terms of Reference.

Context

In December 2015 the Government announced it would implement a range of measures to improve NSW's performance against the ethanol mandate imposed on major fuel sellers. This includes amending the *Biofuels Act 2007* and regulation to extend the ethanol mandate to all service stations which sell three or more fuel types above a certain volume.

The Government also decided to regulate the price of wholesale ethanol to support availability of E10 at petrol stations at an attractive price to customers.

The task

IPART is requested to recommend:

(a) a maximum price for wholesale ethanol for use in automotive fuel blends; and/or

(b) a price methodology which ethanol suppliers must apply to determine a maximum price when selling wholesale ethanol for the purposes of complying with the *Biofuels Act 2007* and regulation.

In deciding the relevant maximum price and/or wholesale ethanol price methodology, the Tribunal is to review prices in the biofuels industry and have regard to:

(a) protecting consumers from potential abuses in monopoly power relating to prices

(b) the efficient costs of supplying ethanol

(c) any other matters the Tribunal considers relevant.

Process and timeframe

The Tribunal is required to consult with the public and provide a final report to the Premier by the end of December 2016. The final report will be made publicly available.

The Finance, Services and Innovation cluster will meet the agreed costs of the review.

B IPART's previous estimates of externalities

Table B.1 IPART 2015 assumptions for externalities

Parameter	Assumption	Rationale / source
Own-price elasticity of E10	- 3 (range from -2 to -5)	▾ **Aggregate demand for petrol:** Meta-analysis of elasticities based on more than 350 studies conducted to 1998 have found the short run own-price elasticity of demand for petrol in the range of 0 to -1.36, with a mean of -0.26 and a median of -0.23. More recent studies confirm the values in the -0.03 to -0.09 range. (Hughes J.E., Knittel C.R., and Sperling D., *Evidence of a shift in the short run price elasticity of gasoline demand*, NBER Working Paper No. 12530, September 2006, p 4; Small K.A. and Van Dender K., *Long run trends in transport demand, fuel price elasticities and implications of the oil outlook for transport policy*, OECD Discussion Paper No. 2007-16, p 16. Baranzini A and Weber S., *Elasticities of gasoline demand in Switzerland*, Energy Policy 2013, vol. 63, pp 674-80; Espey M., 'Gasoline demand revisited: an international meta-analysis of elasticities', *Energy Economics,* 20 1998, pp 273-95). ▾ **Demand for E10:** An estimate of price elasticity for E10 using NSW data is -0.01 (Noel M. and Roach T., *Regulated and unregulated almost-perfect substitutes: Aversion effects from a selective ethanol mandate*, Department of Economics, Texas Tech University, Lubbock, Texas, 31 March 2014, p 23). ▾ **Options modelled without price change:** For all options other than Option 9a and Option 9b, the final shares of fuels were modelled directly based on the scenario assumptions about the switching consumers. Relative prices of the fuels were kept constant. ▾ **Options modelled with price change:** For Option 9a and Option 9b, we allowed for a higher own-price response of the demand for E10, and also for the higher degree of substitution between RULP and E10. We modelled the price response of demand for E10 in the range of scenarios regarding cross-price elasticity of demand for RULP with respect to changes in the price of E10 (from 0.5 to 2). ▾ **Range of own-price elasticity**: Under the assumption of constant elasticity substitution (CES) utility function, we tested the demand response for E10 allowing for the own-price elasticity of up to -5 (for the methodology on estimating cross-price elasticities, see eg, Tarr D., 'A note in obtaining estimates of cross-elasticities of demand', Bureau of Economics, Federal Trade Commission, Working Paper No. 153, May 1987, pp 4-5). Demand based on the CES function satisfies the property %change(Q_i/Q_j)/%change(Pi/Pj) = constant. More technically, for the fuel demand system under the CES functional specification, $d\ln(Q_{RULP}/Q_{E10})/d\ln(P_{RULP}/P_{E10})=E$ is constant; cross-price elasticity of RULP with respect to the price of E10 is $\varepsilon_{RULP,E10}=(E-1)s_{E10,}$ own-price elasticity of E10 is $\varepsilon_{E10,E10}=-E+(E-1)s_{E10}$, where s_{E10} is the expenditure share of E10 in the fuel consumption basket (see eg Ramskov J. and Munksgaard J., *Elasticities – a theoretical introduction,* 2001, p 11.)

Parameter	Assumption	Rationale / source
Cross-price elasticity of RULP with respect to changes in price of E10	1 (range from 0.5 to 2)	▾ **Substitution between fuel types:** Most of the existing literature pertains to Brazil and US, where market penetration of fuel ethanol is high and in E85 form, used in the flex-fuel vehicles. The range of cross-price elasticity between gasoline and ethanol was estimated at between 0.48 and 2.7 to 3.5 (Alves D. and da Silveira Bueno R.D.L., 'Short run, long run and cross-elasticities of gasoline demand in Brazil', *Energy Economics*, 2003, 25(2), pp 191-9; Anderson S., *The demand for ethanol as a gasoline substitute*, NBER Working Paper 16371, September 2010, p 29). ▾ **Switch from RULP to E10 in response to price:** We modelled the switch from RULP to E10 as a price response of the demand for RULP with respect to changes in price of E10. While the literature does not directly address the substitution between RULP and E10, the above studies suggest the possibility of a degree of substitution in response to change in relative prices. There is also evidence in the literature that switching between gasoline and ethanol by a median consumer occurs over a wider range of relative price variation, suggesting that there is substantial consumer heterogeneity in the choice of fuel. The implications are that switching away from gasoline would require significant price discounts to boost voluntary adoption of ethanol (Salvo A. and Huse C., 'Consumer choice between gasoline and sugarcane ethanol', February 2011, mimeo). ▾ **Scenario values:** Based on the NSW evidence of increased sale of PULP once RULP became less available, and with the price of PULP in excess of 15 cpl compared with E10, we accepted somewhat lower values of the cross-price elasticity (low 0.5, medium 1 and high 2) of RULP with respect to the price of E10.
GHG abatement benefits per ML E100		
GHG abatement benefits ($2015), per ML ethanol, $ low	4,591	We considered the international price of carbon based on the EU emissions trading scheme. As of April 2015, the price of generic first emissions (ICE Futures Europe Commodities) is Euro 7.09/ tCO2, or A$10/ tCO2. At these prices, the abatement benefit on a LCA basis is $4,591/ML (see discussion of medium scenario below on the LCA of GHG emissions).
GHG abatement benefits ($2015), per ML ethanol, $ medium	11,477	Based on the LCA of the GHG emissions, and using Manildra's published estimate of GHG intensities from http://www.manildra.com.au/community/ea_ethanol/Annex_N_-_Greenhouse_Gas.pdf. For our analysis we used Manildra's published estimate of gross emission intensity from ethanol production (following upgrade to 300 ML per year capacity) of 1.09 tCO2-e/kl or 1,090 tCO2-e/ML. Without the LCA assessment, 1 ML of ethanol displacing RULP sales results in 1,549 tCO2-e savings in emissions. Accounting for additional LCA emissions during the production process, the net savings in emissions are 459 tCO2-e per ML of ethanol. Applying the price of carbon of A$25/ tCO2, the abatement benefits on a LCA basis is $11,477/ML
GHG abatement benefits ($2015), per ML ethanol, $ high	38,727	Based on Bureau of Resources and Energy Economics (BREE), *An assessment of key costs and benefits associated with the Ethanol Production Grants program - Report for the Department of Industry*, February 2014, p 18. Calculated using the carbon price of $25/tonne of CO2 equivalent.

Parameter	Assumption	Rationale / source
Health benefits		
Health benefit, ($2015), per ML ethanol, switch from RULP to E10, $ low	14,755	Calculated based on EPA, *Renewable Fuel Standard Program (RSF2) Regulatory Impact Analysis*, US Environmental Protection Agency, February 2010, p. 5.; Beer T, Carras J. et al, 'The health impacts of ethanol blend petrol', *Energies* 2011, 4(2), pp 352-67, p. 365, and PAE Holmes, *Methodology for valuing the health impacts of changes in particle emissions – Final report – Report to NSW EPA*, February 2013; MMA, *Cost-benefit analysis of implementing Stage 2 Vapour recovery – Report to Department of Environment and Climate Change (NSW)*, June 2008.
Health benefits per ML ethanol, switch from RULP to E10, $ medium	67,132	Calculated based on EPA, *Renewable Fuel Standard Program (RSF2) Regulatory Impact Analysis*, US Environmental Protection Agency, February 2010, p. 5.; Beer T, Carras J. et al, 'The health impacts of ethanol blend petrol', *Energies* 2011, 4(2), pp 352-67, p. 365, and PAE Holmes, *Methodology for valuing the health impacts of changes in particle emissions – Final report – Report to NSW EPA*, February 2013; MMA, *Cost-benefit analysis of implementing Stage 2 Vapour recovery – Report to Department of Environment and Climate Change (NSW)*, June 2008.
Health benefits per ML ethanol, switch from RULP to E10, $ high	150,200	Calculated based on EPA, *Renewable Fuel Standard Program (RSF2) Regulatory Impact Analysis*, US Environmental Protection Agency, February 2010, p. 5.; Beer T, Carras J. et al, 'The health impacts of ethanol blend petrol', *Energies* 2011, 4(2), pp 352-67, p. 365, and PAE Holmes, *Methodology for valuing the health impacts of changes in particle emissions – Final report –Report to NSW EPA*, February 2013; MMA, *Cost-benefit analysis of implementing Stage 2 Vapour recovery – Report to Department of Environment and Climate Change (NSW)*, June 2008.
Health benefit , ($2015), per ML ethanol, switch from PULP to E10, $ low	0	There may be no material health benefits if consumers switch from PULP to E10, due to RULP (the blend stock used in E10) containing higher sulphur levels than PULP (the Australian fuel standards for PULP is sulphur of no more than 50ppm and for RULP, no more than 150ppm). However, the actual sulphur content of E10 sold in NSW can vary considerably depending on where the blend stock, RULP, has been sourced overseas. Given the variability of sulphur levels in E10 in NSW, we used a range of $0, if E10 contains higher sulphur levels than PULP, $50,000 as a conservative medium estimate based on health benefits that can arise when switching from RULP to E10 (see section above), and $150,200 if E10 has sulphur levels that meet PULP standards (see section above).
Health benefits per ML ethanol, switch from PULP to E10, $ medium	50,000	See explanation above.
Health benefits per ML ethanol, switch from PULP to E10, $ high	150,200	See explanation above.

Parameter	Assumption	Rationale / source
Cost of E10 retrofitting/replacement		
Low, $ per tank ($2015)	12,500	Based on confidential submission to IPART, 11 March 2015.
Med, $ per tank($2015)	40,000	Based on confidential submission to IPART, 17 February 2015.
High, $ per tank ($2015)	200,000	Based on confidential submission to IPART, 25 February 2015.
$ per depot ($2015)	500,000	Based on confidential submission to IPART, 3 February 2015.