Figure 19: High oil price case: impact on engine technology choices

Queensland: energy use by engine type (PJ)

<table>
<thead>
<tr>
<th>Year</th>
<th>Electric</th>
<th>PHEV</th>
<th>Hybrid</th>
<th>IC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>250</td>
<td>0</td>
<td>119</td>
<td>3</td>
</tr>
<tr>
<td>2020</td>
<td>288</td>
<td>0</td>
<td>187</td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Australia: energy use by engine type (PJ)

<table>
<thead>
<tr>
<th>Year</th>
<th>Electric</th>
<th>PHEV</th>
<th>Hybrid</th>
<th>IC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1122</td>
<td>0</td>
<td>1190</td>
<td>29</td>
</tr>
<tr>
<td>2020</td>
<td>1190</td>
<td>0</td>
<td>513</td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
<td>673</td>
<td></td>
</tr>
</tbody>
</table>

f. Transport oil vulnerability – what the modelling is showing

At an aggregate level, the model results for an ETS and higher oil prices generate a significant reduction in the overall energy intensity of the transport task in Queensland (Figure 20a). In the highest oil price scenario – broadly consistent with a plateauing of world oil production – the oil intensity of the transport task falls by over 60% by 2030 (Figure 20b).
These shifts primarily reflect the impact of changes in drive train technology across the freight and passenger fleet and fuel switching generated by higher oil prices, together with a smaller element of demand destruction.

These impacts underpin Queensland’s projected demand for conventional oil-based fuels under the different pricing scenarios (Figure 21). Under the highest oil price scenario, by 2020 oil demand in the road transport sector is some 70PJ lower compared with BAU and 60PJ lower than the NETT scenario. By 2030 these numbers increase to 176PJ and 140PJ respectively. Compared with the 2006 actual consumption, the highest oil price scenario results in a projected outcome that is 100PJ less than the figure for 2006.
6. Implications of the modelling for oil supply risk and uncertainty

The scenarios modelled suggest that the Queensland (and national) road transport sector could adjust over time to sustained high oil prices and carbon pricing in a way that would significantly reduce demand for oil-based liquid fuels, with price doing most of the heavy lifting. In the highest price case - which seems broadly consistent with a world where oil production reaches a plateau in the face of continuing growth in demand - this results in conventional oil-based liquid fuel demand of some 60% of the current level.

There remain, however, two critical considerations. These are, firstly, the uncertainties and limitations inherent in the model structure and its use; and, secondly, the acceptability from a policy perspective of the risk profile generated by the model results and their interpretation.

On the first point, there are a number of uncertainties surrounding critical assumptions in the model, for example:
The continuation of historically low levels of price elasticity of demand for transport in the face of continued real increases in oil prices:

- Recent evidence in the United States suggests that oil demand in developed economies with relatively high levels of car ownership may respond more sharply to both the experience of and belief in sustained higher oil prices (compared with developing economies where income effects tend to overwhelm price).

The modelling also assumes little or no diversion of passengers or freight from road to rail and quite limited passenger modal shifts to buses:

- Recent experience in Australia suggests significant public transport (PT) demand response to increased petrol prices. In aggregate terms which is already having implications for capital and recurrent spending in PT systems and which may be understated for higher oil price environments.

The availability/continuity of supply is also a strategic issue – particularly of diesel (which is assumed to become increasingly important for the passenger sector for fuel efficiency reasons) and, from 2020 onwards, biofuels and GTL diesel. Under the CSIRO modelling, as long as production costs are covered by the fuel prices, and the appropriate vehicles are available, it is assumed that the fuel volumes demanded will be supplied to the market. The critical issue here is the risk from an investor perspective generated for capital intensive projects by government policy (for example, carbon pricing) and price uncertainty. In the face of significant uncertainty investment in alternative fuels will only occur if risk adjusted returns are expected to exceed costs by a large margin.

In addition:

- The model does not address risks to conventional diesel supply arising from the current outlook for Australian refining capacity and the domestic crude oil mix (which is not generally suitable for diesel production).

- It is also not clear whether there are potential economic and/or environmental constraints to major expansion of biofuels production and GTL capacity over the period to 2030 which both form an important part of fuel switching towards the end of the period modelled.

More generally, the analysis needs to be extended to other significant oil using sectors in the Queensland economy to understand how robust they are likely to be to oil price volatility and supply disruption, notably the implications for agricultural and horticultural products and the flow on effects to food prices.

Against this background, it is for consideration whether the adjustment path, and its associated risks, implied by the modelling are acceptable in terms of the economic, environmental and social implications. Issues here include:
• The appropriate response to the geographical equity and access issues raised in the Dodson and Sipe analysis (section 3 above)

• A reliance on market responses that are predicated on a relatively smooth transition to sustained higher oil prices which in turn leads to demand reduction and fuel switching that occurs predominantly towards the end of the modelling period. Risks here include the more rapid onset of both a higher and more volatile oil price environment

Such an environment (particularly if coupled with carbon price uncertainty) could undermine the willingness of investors to put in place the supply capacities needed to facilitate a transition to a lower oil intensity path. In the limiting case this could result in absolute physical shortages, particularly in products for which Australia does not have refining capacity (such as low sulphur diesel).

Both price and supply risk would have implications for not only the transport sector but all major oil using sectors (such as agricultural, mining, petrochemicals).

7. Policy responses and options

a. Oil price/supply risk – current policy framework

The current State and Federal policy framework very largely leaves the management of both oil price and supply risk with the private sector. The Government’s policy role in relation to liquid fuel markets is essentially restricted to emergency preparedness in relation to defence and terrorism issues and to give effect to International Energy Agency (IEA) emergency preparedness policies involving allocating fuel for essential services under the Liquid Fuel Emergency Act 1984. Implementation of these measures is devolved to State Governments.19

ACIL/Tasman has just completed a review of the 1984 Act for the Federal Government which is expected to recommend no major changes in the current framework but has identified risks associated with the age and capacity constraints of refining and pipeline capacity which point to the need for expanded on-site storage for major users of petrol and distillate.20

The Federal Government is also currently undertaking a National Energy Security Assessment (NESA). This is intended to address the current strategic energy security issues in the liquid fuels,

19 Within Queensland, day to day responsibility for liquid fuel emergency preparedness rests with the State government’s Department of Mines and Energy.

20 Private communication.
natural gas and electricity sectors and those likely to influence the level of energy security in 2013, 2018 and 2023. The assessment will consider how the identified strategic issues affect adequacy, reliability and affordability in each of these energy sectors. It is expected to be completed by the end of calendar 2008.

The direction the NESA review will take is not known at this stage. The likely starting point in terms of the rationale for policy intervention will be the identification of market failures where any potential costs of government intervention are significantly outweighed by the public benefits. But it is not clear, whether, and if so how such review will address the potential interaction of global oil supply shocks (arising from the high sovereign risk in many supply provinces), physical supply constraints (associated with underinvestment) and the underlying dynamic of largely inelastic demand in the fast growing developing world.

Beyond general policies relating to fuel security, there is a wide range of Federal and State government measures that directly or indirectly influence liquid fuel demand – taxes, subsidies, infrastructure and service provision, fuel efficiency standards/regulations, urban planning/design. The importance of, and need for change in these policy areas is currently being heavily debated in relation to their potential for cost effective reduction in energy demand and greenhouse gas emissions, compared with relying solely/primarily on the pricing of carbon through an emissions trading scheme.

8. Identifying Insurance options for Queensland - demand reduction

a. The transport sector

This section examines from a high level perspective the impact on transport related fuel demand of two critical change vectors operating at faster rates than determined by the CSIRO modelling of pricing/carbon impacts – an accelerated modal shift in the way passenger and freight services are delivered and an increase in the fuel efficiency of the passenger and freight vehicle fleet.

There is a wide range of detailed policies and programmatic approaches to delivering travel reduction and improved fuel efficiency which are broadly summarised thematically in Figure 22.21

<table>
<thead>
<tr>
<th>Vehicle Travel Reduction</th>
<th>Reducing Vehicle Fuel Use /CO2 Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pricing of vehicles, fuels, and roadway usage to discourage vehicle ownership and driving</td>
<td>Increased new car and freight vehicle efficiency through technical measures, including greater adoption of near-term and “next-generation” technologies</td>
</tr>
<tr>
<td>Land use changes and related</td>
<td>Encouraging consumer purchases of the most efficient</td>
</tr>
</tbody>
</table>

21 Sitting alongside these measures, there is potential to remove/reduce policies that effectively incentivise increased fuel consumption and/or discourage use of public transport.
measures that promote transit and non-motorized travel
Improvements in public transport services and incentives for increased patronage
Facilitation of telecommuting
Changes in work patterns (e.g. 4 day weeks)
Freight modal shift (road to rail & sea)

vehicles available
Optimizing on-road efficiency through appropriate capacity enhancements, traffic flow improvements, vehicle maintenance and driver education
Improved freight vehicle utilisation – larger vehicles/better logistical planning
Promoting alternative fuels that reduce oil use, increase overall energy efficiency, and reduce CO2 (and other GHG) emissions.

The currently proposed trajectory for Australian fuel efficiency standards falls well short of those in the European Union, Japan and China (Figure 23).

Figure 23: Comparative light vehicle fuel efficiency standards

Policies to improve vehicle fuel economy will, however, tend to increase travel levels (by lowering the cost of driving) and therefore, as a group, generally work in a different direction than policies that are directly targeted toward vehicle travel reductions (this is the so-called rebound effect).22

22 If mandated fuel efficiency standards resulted in a more fuel-efficient fleet, resulting greenhouse gains would be reduced by the ‘rebound effect’—the tendency for people to drive more when the fuel cost per kilometre decreases. Hence, a 10 per cent improvement in fuel efficiency, regardless of the source, will not translate into a 10 per cent reduction in emissions. Estimates of the rebound effect vary but range between 20...
Policies that effectively increase roadway capacity or improve traffic flow may also induce increased travel.

Previous analysis of a wide range of transport related measures in other countries suggests that most offer modest oil (and carbon dioxide, CO2) reductions when implemented alone, typically in the range of 1% to 3%. A few offer bigger reductions, notably measures targeted at technical improvements in fuel efficiency (as is clear from Figure 23). However, this analysis also indicates that when properly combined, it is not difficult to construct a package of measures that can result in savings of 10% or more.

Further development of an oil mitigation strategy suited to Queensland’s needs and circumstances therefore requires:

- Model based analysis to understand the likely size and cost of avoided oil demand and CO2 emissions associated with individual transport measures; and
- Integration of individual policies and measures into packages that benefit from a synergistic interaction among the components and are supportive of other policy objectives.

It is for consideration whether and, if so, how the air transport sector should be included in the options analysis. It is one of the fastest growing sectors and one in which the Queensland Government has a major direct interest via its assistance to regional and remote area air services. Given the national linkages in the air transport system and the international nature of technology change drivers it may best be primarily managed as a national issue.

**b. Non-transport oil using sectors**

The current composition of non-transport oil use in Queensland is shown in Figure 24. Growth in all sectors out to 2030 is assumed to grow in line with GSP. More detailed analysis is required:

- To calibrate likely demand growth against more recent GSP and sectoral analysis carried out by OESR for the Garnaut Review;
- To understand the implications of higher oil price trajectories and supply disruptions for each of the sectors; and
- To identify and evaluate potential options for managing oil price and supply risk via demand reduction and or fuel switching.

and 40 per cent, depending on the price of fuel. (Greenhouse Policy Options for Transport, Bureau of Regional & Transport Economics, 2001)

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23 Saving Oil and Reducing CO2 Emissions in Transport: *Options & Strategies* (IEA, 2001)

24 Governments often implement transport policies primarily to have effects other than on oil use or CO2 emissions (e.g. safety, congestion reduction, economic development, air quality improvements).
9. Identifying insurance options for Queensland: Increasing/diversifying liquid fuel supply

The CSIRO scenarios modelled reflect generalised assumptions about the supply response to emerging shifts in demand for different fuels.

As noted above, it is not clear that supply will necessarily be forthcoming with existing policy settings given critical risks and uncertainties facing investors. These include:

- the oil and gas price outlook (the latter particularly on the east coast of Australia);
- the competition between food and energy markets for critical biofuels inputs;
- the environmental constraints on larger scale biofuels production (and the full cycle greenhouse impacts);
- cost inflation for large capital intense plants (such as GTL/CTL);
- the future cost of carbon; and
- the cost effectiveness of large scale carbon capture and storage technology.
In developing an oil risk mitigation strategy further work is required to evaluate the option value and costs and benefits of government intervention to accelerate non-conventional liquid fuel supplies to Queensland. Options for further analysis and evaluation could include:

- Supporting increased gas/oil exploration development;
- Increasing distillate storage facilities;
- Supporting strategic refinery investment;
- Expanding CNG distribution/refuelling facilities;
- Supporting accelerated GTL investment; and
- Supporting accelerated CTL capacity.

This is clearly not an exhaustive list but, of the options set out above, preliminary analysis suggests in a high oil price environment, Queensland (and NSW) coal seam gas (CSG) could potentially supply some 50-60% of liquid fuel demand in road transport in Queensland comprising diesel and gas (CNG) demand, with diesel supply coming via the Gas to Liquids route (Figure 26)

**Figure 26: CNG/GTL substitution potential**

![CNG/GTL substitution potential](image-url)
The construction of a 25,000 bbl/day GTL plant based on Queensland/NSW CSG would cost some AS3bn ( @ AS1=US80 cents). This would reduce Queensland’s “import” dependence in transport fuels in 2020 by 15 percentage points, from 80% to 65%. As such, it arguably has a potentially high option value in managing absolute supply shocks to liquid fuel supply.

The level of CSG supply required (55-60 PJ pa over 20 years) would be supportable with current and prospective levels of CSG resources and demand, including significant LNG exports. Further analysis would, however, be required to:

- Validate the supply and cost /economics (including greenhouse/ETS implications);
- Frame and evaluate options for providing incentives that would accelerate the build out of GTL capacity as a cost effective risk management option.

These options could include either State and/or Federal assistance in the form of accelerated project clearance, royalty holidays, capital grants or accelerated tax write-offs. More detailed work would be required to understand the full range of costs, benefits and risks and develop a business case.

10. Initial conclusions
   a. Preliminary findings

Analysis to date suggests that:

- At a broad macroeconomic level, Queensland’s rich resource endowments of gas and coal provide a natural hedge against the oil price outlook that would be consistent with a nearer term plateauing of global oil production. Absent a major global recession, the general upward movement in energy prices would be reflected in improved terms of trade, economic activity and higher government revenue for Queensland;

- Higher prices would likely generate adverse sectoral impacts for industry sectors unable to pass on these higher input prices to downstream markets and/or exposed to end markets that are particularly sensitive to higher oil prices (such as air transport).

For households, initial evidence suggests that such a high oil price environment could combine with other proximate factors (location and low household income) to generate adverse equity impacts that would require consideration in terms of offsetting policy measures.

Detailed modelling of the road transport impacts of high oil price scenarios indicate a major response in terms of reduced oil-based liquid fuel use, delivered primarily via sharply increased fuel efficiency and fuel switching. This response is critically dependent on the underlying model assumptions about both consumer choices and the supply response from providers of alternative fuels and technologies. Further work is required to:

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25 Shell is the leading exponent of GTL technology and has taken a position in a CSG player - Arrow Energy which has 3P reserves of some 3000PJ. This is sufficient for a 50k bbl/day GTL plant operating for 20 years.
• Test and validate these assumptions, particularly those that involve large scale capital investments under conditions of significant uncertainty about future oil and carbon prices;

• Develop and test policy packages in the transport sector for robustness, cost effectiveness and coherence in relation to reducing liquid fuel demand & CO2 emissions and meeting other policy objectives for the sectors.

Physical supply risks, impacts and mitigation options have not been evaluated via either economic modelling or detailed interaction with critically exposed sectors.

Initial analysis suggests that Queensland’s CSG resource provides a significant source of liquid fuel diversification away from conventional oil, both via CNG and GTL. Further work is required to validate/evaluate options in this area compared with a range of other supply side options.

Most of the work to date has been drawn on existing sources of data without the benefit of input from agencies with detailed knowledge of key sectors outside the transport sector and with broader oversight of economic issues/expertise. Interaction with these agencies would assist in generating deeper understanding of sectoral exposures to oil risk and approaches to oil risk mitigation as well as clarify possible risk management objectives in relation to oil price and/or supply risk.