# Sunshine Coast Peak Oil Background Study

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1. Introduction

The *Peak Oil Background Study* is a supporting document for the *Sunshine Coast Climate Change and Peak Oil Strategy 2010-2020*.

1.1 The Climate Change and Peak Oil Strategy

It is the goal of the *Climate Change and Peak Oil Strategy* ‘to build a low carbon, low oil, resilient future for the Sunshine Coast’. The *Peak Oil Background Study* identifies the basis for the policy approaches in the *Climate Change and Peak Oil Strategy* relevant to ‘energy transition’.

1.2 The Policy Context

Council’s *Corporate Plan 2009-2014* promotes policy actions which are intended to ensure the region’s environmental, social and economic prosperity. The *Corporate Plan* objective is to be achieved through the implementation of a number of environmental, social and economic strategies including the *Climate Change and Peak Oil Strategy*.

In addition to supporting the *Climate Change and Peak Oil Strategy*, the *Peak Oil Background Study* can be used to:

- Inform Council planning and operational activities and the Planning Scheme;
- Guide Council and community decision-making;
- Engage community and educate stakeholders; and
- Drive a range of actions to deliver upon the goal.
2. Technical Overview of Peak Oil

2.1 Introduction

‘Peak Oil’ is when the rate of global oil production reaches a peak. A more technical explanation is that peak oil is the point at which the extraction of conventional crude oil from all the oil fields in the world is at its maximum rate. It is important to emphasise that Peak Oil is not when oil is going to run out; rather it signals when the rate of oil being produced will begin to decline. Despite continuing debate about when peak oil will occur there is a consensus amongst oil industry analysts that oil prices will rise and increase in their volatility over the next decade - between 2010 and 2020.

The potential for a decline in the rate of global oil production in the next few years coincides with government initiatives around the world to reduce carbon emissions. A key initiative is to establish emission trading schemes and place a price on carbon. This has implications for the cost of electricity generation in Australia because most electricity is generated from the burning of coal. Coal fired electricity generation is therefore likely to increase in price over the next decade – between 2010 and 2020.

There is a high probability that rising and volatile oil prices on the world market will coincide with rising electricity prices in Australia. To mitigate the impacts of these price rises, Australia will need to transition to a new mix of energy sources to power its economy. The implications of this energy transition for the Sunshine Coast are presented in this background study.

2.2 Reliance on Oil

Oil pervades our economy and modern lifestyle. It became an important commodity in the economy in the 1860s when oil was distilled to produce kerosene. Kerosene was used in lamps for domestic lighting as a cheap and superior alternative to whale oil. From the 1880s oil was also refined into petrol and diesel which became the new fuels for cars, trucks, agricultural and industrial machinery, trains, ships, and later aircraft. Today refined oil is used to:

- Heat homes, offices, and factories;
- Grow, process, package, distribute, refrigerate, and cook food;
- Produce waxes, lubricants, synthetic fibres and fabric;
- Produce detergents, solvents and paint thinners;
- Provide a chemical base for medicines, cosmetics and pharmaceutical products; and
- Produce plastic products (eg. toys to building materials).

The diversity of oil refinery products are shown in Figure 1 and demonstrate the pervasive nature of oil in our economy.
### 2.3 Oil Production Profiles

Given the global economic significance of oil, it is necessary for governments to understand and plan for a decline in global oil supplies.

Oil production profiles describe how the production of individual oil fields and the production of oil from entire countries follow similar patterns over time. In the 1950s, a petroleum geologist (Hubbert) proposed a model to explain the pattern of oil production from an individual field or from a number of fields. His model has since been used to predict when Peak Oil will occur.

#### 2.3.1 Oil Production from Individual Fields

Petroleum geologists that specialise in oil exploration and production have found that once an oil well is constructed its production begins to rise, reaches a peak in its rate of oil production and then begins to decline. Figure 2 demonstrates two examples of giant oil field production profiles that exhibit this ‘rise, peak and decline’ characteristic.
2.3.2 Oil Production from Individual Countries

The same ‘rise, peak and decline’ characteristic applies to oil production profiles of entire countries. A country’s oil production profile aggregates the production from all the oil fields in that country. Figure 3 provides examples of Egypt, which reached a peak in its oil production in 1993 (approximately 0.9 million barrels per day) and Norway, which has large reserves of oil in the North Sea and reached a peak in its oil production in 2001 (approximately 3.5 million barrels per day).

Figure 3: Oil production profiles of Norway and Egypt to 2008.

Source: Koppelar 2008

2.3.3 Australian Oil Production

Australia’s oil production is shown in Figure 4 and began in 1965 when the giant Gippsland oil fields located in Bass Strait were brought into production. By 1973 national oil production was rising rapidly towards 500,000 barrels per day. The Gippsland oil fields peaked in their oil production in the late 1970s, but their declining production in the early 1980s was offset by the North West Shelf oil fields which began producing large quantities of oil. Total oil production in Australia continued to rise until 2000 when it peaked at 809,000 barrels of oil per day. Since then, Australian oil production has been declining, producing less than 600,000 barrels per day in 2008.
2.3.4 Modelling Future Oil Production

While oil profiles for individual countries vary in detail from oil profiles for individual oil fields they demonstrate a consistent ‘rise, peak and decline’ pattern.

Hubbert’s model indicates that half of the crude oil resource is used up by the ‘peak’ of production. In 1956, he used his model (Figure 5 - LHS) to predict that oil production would peak in the United States (US) between 1965 and 1970, depending on which of the contemporary estimates of total oil reserves were considered the most accurate. Oil production in the US did peak in 1970 and signalled its ongoing oil production decline (Figure 5 - RHS).

The peaking of oil production in individual oil fields and for entire countries is now well documented. According to Aleklett (2005), of the 65 largest oil producing countries in the world, 54 have passed their peak in oil production and by 2010 another five will have peaked.

This has led petroleum geologists and others to consider whether the global oil production profile will exhibit the same ‘rise, peak and decline’ characteristics as individual oil field production profiles have shown and as entire country production profiles have shown. Hubbert’s model, and variations of it, have been used extensively as predictive models for oil production and are now being used to determine whether global oil production will peak in the near future.
### 2.4 Global Oil Production

#### 2.4.1 Global Oil Production Profile

The global oil production profile for the past 70 years is shown in Figure 6. It depicts global oil production rising exponentially between 1937 and 1973. In 1974, the world experienced a significant decline in oil production due to a deliberate reduction in oil production by the Middle Eastern oil exporting countries in retaliation against the United States for supporting Israel in the Yom Kippur war.

Similarly, production of oil from Iran and Iraq was severely constrained in 1979 when Iran and Iraq went to war. A pronounced decline in global oil production was recorded for the following 3 years. These two periods which temporarily halted the rise in global oil production are commonly referred to as the Middle East Oil Crises.

**Figure 6:** Global oil production profile 1937 – 2007.

Since the 1970s, global oil production has continued to rise. The global economy in 2007, consumed approximately 86 million barrels a day of ‘Liquids’. ‘Liquids’ refers to ‘liquid fuels’; a commonly used term which refers to ‘conventional’ crude oil as well as ‘unconventional’ oil. ‘Conventional Crude’ oil consumption made up approximately 85 percent of all ‘liquid’ fuels in 2007 and is currently being consumed at a rate of approximately 74 million barrels a day (or 27 billion barrels per year). ‘Unconventional’ oil includes biofuels, heavy oil, tar sands, natural gas liquids and other ‘unconventional’ oil products.
3. The Need to Manage Peak Oil

Global oil production has remained at between 84 and 87 million barrels per day for the past four years, despite rising oil prices for the past decade. Many analysts warn that this ‘plateau’ in production signals that global Peak Oil is imminent and that declining oil supplies will begin in the next few years. The increasing warnings of the need to manage Peak Oil have invigorated the international debate about the imminence of a global peak in oil production (Lynch 2004; Koppelar 2005; Al Husseini 2006; Skrebowski 2007; CERA 2007; Hirsch 2007; USGAO 2007; Robelius 2007; UK Industry Taskforce on Peak Oil and Energy Security 2008; Stevens 2009).

3.1 Estimating when Peak Oil will occur

Most analysts that forecast a peak in world oil production by 2030 fall into the following 3 groups:

1. Those who believe the peak will occur immediately - 2005 to 2010;
2. Those who believe the peak will occur in the next decade - 2010 to 2020; and
3. Those that do not believe oil will peak until after 2020.

Some of those forecasts are demonstrated in Figure 9.

Figure 9: Predictive graphs of Peak Oil from a number of studies during the past two years.
Some oil analysts challenge the concept of Peak Oil (Lynch 2004, CERA 2007) insisting that the rate of oil production is influenced by geological reasons, political decisions and technological advances in oil production. They note that:

- Politics and advances in oil production technology influence production rates;
- Production from non-conventional sources of oil will increase as prices increase; and
- Fuel-switching away from oil will also increase with prices, leading to a ‘prolonged plateau’ in oil production.

In 2007 Cambridge Energy Research Associates (CERA) published findings that world oil production would reach 112 million barrels per day by 2017 (CERA 2007). They were challenged by the United States branch of the Association for the Study of Peak Oil and Gas (ASPO-USA) and two former Saudi Aramco executives in the Oil and Gas Journal based on their experience in Saudi Arabia’s national oil company (Saudi Aramco) which is responsible for the largest oil reserves in the world (Andrews 2008).

The January 17 press release by Cambridge Energy Research Associates reported the world's oil supplies were to rise to 112 million barrels per day (M b/d) by 2017. This rise is in spite of their other conclusion that the world's oil fields are declining in capacity at the average rate of 4.5 percent per year. These conclusions are clearly suspect.

Given the current global production of 86 Mb/d and Cera’s 4.5 percent decline rate, global capacity would have to increase by 7.5 M b/d each year for the next ten years to reach 112 M b/d. This is a total of 75 M b/d of new capacity in 10 years. Even excluding the effect of declining rates, achieving 112 M b/d within a decade represents a massive leap of 26 M b/d in global capacity.

To put this in perspective, 75 M b/d of new capacity is the equivalent of eight new Saudi Arabias or 14 new Irans in just 10 years. Considering the reality that Saudi Arabia, with 25 per cent of the world's best proven reserves, is already investing $50 billion to increase its production capacity by 2 M b/d, where does Cera expect the additional 24 M b/d of production capacity to come from, let alone the replacement for the 51 M b/d of declines?

Dr. Moujahed Al-Husseini, Editor-in-Chief, GeoArabia
Dr. Sadad Al-Husseini, Former Saudi Aramco Vice-President, Exploration and Production

The claim by CERA that world oil production would reach 112 million barrels per day by 2017 is not supported by many oil companies. The following four senior oil industry leaders that have stated that global oil production reaching 100 million barrels per day will be very unlikely are:

- ConocoPhillips’ Chief Executive Officer, James Mulva (Andrews 2008);
- Chairman of Libya’s national oil company, Shoki Ghanem (Andrews 2008);
- Total’s Chief Executive Officer, Christophe de Margerie (Andrews 2008); and
- Robin West Chairman of PFC Energy (Strahan 2008).

The International Energy Agency has also provided explicit warnings to OECD governments about global oil production not keeping pace with global oil consumption. The IEA made its first explicit warning about the oil market in July 2007 Mid Term Oil Market Report (IEA 2007) where it warned of an oil “supply crunch” between 2010 and 2012.
In November 2008 the IEA again warned governments that they must act with the release of its annual report, the World Energy Outlook 2008 (IEA 2008). That report detailed the findings of a study that investigated the status of the worlds 800 largest oil fields and their production. Following are the key messages from that report:

- There remains a real risk that under-investment will cause an oil ‘supply crunch’ by 2015, that conventional oil production will peak in 2020 and that global oil production (liquids) is not expected to peak before 2030;
- The average decline rates of all oil fields is 5.1 percent, higher than previous estimates;
- The global oil industry needs to find the equivalent of six Saudi Arabia’s to meet the projected oil output (106 million barrels per day in 2030);
- The era of cheap oil is over with oil import prices averaging $100 per barrel between 2008 and 2015 and increasing after 2015;
- Pronounced short-term swings in prices are likely to remain the norm and temporary price spikes or sharp falls cannot be ruled out;
- Governments must secure energy supplies and move quickly to a low carbon energy system because “time is running out and the time to act is now”.

The urgency with which the IEA believes governments must begin a rapid energy transition is clearly stated:

“The future of human prosperity depends on how successfully we tackle the two central energy challenges facing us today: securing the supply of reliable and affordable energy; and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply. **What is needed is nothing short of an energy revolution.**”

IEA 2008

The IEA has continued to raise the issue of under-investment due to the current recession. Birol has stated in two interviews since the release of the report that global conventional oil production will “peak in about ten years” – by 2020 (Monbiot 2008; Connor 2009). This is an important change in the IEA’s stance which has consistently dismissed Peak Oil as an issue.

In summary, many petroleum geologists, oil industry analysts, oil industry leaders, and government agencies have warned that Peak Oil is imminent. McCarthy (2008) concludes that:

“there is little or no evidence that world oil production can continue to grow beyond the next decade, indeed the evidence strongly indicates the opposite – a high probability that world oil production will be declining within several years”.

**The key implication from this view is that global oil prices will rise and increase in their volatility.**

Those that cast doubt on the timing or imminence of Peak Oil nevertheless believe that the oil industry will struggle to maintain supplies of oil cheaply. Taylor (2009) concludes that:
While there is doubt about the timing of Peak Oil, there is no doubt that: new sources of conventional oil are becoming more scarce/costly, with deeper drilling in increasingly remote areas; and non-conventional liquid and gaseous fuels are uneconomic below about US$70/bbl.

The key implication from this alternative view is essentially the same - that global oil prices will rise and increase in their volatility.

Both views are therefore indicating that it is timely to examine an energy transition based on oil prices which will be both higher on average and more volatile in the future.

### 3.2 Declining Oil Exports

Once global oil production reaches its peak, and begins its decline, oil exports will decline more rapidly. Oil exporting nations sell their excess oil on world markets after they satisfy domestic oil consumption needs. When their domestic oil production peaks and begins to decline, their domestic consumption of oil does not peak and decline in unison. The outcome is that their oil exports decline more rapidly than their oil production decline rate (Brown and Foucher 2008).

The exporting countries of Indonesia, Egypt, China and the United Kingdom have ceased exporting oil, while Mexico and Norway are experiencing accelerating export decline rates (Brown and Foucher 2009). As shown in Figure 7, the oil exporting nations have not increased oil exports from 2005 to 2008 despite oil prices rising from $40 to more than $100 per barrel.

**Figure 7:** Oil exports from 30 nations 1981 – 2008

![Net oil exports EIA data](image)

Source: Mushalik (in Tverberg 2009) NB. Units for the Y axis are ‘000s barrels per day

The accelerated decline rate may also be exacerbated in the future by oil exporting countries recognising that oil is becoming scarce and making political decisions to reduce their oil exports in anticipation of higher prices in the future.
3.3 Declining Rate of Global Oil Discoveries

Another oil industry trend that concerns analysts is the declining rate of oil discoveries worldwide. As oil production lags oil discoveries, this trend may also be a signal that global Peak Oil is close at hand.

To sustain the current level of global oil production, ongoing oil field discoveries need to be made to offset the oil fields that are in their decline phase. Figure 8 shows that from 1930 until the early 1980s the rate of oil discovered was greater than the oil produced. Since then, however, the rate of oil discoveries has not kept pace with the rate of oil production.

**Figure 8:** The growing gap between World Oil Production and World Oil Discoveries 1930-2007.

![The growing gap between World Oil Production and World Oil Discoveries 1930-2007.](source)

The world is now consuming approximately 27 billion barrels of conventional crude oil per year which is almost four times the rate of current discoveries - approximately 6 to 7 billion barrels per year. There is considerable concern about this growing gap. It is not possible for the world to continue consuming oil at a much greater rate than it is being discovered.
4. Approaches to Managing Peak Oil

The next section briefly explains that Peak Oil by itself is not the problem. It is the decline in oil supplies that follows the peak that is the problem. It is declining oil supplies that the Sunshine Coast community and its economy must manage by rapidly transitioning to other energy sources.

4.1 Energy Transition

An energy transition is when the mix of energy sources used in an economy change over time, in terms of both energy quantity and energy quality. To address Peak Oil and climate change, the region must transition to alternative energy sources and reduce its demand for oil and other carbon based fuels.

Energy Transition is a key policy approach for the Sunshine Coast Climate Change and Peak Oil Strategy 2010-2020.

4.2 Previous Energy Transitions

There have been a number of transitions to new energy sources throughout history. Prior to 1800, the energy sources used to power economies were wind (e.g. sailing ships and windmills), running water (e.g. watermills), animal power (e.g. horses, bullocks, camels and elephants), wood (e.g. space heating and cooking) and human labour. Nations prior to 1800 did not have the technology to harness the modern energy sources of coal, gas, oil, nuclear etc. Since then, developed countries have gone through two energy transitions during which time the proportion of energy provided by different sources changed significantly.

The first energy transition, between 1860 and 1910, saw coal substitute traditional renewable sources of energy such as wood, wind, water and animals. The second energy transition, between 1910 and 1960, saw oil substitute coal as the primary energy source.

United States data for the past 200 years indicates the transitioning between energy sources during the modern era (Figure 10).
Figure 10: The proportionate use of different energy sources in the United States (1800 to 2000).

Australia has also gone through two energy transitions; first to coal and then to oil. Australia differs from the United States in that it still relies more heavily on coal than oil, particularly for electricity production. However, the Australian industry sectors of transportation, construction and agriculture are still highly dependent on oil.

After the Second World War, a new energy transition towards nuclear energy began (Hubbert 1956; Rickover 1957). While it has become a significant energy source for other countries, Australian Governments have not permitted nuclear energy production as an energy source. The primary energy source worldwide continues to be oil.

### 4.3 The Next Energy Transition

During the past 10 years, growing evidence supports the proposition that the decline in global oil production will begin within the next 10 years. This will have profound implications for all the world’s economies, including Australia and will accelerate the transition towards alternative energy sources.

There has also been recognition during the past decade that the climate is changing, largely as a result of human activity. Part of the current Federal Government’s policy to mitigate climate change is the future adoption of an emission trading scheme which is aimed at transitioning to alternative energy sources.

Thus we have two key drivers for change. Peak Oil and/or emission trading schemes will force a rapid transition to alternative energy sources. The next energy transition (depicted as the 3rd Energy Transition in Figure 11) will be characterised by a need to find alternative energy sources that will not pollute the atmosphere with greenhouse gases but will be able to substitute for the declining supply of oil.
Figure 11: Timeline showing the two energy transitions that have occurred during the last 200 years and the next (or third) energy transition that is about to occur.

The next energy transition may take the next 50 years (2010 to 2060) to complete if it follows the rate of energy transitions in the past. However, this energy transition is fundamentally different to previous ones as it will be the first time the world has had to adapt to declining total energy supplies instead of increasing total energy supplies.

4.4 Managing the Next Energy Transition

The energy transition is primarily concerned with accelerating the reduction of our economy’s oil and carbon intensity. Industrialised economies began to reduce their oil intensity quite significantly after the 1st and 2nd oil price shocks of the 1970s as shown in Figure 12. In 2007 Australia had reduced its oil intensity by 40 percent relative to 1979 (RBA 2008).

Figure 12: Oil intensity of four developed economies 1965 – 2007

Source: RBA 2008
Some countries took very strong measures in the 1980s to reduce the oil intensity of their economy and their exposure to future oil price shocks. Brazil, for example, began to produce ethanol from sugarcane in large quantities to substitute for oil in transport. Ethanol now makes up more than 40 percent of the fuel used in Brazil’s vehicle fleet. The Brazilian Government has recently mandated that 5 percent of all diesel consumption will be biodiesel by 2013 (Jamison Group 2008). In addition, in 2008 84 percent of its electricity is produced by hydroelectric power stations (EIA 2008). It is therefore reducing not only the oil intensity of its economy but the carbon intensity of its economy as well.

The Sunshine Coast needs to work to reduce the oil intensity and carbon intensity of its economy, to reduce its regional oil consumption and find alternative energies (particularly for transport fuel) to mitigate the impacts of rising and volatile oil prices. As the region’s economic system is still dependent on oil, and because there are no current alternative fuels that can easily and cheaply substitute oil, there is a need to build resilience across the community to rising and volatile oil supplies (Queensland Government 2008). Responding to oil supply vulnerability is also a key policy in the South East Queensland (SEQ) Regional Plan 2009-2031 (DIP 2009).

Hirsch et al (2005) have estimated that preparation needs to begin 10 and 20 years before global oil production peaks. The Australian Senate’s Standing Committee on Rural and Regional Affairs and Transport (2007), as well as the Queensland Government’s MacNamara Report (2007), state that the prudent approach for Australia and Queensland to take is to start planning for the impacts of rising and volatile oil prices immediately.
5. A Risk Management Approach

5.1 Risk Management

The Sunshine Coast Council is taking a proactive and risk management approach to the issue of Peak Oil and is currently progressing through a three step process:

1. Identify the nature of the risk (or opportunity): The nature of the risk has been identified as the potential for global oil production to decline within 10 years. It also identified that this would lead to rising and volatile oil prices and accelerate a global energy transition.

2. Assess the likelihood and consequences of the risk (or opportunity): The Sunshine Coast economy, its sectors and households will be assessed to determine the likelihood and consequences of the risks and opportunities. These assessments are discussed in the next section.

3. Prepare a strategy and action plan to control that risk and/or take advantage of it through the opportunities it presents. An action from the Climate Change and Peak Oil Strategy is for the Sunshine Coast Council to complete an Energy Transition Plan.

This risk management approach follows the approach taken by the Queensland Government since 2007 when it identified the nature of the risk with its release of the report ‘Queensland’s Vulnerability to Rising Oil Prices’ (Queensland Government McNamara Report 2007). It subsequently released its preliminary assessment of the risks and opportunities for Queensland’s economy (Waller 2008) and is currently preparing an Oil Vulnerability Mitigation Strategy and Action Plan (Queensland Government 2008).

5.2 Assessing the Sunshine Coast’s Risks and Opportunities

Seven assessments that identify the implications for the Sunshine Coast are outlined in this background study. These assessments examine the risks and opportunities to the Australian economy, five Sunshine Coast industry sectors and finally, Sunshine Coast households.

The Australian economy’s energy use is dominated by oil and coal. Figure 13 indicates that oil and coal (both black and brown coal) contribute 76 percent of the Australian economy’s energy use.

Figure 13: Contribution to energy use by primary fuel type, 1997-98

![Energy Use by Fuel Type](source: Fuel Taxation Inquiry 2001)
Therefore it is almost certain that changes to the price of these energy sources will impact the Australian economy with major consequences. An assessment of the implications for the Australian economy has been undertaken.

Industry sectors in the economy display considerable variation in the types of fuel used to provide that sectors energy requirements. Figure 14 demonstrates that the sectors in the Australian economy that are most dependent (ie. >50 percent) on oil derived products (ie. petrol, diesel and LPG) are:

- Road Transport: 100 percent dependent on oil derived products;
- Construction: 96 percent dependent on oil derived products;
- Agriculture/ Forestry/Fishing 85 percent dependent on oil derived products; and
- Mining 50 percent dependent on oil derived products;

Figure 14: Contribution to fuel type by energy use and sector, 1998-99

Tourism is a key industry sector not identified in this list. The tourism sector is a major economic driver for the Australian economy and is highly dependent on transport, particularly air transport. Air transport is 100 percent dependent on jet fuel, which is another refined product of crude oil.
The Sunshine Coast economy differs markedly from the Australian economy. The largest 18 industry sectors of the Sunshine Coast regional economy is shown in Figure 15.

**Figure 15:** (Real) Industry Contribution (including Tourism) to Gross Regional Product, Sunshine Coast, 2002 and 2007

Of the largest 18 industry sectors on the Sunshine Coast, tourism is the largest contributor to Gross Regional Product and mining is the smallest contributor. Of the other industry sectors identified as vulnerable in their oil dependence construction, manufacturing and agriculture/forestry/fishing are amongst the top 10 on the Sunshine Coast.

As such the following industry vulnerability (and opportunity) assessments warranted further review for the Sunshine Coast:

- Road transport Sector
- Construction Sector
- Tourism Sector
- Agriculture/Forestry/Fisheries (Food Supply Sector)

The impact of rising and volatile oil prices on industry sectors will, in turn, have secondary impacts on individual households. An additional assessment of the vulnerability of Sunshine Coast households to rising and volatile oil prices and the global energy transition has been provided.

There are also opportunities for new, alternative energy production on the Sunshine Coast. Producing renewable energy regionally may provide an important opportunity for the Sunshine Coast economy to move through the energy transition to a low carbon economy.
Using a risk management approach assessments are made to identify the implications of rising and volatile oil prices exacerbated by increasing carbon prices for the Sunshine coast community. The seven assessments detailed in the next section are:

1. The Australian economy;
2. Road transport sector;
3. Construction sector;
4. Food supply sector;
5. Tourism sector;
6. Regional energy production; and
7. Sunshine Coast Households.

This vulnerability analysis is represented in figure 16. The arrows represent the destination of the impact. The nature of the risk is the rising and volatile oil prices. The primary impacts (black arrows) will be felt by the Australian economy, the individual sectors of the economy and the individual household. The secondary impacts (red arrows) will be passed onto industry sectors and individual households from an economy constrained by high oil prices. A tertiary impact (blue arrows) is felt by the household when the economy and industry sectors are suffering from the impacts of the rising oil prices. It is this complex cascade and interaction of impacts that makes it difficult to predict the exact impact of a rising and volatile oil price scenario on Sunshine Coast households and the community as a whole.

**Figure 16**: Representation of the Sunshine Coast’s vulnerability analysis.
6. Peak Oil Implications for the Sunshine Coast Community

6.1 Assessment 1: Implications for the Australian economy

Summary: Oil price rises and the economy

- Oil price spikes can constrain global and Australian economic growth.
- As Australia’s oil imports rise, Australia’s exposure to global oil markets increases.
- Future rising and volatile oil prices are expected to coincide with rising electricity prices.
- By transitioning its economy to a less oil and carbon intensive one, the Sunshine Coast will increase its resilience to Peak Oil.

6.1.1 The Link between Oil Price Shocks and Recessions

The history of the crude oil price over the past 40 years is displayed in Figure 17 along with associated recessions and ‘oil price shocks’.

Figure 17: The price of crude oil (nominal and inflation adjusted) from 1970 to 2009.

Source: Adapted from Kopits 2009

Figure 17 shows the oil price rising during the period from 2002 to 2007 when the inflation adjusted price rose higher than the first oil price shock. By 2008 it was as high as the second oil price shock.

During 2007 analysts increasingly questioned why the 2007 oil price shock had not induced a recession, given that eight out of nine US recessions since World War II had been preceded by rising oil prices.
In response, economists explained that a number of factors mitigated the impacts of the oil price rise on the World and Australian economies (Eslake 2005; Fernald and Trehan 2005; Gruen and Lin 2006), including a long ‘resources boom’ in Australia. They reported that, in comparison to the first two oil shocks of the 1970s:

- Oil price rises had not been sudden (i.e. over a few months) but relatively gradual and ‘orderly’ (ie over a few years);
- Oil price rises had not increased inflation or interest rates significantly;
- Oil price rises were due to increasing demand rather than supply interruption;
- Australia’s economy (and the world’s) had become less intensive in its use of oil;
- Australia was a net exporter of energy (natural gas, coal, uranium) and iron ore (all of which were increasing in price as well) which compensated for the negative effects of the rising oil prices.
- The regional economies of North America, Europe and Asia, were all growing concurrently.

Australian studies modelling the potential impacts of further rises in oil prices at the time reported that:

- sustained high oil prices could lead to Australia’s GDP decreasing by 0.8-2 percent (ABARE 2005);
- a rise in the price of oil to $80 a barrel and resultant 10 per cent fall in world trade would reduce Australia’s GDP by 1.3 per cent (ACILTasman 2005); and
- the effect of a doubling of oil price (from $30 to $60 over two years) on the Queensland Gross State Product would be an initial 2.98 per cent decrease levelling out to a 1.01 per cent long term decrease (Queensland Government 2006).

In 2006 Campbell (2006), a retired petroleum geologist of 40 years who founded the Association for the Study of Peak Oil and Gas (ASPO) made a presentation to the British Government’s Department of Trade and Industry, warning that:

“It would be reasonable to anticipate an epoch of recurring vicious circles, made up of Price shock – Recession – Recovery – Price shock, of ever increasing severity as the [oil production] capacity ceiling declines in the years ahead. Such price volatility may indeed be a significant marker of the unprecedented discontinuity associated with the end of the First Half of the Age of Oil.”

This projected volatility in future oil prices is illustrated by Cohen (2009) who forecasts ever increasing oil prices punctuated by volatility as shown in Figure 18.

Figure 18: A projection for the volatility of rising oil prices in the future.
In July 2008 global oil prices produced a third oil shock rising to their highest ever price of $147 per barrel. Rubin (Chief Economist at the Canadian Imperial Bank of Commerce) and Buchanan (2008) pointed out that the oil price rose more than 500 percent between 2002 and 2008, which was twice the climb in real oil prices that produced the two biggest recessions in the post-war era: the 1974 recession and the double-dip recession in 1980 and 1982. They assert that the current recession in the US, like the eight out of the nine that preceded it was primarily due to rising oil prices.

Hamilton (2009), an economist at the University of California supports Rubin and Buchanan’s assertion and concludes that while other factors, such as the US housing crisis, played significant roles in causing the current global economic recession, the oil price shock contributed significantly to it. Kopits (2009), the managing director of Douglas-Westwood Energy Business Analysts in his analysis contends that “in every case when oil consumption breeched 4 percent of GDP the US has suffered a recession”. He states that this recession threshold is equivalent to a global oil price of $80 per barrel and warns that with current oil prices rallying back up to $70 per barrel, returning to an oil price of $150 per barrel again will certainly trigger another recession.

Despite the price of oil dropping to $30 in late 2008 the International Energy Agency re-iterated its warnings of another supply crunch in its World Energy Outlook 2008. It cautions that the next supply crunch is likely to occur by 2015. Shell Oil Company’s CEO Jeroem Van de Veer (2008) estimates “that after 2015 supplies of easy-to-access oil and gas will no longer keep up with demand”. The UK Industry Taskforce on Peak Oil and Energy Security (2008) believes that the supply crunch will occur by 2013. Stevens (2009) argues that an ‘oil supply crunch’ will occur in the next five to ten years but Nyquist and Rosenfeld (2009) of Mckinsey and Company contend that the next “tight demand-supply balance” may occur earlier:

“the tight demand–supply balance seen at the end of 2007 could return sooner than many observers might have anticipated. A spike in the price of oil could occur as soon as 2010”.

The above conclusions and forecasts by respected individuals, companies and agencies support Campbell’s proposal that global oil prices will increase in their volatility and their magnitude and may also induce further economic contractions.

Future volatile and rising oil prices are therefore the key risk that Peak Oil brings to the Australian economy. Oil prices similar to those sustained during 2008 are also likely to constrain economic growth.

6.1.2 Australia’s exposure to rising Oil Prices

Australia’s consumption of liquid fuels, along with its own oil and condensate production, is shown in Figure 19. The forecast scenarios are based on 90 percent, 50 percent and 10 percent probabilities of oil production coming on stream after 2008.

If Australia was self sufficient in oil production volatile global oil prices would not have a significant impact on Australia’s economy. While Australia has been ‘self sufficient’ in the past, notably during the 1980s, it has been importing increasing quantities of oil since 2000. As a result of declining oil production and higher rates of oil consumption only 70 percent of domestic demand for oil was being met by
domestic production in 2005 (Geoscience Australia 2006). Geoscience Australia is forecasting further declines to 52 percent in 2010, and 25 percent in 2020.

**Figure 19:** Australia’s crude oil and condensate production and liquid fuels consumption, 1975 – 2023

As a result of declining oil production, Australia increased its imports of oil by 39 billion litres of crude oil, petrol, diesel and jet fuel in 2007-08 (Bethune 2008). The cost of this increasing dependence on imported oil can be seen in Figure 20.

Bethune (2007) points out that during the 1990s, Australia had a small petroleum trade surplus. In 2000-01, at the peak of oil production in Australia, there was a petroleum trade surplus more than $3 billion. However, by 2004 Australia’s petroleum trade became negative as oil production in Australia declined significantly.

**Figure 20:** Australian Petroleum Trade 1982 to 2006.

According to APPEA (2009) the petroleum trade deficit increased to $8.4 billion in 2007 and $13.1 billion in 2008. This trade deficit is costing the Australian economy more than $1 billion a month (or $36 million a day). Orchison (2009) states that “a $10 increase in the price of crude oil delivers [a] $2.8 billion blow directly to the domestic economy”.
Federal Minister for Resources, Martin Ferguson highlighted Australia’s future exposure (7.30 Report 2008):

“We’ve got to find another Bass Strait, because if we don’t by 2015 we will go from importing about 20 per cent of our needs in the 1990s to importing 80 per cent of our oil and related product needs, effectively contributing to a $27 billion per year trade deficit.”

Ferguson 2008

Considering Australia’s dependence on imported oil, the potential price impacts must be considered. CSIRO’s (2008) forecasting of petrol and diesel prices identifies only a slight rise in present levels if the international oil supply continues to grow steadily. However, if future oil supplies decline and the technology response is slow, petrol prices could increase to between A$2 and A$8 per litre by 2018 as shown in Figure 21.

**Figure 21:** CSIRO’s modelled price impacts for different rates of post-peak oil decline in oil supplies and slow, moderate and fast technology and infrastructure responses.

![CSIRO’s modelled price impacts for different rates of post-peak oil decline in oil supplies and slow, moderate and fast technology and infrastructure responses.](source: CSIRO 2008)

CSIRO also examined the impact on oil prices of an emission trading scheme. Emission permit prices of A$40 and A$100/tCO$_2$e translated to petroleum fuel price increases of A$0.10 and A$0.25 per litre, respectively, as shown in Figure 22. While significant, the impact of emission permit prices is proportionally less than the potential changes in oil prices due to Peak Oil (see figure 20).

**Figure 22:** Potential future petrol prices under alternate international oil market conditions.

![Potential future petrol prices under alternate international oil market conditions.](source: CSIRO 2008)
This assessment illustrates that Australia is becoming increasingly dependent on imported oil and is increasingly exposed to rising and volatile global oil market prices. It is expected that emission permit prices will also increase fuel prices, but not to the same extent as declining global oil supplies.

6.1.3 Australia’s exposure to rising Carbon Prices

Electricity prices in Australia are some of the lowest in the OECD and are less than half the cost in many countries of Europe as shown in Figure 23.

**Figure 23**: Comparison of electricity prices in selected OECD countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Residential</th>
<th>Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Netherlands</td>
<td>10</td>
<td>25</td>
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<tr>
<td>Italy</td>
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<tr>
<td>Ireland</td>
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<td>25</td>
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<tr>
<td>Luxembourg</td>
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<td>United Kingdom</td>
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<tr>
<td>Portugal</td>
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<td>Austria</td>
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<td>Spain</td>
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<tr>
<td>Slovak Republic</td>
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<td>Hungary</td>
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<tr>
<td>New Zealand</td>
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<td>France</td>
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<td>Poland</td>
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<td>Finland</td>
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<tr>
<td>Czech Republic</td>
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<td>Switzerland</td>
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<td>Norway</td>
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<td>Turkey</td>
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<td>25</td>
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<tr>
<td>Australia</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>United States</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Korea, Republic of</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Mexico</td>
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<tr>
<td>Italy</td>
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<td>Ireland</td>
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<td>Slovak Republic</td>
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<td>United Kingdom</td>
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<td>Czech Republic</td>
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<td>Turkey</td>
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<tr>
<td>Australia</td>
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<tr>
<td>United States</td>
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<td>France</td>
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<td>25</td>
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<tr>
<td>Norway</td>
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<td>25</td>
</tr>
</tbody>
</table>

Source: ABARE 2009

Queensland’s comparatively cheap electricity price is partly attributed to its reliance on black coal which generates 70 percent of the State’s energy (see Figure 24).

**Figure 24**: Queensland’s Electricity Generation Capacity by Fuel Type 2000–01 and 2005–06

Source: DIP 2008
However, the Queensland Government has recently raised the cost of electricity to provide additional transmission and distribution infrastructure. Additional infrastructure has been required in South East Queensland because maximum (or peak) electricity demand has grown by 38 percent during the last five years. The rapid growth in both population and peak power demand in South East Queensland (DIP 2008) has meant that Energex will spend almost $9 billion on infrastructure during 2005-2010 to service the peak demand periods of the year. To fund the increasing costs of infrastructure electricity retail costs have risen by 11.37 per cent in 2006-07, by 9.06 percent in 2007-08, and by 11.82 per cent in 2008-2009 (DME 2009).

The impact of the Federal Government’s proposed *Carbon Pollution Reduction Scheme* will be to raise electricity generation costs. This rise will add to rising transmission and distribution costs in Queensland. Garnaut (2008) has estimated that the impact of a 550ppm CO$_2$ target would be to effectively double the cost of electricity by 2015 - 2020 whereas a 450ppm CO$_2$ target would increase the cost of electricity by two and a half times as shown in Figure 25.

**Figure 25: Impact of CO$_2$ targets on wholesale electricity prices, 2005–50**

![Impact of CO$_2$ targets on wholesale electricity prices, 2005–50](source: Garnaut 2008)

In this assessment the primary implication of rising and volatile oil prices for the Sunshine Coast economy is constrained economic growth exacerbated by rising carbon prices and electricity prices as well.

By transitioning to a less oil and carbon intensive economy the Sunshine Coast will be resilient to future oil shocks and carbon pricing. It is therefore recommended that Council lead its community and build resilience by reducing its crude oil based fuel consumption by 5 per cent per year from 2011-2012. This target corresponds to the International Energy Agency’s “observed decline rate averaged across all 800 of the largest global oil fields”.
6.2 Assessment 2: Road Transport Sector

Summary: Oil price rises and the Road Transport Sector

The implications for the Road Transport Sector of rising and volatile oil prices are:

- The Road Transport Sector is highly dependent on diesel fuel.
- Oil price spikes increase operating costs and reduce profits for transport companies.
- There are few current economic substitutes for diesel which makes the road transport sector highly exposed to rising and volatile oil prices.
- Re-localisation of trade is a likely future trend as transport becomes more expensive. Town revitalisation and economic diversification could build resilience to high transport costs.

The transport and logistics sector is central to Australia’s economic growth and contributes 14.5 percent of Australia’s gross domestic product. It generates approximately 464,000 jobs and encompasses about 165,000 businesses (135,000 of these with five or less employees). In Queensland it contributes 18.6 percent of Gross State Product (Apelbaum Consulting Group 2007). In 2003, this sector consumed more than 10 billion litres of fuel which represented 35 percent of Australia’s total fuel consumption (Australian Government 2006).

The Australian transport industry is completely dependent on the oil derived products of petrol, diesel and LPG and unlike other sectors of the economy has not responded to the oil price shocks of the 1970s. As shown in Figure 26 the ‘Industry’ and ‘Other Sectors’ of the economy have increased their use of energy, since 1973, consuming more gas and electricity and reducing the use of oil. The transport industry has also increased its consumption of energy; however, it has not substituted into other energy sources and is still almost completely dependent on oil.

Figure 26: Breakdown of Australian industry sectors energy consumption by source in 1973 and 2006.

Source: IEA 2009 (Note: Mtoe = million tonnes of oil equivalent)
The impact of rising fuel prices can be severe on the road transport sector. According to Crothers (2008) since 2003, fuel costs as a proportion of transport operating costs rose from a range of 11-13.4 per cent in 2003 to 18-19.2 per cent in 2008 (depending on the vehicle type).

Accountancy firm Prentice Parbery Barilla (PPB) indicated that fuel costs made up 70 percent of total vehicle running costs for small operators in 2005 (PPB 2005a). They warned that if the price of oil averaged $40 in 2005 and $35 in 2006, small operators would increase their operating costs from 27 per cent to 35 per cent, effectively eliminating 7 per cent profit margins. More than 6,000 owner-drivers of transport vehicles left the industry during 2004-2005 citing high diesel prices as a major reason (Worth 2005). By 2006, oil prices had risen by more than $60.

It is expected that fuel prices during 2007 and 2008 contributed to further decline in transport operator margins. Operators who remained in business passed on the fuel price increases to their customers in the form of fuel levies. The retail trade sector, which is highly dependent on road freight, was affected. Companies began to realise that proximity to markets and reduced transport costs were critical in gaining a comparative advantage (Rubin and Tal 2005). A ‘re-localisation’ of trade is likely to emerge as rising oil prices become a significant barrier to global trade.

In summary, the road transport sector in Queensland and the Sunshine Coast is almost completely dependent on oil and is highly vulnerable to the potential impacts of oil price rises. Major changes by road transport businesses to adapt to rising fuel prices have flow on implications for many other sectors of the Sunshine Coast economy such as tourism, construction and food supply. As a result of rising fuel prices, a re-localisation of economic development may emerge on the Sunshine Coast in the long-term. Rail networks may be revitalised as rail freight becomes better able to compete with road freight.

The Sunshine Coast has a major rail line running through the region, from north to south. The State Government is currently duplicating the rail line from Caboolture to Landsborough and is planning to duplicate the line from Landsborough to Nambour. Continued advocacy for rail extension and rail links to the coast should continue to be a priority for Council.
6.3 Assessment 3: Construction Sector

Summary: Oil price rises and the Construction Sector

- Construction materials will increase in price in response to rising and volatile oil prices due to rising commodity prices and rising transport costs.
- Rising construction transport costs as well as rising material costs will put pressure on construction company margins.
- The greatest potential impact on the construction sector will be a reduction in demand for construction from constrained economic growth induced by future oil price shocks.
- The construction sector on the Sunshine Coast has the opportunity to substitute oil dependent construction materials with materials that are produced regionally and require less oil in their formulation and transport.

The construction sector is the sixth largest sector on the Sunshine Coast generating more than $500 million in 2007 (SGS 2007). It is anticipated that rising and volatile oil prices will threaten profit margins in the construction sector in four ways:

- Increased construction material prices;
- Increased transport costs for both materials and labour;
- Increased earth moving costs; and
- Decreased demand for construction from rising oil prices constraining Australia’s economic growth.

As shown in Figure 27 rising steel prices occurred at the same time as rising fuel prices between 2000 and 2008.

Figure 27: Monthly average petrol prices and Asia Steel Prices Index.

Source: AIG 2008

Rising oil prices have contributed to construction material costs, as increased transport costs push up the price of construction materials. Rising road freight costs identified in the previous assessment, coupled with rising shipping costs from the increase in ‘bunker fuel’ prices, have contributed to
construction material costs. Similar price increases have occurred for other metals including aluminium and copper (AIG 2008).

The amount of embodied energy in construction materials is illustrated in Table 1. This table does not differentiate between the types of fuels used in the process of converting the raw material to the finished product. However, it does give an indication of the materials that may be most impacted by rising oil and carbon prices. Aluminium, synthetic rubber, copper, plastics and PVC are the most energy intense of the construction materials.

Table 1: Embodied energy of various construction materials

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>EMBODIED ENERGY MJ/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiln dried sawn softwood</td>
<td>3.4</td>
</tr>
<tr>
<td>Kiln dried sawn hardwood</td>
<td>2.0</td>
</tr>
<tr>
<td>Air dried sawn hardwood</td>
<td>0.5</td>
</tr>
<tr>
<td>MDF</td>
<td>11.3</td>
</tr>
<tr>
<td>Plywood</td>
<td>10.4</td>
</tr>
<tr>
<td>Glue-laminated timber</td>
<td>11.0</td>
</tr>
<tr>
<td>Plastics - general</td>
<td>90.0</td>
</tr>
<tr>
<td>PVC</td>
<td>80.0</td>
</tr>
<tr>
<td>Synthetic rubber</td>
<td>110.0</td>
</tr>
<tr>
<td>Acrylic paint</td>
<td>61.5</td>
</tr>
<tr>
<td>Imported dimension granite</td>
<td>13.9</td>
</tr>
<tr>
<td>Local dimension granite</td>
<td>5.9</td>
</tr>
<tr>
<td>Gypsum plaster</td>
<td>2.9</td>
</tr>
<tr>
<td>Plasterboard</td>
<td>4.4</td>
</tr>
<tr>
<td>Cement</td>
<td>5.6</td>
</tr>
<tr>
<td>In situ Concrete</td>
<td>1.9</td>
</tr>
<tr>
<td>Precast tilt-up concrete</td>
<td>1.9</td>
</tr>
<tr>
<td>Clay bricks</td>
<td>2.5</td>
</tr>
<tr>
<td>Concrete blocks</td>
<td>1.5</td>
</tr>
<tr>
<td>Glass</td>
<td>12.7</td>
</tr>
<tr>
<td>Aluminium</td>
<td>170.0</td>
</tr>
<tr>
<td>Copper</td>
<td>100.0</td>
</tr>
<tr>
<td>Galvanised steel</td>
<td>38.6</td>
</tr>
</tbody>
</table>

Source: Lawson in McDonald 2007

The rising price of fuel has also put strong downward pressure on the profit margins of Australian construction firms, particularly those which rely on large fleets to transport equipment and materials (AIG 2008). Increasing freight costs, through fuel surcharges, have caused businesses to focus on improving supply chain energy efficiency as a new competitive imperative. Lapide (2007) advocated that companies start calculating ‘oil footprints’, which examine the oil intensity of their supply chain, to identify their vulnerability to oil price increases as shown in Figure 28.

By examining ‘oil footprints’ companies are likely to realise that proximity to markets will become more critical in gaining comparative advantage due to decreased transport costs (Rubin and Tal 2007; Simchi-Levi 2008; Deering and Forbes 2009; Meyer 2009).
Simchi-Levi 2008 indicates that as crude oil prices increase, transportation costs become more important relative to production and facility fixed costs. Supply chain managers will need to consider the following:

- Moving production centres closer to demand, despite relatively higher labour costs.
- Increasing the number of distribution centres as outbound transportation becomes more expensive, and it becomes increasingly important to minimise the distance of the final leg in the distribution network.

CTC Consulting (2007) has indicated in its submission to the Australian Senate’s Inquiry into Fuel and Energy that:

“All inputs to construction and manufacturing that are imported will rise at a higher rate than domestically produced product. International shipping costs may soon become a deal breaker for imports eroding their current advantages of cheap capital and labour.”

Earth moving contractors and other contractors to the construction industry use large quantities of fuel in their trucks and earth moving equipment. Huett (2008) illustrated the impact of rising fuel prices between October 2007 and September 2008 suggesting that earth moving contractors that use tippers with trailers would have to increase their hourly rate by 12% to 20%.

Construction firms are also likely to be indirectly impacted by rising and volatile oil prices. The potential for economic growth to be constrained by rising and volatile oil prices has been discussed in the Australian Economy Assessment 1 and may lead to a decrease in demand for construction. In addition, the link between housing construction location and rising fuel prices is discussed in the Household Assessment 7. The housing construction sector may have to consider changes to house types. For example infill dwellings closer to the centre of cities may be in greater demand than single detached dwellings in fringe suburban subdivisions that are further from employment and public transport.
6.4 Assessment 4: Tourism Sector

Summary: Oil price rises and the Tourism Sector

- While the Australian tourism sector relies heavily on international visitors, the Sunshine Coast tourism sector is mainly domestic visitor-driven.
- Domestic visitors who rely on low cost airlines, or are travelling interstate by car, are likely to reduce their number of visits to the Sunshine coast.
- There are no current economic substitutes for Jet fuel and the aviation industry is one of the most exposed industries to oil price fluctuations;
- Regional airports, such as the Sunshine Coast Airport, are exposed to capacity reductions from airlines in the event of rising oil prices.
- A detailed assessment of the impact that future rising and volatile oil prices are likely to have on the Sunshine Coast Airport should be considered.

Studies overseas have indicated that the tourism sector would be negatively affected by rising oil prices. Becken (2007) recently examined the vulnerability of New Zealand’s tourist industry to Peak Oil and warned tourist destination managers that:

“Market composition to a destination is likely to change dramatically up to the extreme of no international tourism. However, an increase in domestic tourism and local recreational activities that involve minimum mobility is likely to increase.”

Yeoman et al (2006) also concluded that Scotland’s (i) international tourism is the sector that will be most affected while domestic tourism (within Scotland) is the sector that will be least affected; and (ii) the viability of low cost air carriers will be severely threatened.

Tourism is a major contributor to the Australian, Queensland and Sunshine Coast economies. In 2005-06, it contributed $37.6 billion towards Australia’s Gross Domestic Product (GDP), representing 3.9 percent of the economy. The previous year, tourism in Queensland contributed $8.7 billion dollars to the Gross State Product (GSP), representing 5.8 percent of the Queensland economy. Tourism is the second largest export earner for Queensland behind coal (Tourism Queensland 2007). PPB (2005b) has advised that businesses dependent on tourist dollars will be affected by rising oil prices. Both international visitation and self-drive motoring holidays are ‘likely casualties’ with international visitors deferring travel as a result of rising oil prices, higher travel costs and lower disposable incomes.

The tourism sector provides the largest contribution to the Sunshine Coast Gross Regional Product. According to SGS (2007) the tourism industry contributed $1,207 million to the Gross Regional Product (GRP) in 2007. This represents 17 percent of the Sunshine Coast’s $7 million GRP. The Sunshine Coast is therefore three times more dependent on the tourism industry than the Queensland State economy.

Access Economics (2009) ranked the Sunshine Coast as one of the most vulnerable regions in Australia to ‘shocks’ in the tourism market. It cited a high proportion of employment being concentrated in the Sunshine Coast’s tourism sector and the third highest level of income derived from tourism per capita as reasons for its assessment.
However, the Sunshine Coast tourism sector may not be so vulnerable to oil and carbon price shocks relative to other regions. This is because the Sunshine Coast tourism sector relies predominantly on ‘domestic overnight’ and ‘domestic day’ visitor expenditure rather than international expenditure (see Figure 29). Tourism Sunshine Coast (2008) indicates that in the year ending June 2008 there was a total of 3,204,000 domestic and international visitors to the Sunshine Coast. Of these 2,922,000 (91 percent) were domestic visitors and only 282,000 (9 percent) were visitors from overseas.

**Figure 29:** Source of tourism expenditure in each tourism region (percent Total)

![Figure 29: Source of tourism expenditure in each tourism region (percent Total)](image)

*Source: Access Economics 2009 (based on TRA tourism expenditure data)*

The vulnerability of the Sunshine Coast tourism sector to oil and carbon prices is potentially further reduced because the largest proportion (45.5 per cent) of domestic overnight visitors are from Brisbane, followed by ‘other Queensland’ sources (26.6 per cent) as shown in Figure 30. Nearly 50 percent of domestic visitors are from Brisbane and have to travel less than 200 kilometres to get to the Sunshine Coast. Contrast this with Alice Springs, for example, that relies on international visitors and domestic visitors who travel thousands of kilometres to the region by air, rail or road.

**Figure 30:** The origin of domestic overnight visitors to the Sunshine Coast

![Figure 30: The origin of domestic overnight visitors to the Sunshine Coast](image)

*Source: Tourism Sunshine Coast and emda 2009*

Of all visitors to the Sunshine Coast, those most likely to be affected by oil and carbon price increases are the 282,000 international tourists who travel long distances on airlines. The top source markets for
international visitors to the Sunshine Coast are Europe (52 per cent), New Zealand (28 per cent) and the USA (4 per cent) according to Tourism Sunshine Coast (2008).

This assessment finds that the tourism sector of the Sunshine Coast will be impacted by rising oil prices, but not as significantly as other Australian tourist regions. No attempt has been made to assess how the Sunshine Coast tourist sector was affected by the rising oil prices of 2007 and 2008.

6.4.1 Aviation

In 2006, the Queensland Government modelled the impact of a sustained higher oil price on Queensland’s economy (Queensland Government 2006). It reported ‘the most adversely affected industry is air transport, for which activity is projected to be some 27 per cent lower by 2016-17 than it would otherwise have been’.

The Sunshine Coast Council owns the Sunshine Coast Airport. It is an important strategic asset that generates significant revenue for the Council. It is also a significant contributor to the Sunshine Coast tourism sector and the regional economy as a whole. Future oil price rises that replicate those experienced in 2007 and 2008 present a long-term challenge to airlines world-wide. The future vulnerability of domestic and international airlines will indirectly affect the capacity for Sunshine Coast airport to generate revenue for the regional economy.

The airline industry relies almost exclusively on a derivative of oil, jet fuel, to power its aircraft. According to Smith (2006) and Schlumberger (2008), there are currently no commercially available fuel alternatives for use in jet aircraft engines. The oil price rises over the past few years have accelerated research into alternative jet engine fuels, but it remains to be seen whether a substitute will be found in the short to medium-term.

Fuel is one of the key operating costs that an airline has to control to remain profitable. Labour costs have been the largest component of total operating costs for commercial airlines historically but in 2006 fuel replaced labour as the largest single cost item. Fuel costs have risen from 13 per cent of total operating costs in 2001 to 27 per cent in 2007 and estimated to be 31 per cent in 2008 (IATA 2009). Figure 31 demonstrates the extraordinary lengths that airlines have gone to in containing their fuel costs to remain profitable.

**Figure 31**: Fuel conservation measures that US airlines are implementing.

<table>
<thead>
<tr>
<th>Fuel Conservation Via Weight or Drag Reduction</th>
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<tbody>
<tr>
<td>• One airline saved over 17 gallons/year per pound of weight per airplane after shedding inflight phones, ovens, excess potable water, and some galley equipment on an older fleet</td>
</tr>
<tr>
<td>• In removing seatback phones from its MD-80s and B737-400s, another airline shed 200 pounds per airplane, translating into 3,400+ gallons saved annually</td>
</tr>
<tr>
<td>• Alaska Airlines indicated in March 2004 that removing just five magazines per aircraft could save $10,000 per year in fuel; also, the airline has reduced the weight of catering supplies</td>
</tr>
<tr>
<td>• Air Canada considered stripping primer and paint from its 767s to save 360 lbs. per plane</td>
</tr>
<tr>
<td>• JetBlue and US Airways and others have moved toward a paperless cockpit</td>
</tr>
<tr>
<td>• By removing six seats, JetBlue reduced A320 weight by approximately 904 pounds</td>
</tr>
<tr>
<td>• Airlines have been able to remove ovens, trash compactors, or even entire galleys, due to the elimination of hot meals on selected flights; others are using lighter seats; they have also removed magazine racks and replaced hard cabin dividers with curtains</td>
</tr>
<tr>
<td>• AirTran ordered carbon fiber Recaro seats for its 737-700s to shave 19.4 pounds per row, resulting in estimated fuel savings of $2,000 per year per aircraft</td>
</tr>
<tr>
<td>• Alaska’s new beverage cart, at 20 lbs. lighter, could save $500,000 in annual fuel costs</td>
</tr>
<tr>
<td>• Pratt &amp; Whitney estimates that its EcoPower engine-washing process saves Hawaiian 2.8 pounds (or $1 million) in fuel annually across the airline’s 51 Boeing 767 engines</td>
</tr>
<tr>
<td>• Some airlines flush lavatories during extended ground delays to minimize takeoff weight</td>
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</tbody>
</table>
Qantas dominates Australia’s air transport sector, and an examination of the company’s annual reports indicate that Qantas fuel expenditure for the year ending June 1999 was $762 million. For the year ending June 2008, Qantas fuel expenditure had risen nearly five fold to $3,602 million despite complex fuel-hedging strategies. The proportion of total expenditure that fuel costs represent has gone from 9.8 per cent (June 1999) to 25.1 per cent in 2009 (see Figure 32).

**Figure 32:** The proportion of three major cost items as a proportion of total operating expenditure for QANTAS between 1999 and 2009.

![Figure 32](chart.png)

Source: QANTAS 2009.

In July 2008, when the price of oil rose to $US147 per barrel, the Qantas CEO, Geoff Dixon, put the issue of rising fuel costs for airlines into perspective:

“Oil, of course, is a finite natural resource and whether or not the world has reached ‘Peak Oil’ is a matter of debate. But there is no question that the cost of finding and extracting oil will continue to climb … Right now airlines around the world are cutting routes and capacity, grounding and retiring aircraft, and shedding staff - it is likely that 100,000 jobs worldwide will be lost before this calendar year is out. In the past six months alone 24 airlines have closed down completely. The major US carriers are now planning to ground 465 aircraft - that is more than twice the size of the Qantas fleet.”

Dixon 2008

Jetstar is a subsidiary of Qantas which uses the Sunshine Coast Airport for domestic flights. Jetstar Chief Executive Officer (CEO) Simon Westaway stated in May 2008 that his company’s fuel costs represented 32 percent of total costs (Inside Business 2008). In response capacity reductions were directed at regional destinations that were less lucrative for the airlines as capital city routes. The Sunshine Coast Airport has experienced a 25 per cent capacity reduction from Jetstar.

Virgin Blue is another of the low cost airlines that uses the Sunshine Coast Airport. In June 2008, fuel costs represented 27 percent of total costs (Virgin Blue 2009). Virgin Blue’s CEO, Brett Godfrey, indicated that the cost of fuel was having a two fold impact on the airline. Not only was it impacting directly on the cost of fuel for the airline but it was also reducing the discretionary spending of its customers (ABC Lateline 2008). The reduction in capacity by Virgin Blue in and out of the Sunshine Coast Airport has been 50 per cent since June 2008.

Virgin Blue (2008) in its submission to the Senate Select Committee Inquiry on Fuel and Energy indicated its responses to rising fuel prices:
The financial pressure that airlines were under in the first six months of 2008, as the oil price rose from $US100 to $US147 per barrel, provides a window into the future of rising and volatile oil prices for the Sunshine Coast Airport. The Principal Air Transport Specialist for the World Bank, Charles Schlumberger, concluded in his examination of the oil price spike in 2008 that:

"Both scenarios [(i) a peak in oil production from under investment or (ii) a peak in global oil supply would undoubtedly lead to very high fuel prices and they present a major risk to an industry [aviation] in which there are presently no substitutes for fossil fuel based energy… The airline industry must address the issue of energy security in the interest of its own future.

Schlumberger 2008

It is recommended that the Sunshine Coast Council conduct a detailed assessment on the impact that future rising and volatile oil prices are likely to have on:

- The viability of airlines that use the Sunshine Coast airport and the strategic implications for Council and its future planning for the airport;
- The likely structural changes in the Sunshine Coast’s tourism sector.

In summary, the tourism sector has been affected by rising oil prices because of its reliance on road transport and particularly air transport. Aviation is the most vulnerable mode of transport to rising oil prices as it is the most intensive user of oil with no foreseeable fuel substitutes. There may be opportunities for the Sunshine Coast tourism sector, however, to capitalise on its close proximity to visitors from the major metropolitan area of South East Queensland who do not have far to travel.
6.5 Assessment 5: Food Supply Sector

**Summary: Rising Oil prices and the Food Supply Sector**

- Australia’s food production and food supply system is vulnerable to the impacts of rising oil prices because both on farm inputs and off farm processing, packaging and distribution are intensive users of diesel and petrol.
- Local production of many food items does not meet consumption needs of the Sunshine Coast population.
- Produce that is imported into the Sunshine Coast relies on cheap road and air transport and threatens the viability of local producers.
- The local prawn fishing fleet is one of the most exposed local food industries and relies heavily on diesel fuel to operate.
- Support for the re-localisation of food production, community gardens, and farmer’s markets will help build the region’s resilience to rising and volatile oil prices.

There are five primary reasons why Australia’s agriculture and fishing industries are vulnerable to rising oil prices.

Firstly, broadscale agricultural production requires powerful machinery for daily tasks such as ploughing, planting, fertiliser spreading, pesticide spraying, irrigation, mustering and transporting produce from the farm gate to markets. Tractors, harvesters, trucks, utes, motorcycles and irrigation pumps all use internal combustion engines fuelled primarily by diesel. Fishing requires trawlers with very large diesel motors to travel long distances out to sea and back to port. According to the Fuel Taxation Inquiry (2001) the agriculture, fishing and forestry sector relies on diesel to provide 84 per cent of its energy requirements.

A second reason is the distributed nature of the Australian population and food growing regions around Australia and the long distances between them. The cost of transporting perishable products quickly on refrigerated trucks, or even planes, has become such a small proportion of a food item’s cost that identical products from many regions in Australia and even other countries compete on the same supermarket shelf.

A third reason is due to its agricultural products being produced in such abundance that domestic consumption represents a minor share of the market. Agricultural production in Australia is highly export oriented. If oil prices continue to rise the cost of Australian agricultural products overseas will rise disproportionately to commodities produced in other countries, given the distance that Australian products have to travel. Following is a snapshot of the percentage of major Australian agricultural commodities destined for export markets (Vaile 2001):

- 98 per cent of all wool;
- 95 per cent of all cotton;
- 76 per cent of all wheat;
- 76 per cent of all sugar;
- 63 per cent of all beef; and
- 54 per cent of all dairy production.
The fourth reason is due to Australian farmers needing to be highly efficient in order to compete with: (1) low wage agricultural labour in developing countries; and (2) heavily subsidised agricultural production in the US, Europe and Japan (Howard 2006). By substituting machinery for labour and reducing labour costs Australian producers have become some of the most efficient farmers in the world (in terms of the amount of labour to produce a unit of production). Historically, farmers have substituted labour for more efficient machinery, with the support of the Federal Government’s diesel fuel rebate scheme (Baker 2000). This labour use efficiency has, however, made Australian food production increasingly dependent on diesel powered machinery and irrigation pumps.

The fifth reason is the increasing use of oil in the manufacturing, packaging and distribution of farm inputs and outputs. Pesticides were the sixth largest cost item for farmers in 1998-99 (Baker 2000) and are derived from petrochemicals in their manufacture. According to Lucas, Jones and Hines 2006 food processing, packaging and distribution has become more dependent on oil for these reasons:

- Highly processed and packaged food using plastics (e.g. polyethylene films and polystyrene products) which are derived from oil;
- Globalisation of the food industry has led to a wider sourcing of food products from overseas;
- Supermarkets emerging as sales leaders has meant a switch from frequent food shopping on foot at small local shops, to shopping by car at large suburban supermarkets;
- The concentration of agricultural production into fewer, larger suppliers to meet supermarket preferences for bulk year-round supply of uniform produce;
- Major changes in delivery patterns, with most goods now routed through supermarket regional distribution centres and use of larger trucks and just-in-time delivery.

The effect of these trends is to increase the number of kilometres that food items travel from farms and fisheries to Australian households. Gaballa and Abraham (2007) examined the kilometres travelled by 29 food items purchased in Melbourne. The total distance travelled by all 29 items in the shopping basket was 70,803 kilometres. Examples include:

- Fresh full cream milk travelled on average 348 kilometres. The cartons that the milk is packaged in were found to have travelled 8,036 kilometres from Singapore and Taiwan before they were transported to Australia;
- The wheat used for bread manufacture travelled on average 486 kilometres; and
- The Heinz baked beans were transported 3,132 kilometres from Hastings in New Zealand.

Australia’s food production and food supply system is vulnerable to the impacts of rising oil prices because both on farm inputs and off farm processing, packaging and distribution are intensive users of diesel and petrol.

The Sunshine Coast has a significant agricultural, forestry and fisheries industry which contributed $376 million to the Sunshine Coast economy. This represented 5.4 per cent of the Gross Regional Product, in 2007, and is the ninth largest sector in the regions economy (SGS 2007).
Council recently undertook a regional food security study to identify the status of food production on the Sunshine Coast. Shelton and Freiser (2009) found that the Sunshine Coast’s production of many food items did not meet the consumption needs of those items by the Sunshine Coast population (see Figure 33).

**Figure 33:** Sunshine Coast food production and consumption.

![Sunshine Coast food production and consumption graph](image)

For specific food items they found that:

- Wheaten flour (used for bread manufacture) is not produced in any quantity on the Sunshine Coast and is brought into the region from grain growing regions such as the Darling Downs and Granite Belt;

- Sunshine Coast produces approximately 20 per cent of its total vegetable consumption needs, although almost half of the vegetables consumed are in the form of potatoes, and the region produces only 0.1 per cent of potato needs;

- Similarly, total fruit production would appear to meet approximately 20 per cent of the region’s fruit needs. But the most popular fruits are apples and bananas, which are not produced in significant quantities in this region;

- Milk production exceeds consumption; however, this does not take into account the consumption of cheese, yoghurts and other dairy products, only a small proportion of which is produced locally. In addition, there are only two milk processing plants in the region.
• Local production of beef and veal makes up approximately one third of the region’s consumption. However, the vast majority of the beef and veal production is processed outside the Sunshine Coast and transported back to the region after numerous journeys through the respective food distribution channels. There is only one small niche abattoir left on the Sunshine Coast;

• It was difficult to get seafood production volumes for the Sunshine Coast. However, in interviewing a local seafood company they estimated that the volume of seafood caught in the region was easily sufficient for local consumption. However, much of the local consumption is provided by local supermarkets which source a lot of their seafood outside the Sunshine Coast region. A large proportion of what is caught locally is exported to Japan because of the premium prices received from that market.

• While very few eggs are produced on the Sunshine Coast, the consumption needs would be met by the eggs produced in the Wide Bay region (just to the north of the Sunshine Coast). Poultry meat production on the Sunshine Coast is nearly double the consumption but this production is primarily from one very large farm and it is also processed outside of the region in Brisbane.

The Sunshine Coast prawn fishing fleet based at Mooloolaba provides a case study that highlights the vulnerability of the food supply sector to rising oil prices. The fishing fleet primarily uses very large diesel engines to drive the boats from Mooloolaba harbour out to the fishing grounds and back. In addition, these engines power refrigeration equipment on board the boats to keep the catch fresh. The Commonwealth Fisheries Association (2008) indicated that diesel fuel comprises between 20-50 per cent of total operating costs (depending on the fishery) highlighting the plight of commercial fisherman in a high diesel price environment:

“Almost the entire commercial fishing fleet is reliant on diesel fuel as its major business input with little or no opportunity to use alternative fuels. In most cases, there exists no ability to pass on increased costs to the consumer. Fishers are therefore especially vulnerable to ‘high diesel prices’.”

Commonwealth Fisheries Association 2008

The Sunshine Coast prawn fishing fleet was heavily impacted by rising fuel prices from 2004 to 2008. Its capacity to compete with cheap imported prawns was diminishing due to the rising value of the Australian dollar, and the decline in local household disposable incomes. The trawlers were using 600 litres of diesel fuel per night and with the diesel fuel price at $1.70 per litre fuel costs were $30,600 per month in mid 2008. Anecdotal evidence suggests that this resulted in the fleet being reduced by five boats to 27 prawn trawlers (Gardner 2008).
Future rising oil prices will contribute to rising food costs on the Sunshine Coast. In addition, rising oil prices will contribute to increasing costs for local food producers who export their produce to markets outside of the region, especially those who rely on air freight to overseas markets. On the positive side, local producers who supply to the local market will benefit from relatively lower transportation costs. Capitalising on this opportunity and taking a proactive approach to the promotion and ‘re-localisation’ of food production will build community resilience to future oil shocks.
Regional energy production provides a potential economic development opportunity for the Sunshine Coast region and will build resilience to the impacts of an energy transition. A regional energy assessment has recently been completed for the Sunshine Coast region with a focus on:

- Transport energy (Liquid fuel) production in the region;
- Stationery energy (Renewable electricity production) in the region;
- Energy reduction (conservation) and energy efficiency in the region;
- The potential for a constructed natural gas pipeline to the region providing opportunities for combined heat and power plants;

The assessment identified 23 different opportunities on the Sunshine Coast and ranked them qualitatively to identify the most appropriate opportunities for Council to pursue. The criteria chosen to rank the opportunities were:

1. Is the opportunity related to energy reduction (demand), energy substitution (fuel switching), or energy production (net generation)? (Highest possible score = 4)

2. Is the opportunity located within the geographic boundaries of the Sunshine Coast Council? (Highest possible score = 3)

3. What is the potential size of the opportunity in terms of energy volume reduced / substituted / produced? (Highest possible score = 3)

4. How commercial is the opportunity in today's terms relative to alternative energy solutions? (Highest possible score = 4)

5. What are the life-cycle implications of the opportunity relative to other comparable alternatives? (Highest possible score = 3)

6. What role could Sunshine Coast Council play in supporting the development of the opportunity? (Highest possible score = 4)

7. When would energy reduction /substitution /production from the opportunity be materially realised? (Highest possible score = 3)
8. How is the community likely to react to the opportunity? (Highest possible score = 3)

9. Does the opportunity have synergies with a known future project in the Sunshine region? (Highest possible score = 3)

The total possible score that an energy opportunity could achieve is 30 and the ranking of the stationary and transport energy opportunities is shown in Figure 35. Using the assessment framework 11 of the opportunities assessed were considered to be suitable to Council, 6 opportunities were considered to be less suitable, and 6 were considered to be unsuitable. It is notable that the energy reduction opportunities all scored highly (ie. 19-23 out of 30).

**Figure 35: Ranking of the 23 opportunities in the Sunshine Coast Regional Energy Assessment**

The potential for the Sunshine Coast Council to facilitate the most suitable of these regional energy opportunities is illustrated by highlighting the biodiesel opportunity as an example.

Biodiesel is identified as the most suitable transport energy (liquid fuel) opportunity in the Sunshine Coast region. The commercial status of biodiesel production is proven with an existing market in operation on the Sunshine Coast primarily through the network of Freedom Fuel service stations. The potential size of the opportunity is significant and there is an opportunity to locate its feedstock production within the Sunshine Coast region. It is likely to be accepted by the community and there are synergies with future projects on the Sunshine Coast. Biodiesel also emits less greenhouse gas emissions compared to petroleum diesel fuel (Romm 2007, Beer et al 2007; ICLEI 2007).
The potential for Council to influence the economic development of biodiesel production on the Sunshine Coast is significant as a consequence of:

- **Research and Development that has already been completed** - The University Of Queensland’s Australian Research Council (ARC) Centre of Excellence for Integrative Legume Research has and continues to research sustainable biofuel production from the native legume *Pongamia pinnata*;

- **Growing conditions on the Sunshine Coast are favourable** - Biophysical conditions across the Sunshine Coast rural hinterland and ‘caneland’ areas are suitable for *Pongamia pinnata* to grow. For example the average annual rainfall is more than adequate and there is limited frosting;

- **Trial plantings have already been established and are currently being monitored** - The South East Queensland Sustainable Trees on Farms Program has established trial plantings of approximately 8,000 *Pongamia pinnata* saplings in the Sunshine Coast region (an initiative of SEQ Catchments and partners, including the Sunshine Coast Council). In addition Origin Energy has expanded their initial trial planting of *Pongamia pinnata* to 300 hectares in central Queensland;

- **Council’s biodiesel trial in 2006 supports the use of biodiesel as a fleet fuel** – The trial compared the performance of a B20 biodiesel blend to petroleum diesel in Council fleet vehicles and waste contractor vehicles and recommended biodiesel as an appropriate substitute to ultra low sulphur diesel; and

- **Council has been switching its fleet to diesel powered vehicles since 2007** and is now using biodiesel blends sourced from outside the Sunshine Coast region. This will assist Council to achieve both its carbon neutral target and fuel reduction target.

Catalysing the establishment of a local biodiesel market would provide regional economic opportunities and help to build resilience to rising and volatile oil prices for Council and the community.
6.7 Assessment 7: Households

Summary: Rising Oil Prices and Households

- Households will not be impacted equally due to a range of factors that increase or decrease the households dependency on oil.
- The proportion of household income spent on transport will increase and household transport is currently highly dependent on the car.
- The spatial distribution of household vulnerability to rising oil prices is not even;
- Households have been shown to respond to rising oil prices by limiting their discretionary spending; purchasing more fuel efficient vehicles and opting to take public transport.
- Future mitigation strategies may include:
  - Relocating closer to public transport;
  - Relocating closer to work;
  - Moving towards a ‘work from home model’ and/or a ‘compressed working week’.

Rising costs in the economy, road transport sector and food supply sector due to rising oil and fuel prices will have indirect impacts on families and households. A family may have to spend more of its disposable income on food and transport as these prices increase in response to rising oil prices. All consumer products that are transported are anticipated to rise in price as a result of increasing input costs and road freight charges. Discretionary holiday travel may be reduced in the household budget due to rising car fuel and aviation costs. The direct impacts of rising oil prices on the household are examined.

6.7.1 Car Dependence

The car has completely dominated urban modal share in Australia since 1950 (Cosgrove and Gargett 2007). In the Brisbane statistical division the car increased its mode share from 78 per cent in 1992 to 80 per cent in 2003. During this period:

- Walking and cycling declined from 15 per cent to 12 per cent; and
- Public transport increased from 7 per cent to 8 per cent (Queensland Government 2003).

Passenger vehicles are the largest fuel consumers in Australia’s road transport sector, accounting for 63 per cent in 2003 (Australian Government 2006). In South East Queensland (SEQ), the growth in car travel is forecast to increase faster than population growth, by 58 per cent from approximately 64 million to 101 million vehicle kilometres per day (see Figure 36).
Figure 36: South East Queensland population and vehicle kilometres travelled per day: the trend from 2001 to 2026.

On the Sunshine Coast this dependence on car travel is even more marked with 89 per cent of journeys made in a car (Household Travel Survey 2007).

6.7.2 Proportion of Household Income spent on Fuel

The petrol prices that households on the Sunshine Coast have been exposed to for the past ten years are shown in Figure 37.

Figure 37: Average monthly capital city unleaded petrol prices (cents per litre)

It is expected that the impact of rising petrol prices will affect different sections of the population. Eslake (2005) stated that an average Australian household bought 35 litres of fuel each week in 2003-2004, at a
total cost of $32.28 (92c/litre). This equated roughly to 3.5 per cent of average Australian household income (after tax). For low income households, this represented 5.5 per cent of family income. In high income households, it represented 2.5 per cent of income. Denniss (2007) provides a more detailed analysis, claiming that those who are income poor (predominantly the unemployed and pensioners) and those who are the most affluent spend the smallest proportion of their incomes and are the least affected, whatever the price of petrol (see Figure 38).

**Figure 38:** The Australian population’s proportion of household expenditure on petrol at 93c per litre, $2 per litre and $3 per litre.

![Figure 38](image)

*Source: Denniss 2007*

The vulnerability of household income to rising fuel prices over time is shown in Figure 37. It shows that in the United States the proportion of household income spent on fuel in 2008 was 10 per cent having risen from a low of 4 per cent in 2002 (Perry 2009). A rising proportion of the household budget being spent on transport means that discretionary spending on other items would have to decrease. This is reflected in the survey responses shown in Figure 39.

**Figure 39:** Proportion of household income spent on fuel in the US 1980 to 2008

![Figure 39](image)

*Source: Perry 2009*
6.7.3 Spatial distribution of Household Vulnerability

Spatial distribution will affect household vulnerability to rising oil prices. Dodson and Sipe (2005, 2006) initially undertook spatial assessments through the use of an oil vulnerability index (the VIPER Index made up of three variables) and then included another variable which measured the degree to which household mortgage rate increases would affect household vulnerability (which was called the VAMPIRE index – four variables).

The results of Dodson and Sipe’s work for Brisbane in 2001 can be seen in Figure 40. It clearly shows that outer suburban locations are the most vulnerable to rising fuel costs and that vulnerability is more widespread when mortgage rate increases are incorporated into the index.

**Figure 40:** The Vulnerability of Brisbane’s Urban Area to Rising Oil Prices using the VIPER index (LHS) and the VAMPIRE index (RHS).

From this work Dodson and Sipe (2006) concluded that:

“households with mortgages residing in outer-suburban locations in Australian cities will be the most adversely affected by rising fuel costs, in large part because of their exposure to housing debt and the poor quality of alternative travel modes to the private car. In contrast, wealthier inner-urban and middle-ring localities appear less likely to be vulnerable to increasing fuel prices, due to relatively higher incomes and greater availability of public transport”.

Source: Dodson and Sipe 2005,2006  (Note: Red shading indicates those areas that are highly vulnerable; dark green shading represents those areas that are the least vulnerable to rising fuel costs.)
The vulnerability of outer suburban locations to rising petrol prices has been examined in the United States by Cortright (2008) who stated that it was apparent by early 2007, when the price per gallon in the US had risen to $US3 (a 50 per cent increase from mid 2004), that the interplay between housing and transportation costs played a critical role in explaining the pattern of decline in the US housing market collapse. Cortright concluded that:

“As measured by the change in housing prices over the last year, distant suburbs have seen the largest declines, while values in close-in neighborhoods have held up better, and in some cases continued to increase.”

Cortright’s (2008) conclusions support the Australian findings of Dodson and Sipe who claimed that outer-suburban development was the most vulnerable to rising fuel prices.

The Sunshine Coast Council commissioned Dodson and Sipe (2009) to prepare VAMPIRE maps for the Sunshine Coast. They were requested to include a fifth variable (the proportion of children aged between 5 and 14 per household) as it is highly likely that families with children are likely to spend a larger proportion of their household budget on transport driving their children to school, friend’s houses, sports events etc. compared to those households that do not have children. The results are shown in Figure 41.

**Figure 41: The Vulnerability of Sunshine Coast households to Rising Oil Prices using the VAMPIRE² index.**

(Note: Red shading indicates those areas that are highly vulnerable; dark green shading represents those areas that are the least vulnerable to rising fuel prices.)
Figure 42 compares the Sunshine Coast’s vulnerability with the entire South East Queensland region.

**Figure 42:** The Vulnerability of the South East Queensland region to Rising Oil Prices using the VAMPIRE\(^2\) index.

Dodson and Sipe (2009) point out that local government can reduce their community’s vulnerability by focusing on the variables in the index that they have some influence over. Council has little influence on household income, the number of children in the household and whether the household has a mortgage but they can exert some influence over a household’s decision to own one or two cars and whether those cars are used to travel to work through its land use and transport planning provisions. In order to prevent more areas of the Sunshine Coast becoming highly vulnerable they identified 73 collection districts in medium density areas (1,800 to 3,250 people/sq km) that are highly vulnerable (see Figure 43) and suggested that Council concentrate on those areas when preparing new planning documents and strategies.

(Note: Red shading indicates those areas that are highly vulnerable; dark green shading represents those areas that are the least vulnerable to rising fuel prices.)
The Sunshine Coast Council is already addressing the need to contain suburban sprawl and provide fast, efficient and attractive public transport options as a priority in response to rising oil prices and peak oil. The *Corporate Plan 2009-2014; Growth Management Position Paper 2008; and Draft Sustainable Transport Discussion Paper 2009* all identify this as a priority. The areas identified in Figure 43 as highly vulnerable may have their vulnerability reduced as a result of two proposed (and planned) public transport projects that have been incorporated into planning documents, the CAMCOS rail corridor and the Coast Connect rapid bus project.

The Council also recently endorsed the introduction of a public transport levy of $20 per ratepayer which will enable Council to accelerate investment in projects to improve public transport infrastructure and services. The *Draft Sustainable Transport Discussion Paper 2009* also identifies the need for Council to address climate change and peak oil by reducing its ecological footprint, increasing self containment and promoting alternative forms of transport to reduce private motor vehicle dependence.
6.7.4 Household Responses to the Rising Fuel Prices of 2004 to 2008

A survey by AC Neilsen in November 2005 (AC Neilsen 2006) asked 500 Australians to indicate which strategies they were adopting in response to higher fuel prices. Two years later (August 2007) 110 residents of Nambour on the Sunshine Coast were surveyed by Woods (2007) and indicated similar responses (see Figure 44).

**Figure 44:** The Response to Higher Fuel Prices by Australian Residents (LHS) and Nambour Residents on the Sunshine Coast (RHS).

As the surveys indicate, one household response to rising fuel prices is to purchase more fuel efficient cars. The purchase of smaller cars in both the United States and Australia began to increase relative to the purchase of larger cars from 2004 (RBA 2008; Green Car Congress 2008). Smaller cars are more fuel efficient and have captured an increasing share of the passenger vehicle market in Australia (see Figure 45).

**Figure 45:** Share of total market sales of passenger vehicles in Australia

Source: AC Neilsen 2006 (LHS) and Woods 2007(RHS)

Source: RBA 2008
The international car industry is now responding to rising fuel prices and households renewed demand for fuel efficiency in new car purchases. There is some debate as to the future fuel substitute for passenger cars but biofuels (ethanol, biodiesel) and electricity are beginning to compete in the current new car marketplace with fuel cell hydrogen being seen by some as a long term possibility.

Households are also responding to rising fuel prices by buying motorcycles and scooters (see Figure 46). Motorcycle sales in the US and Australia have been increasing (US Department of Energy 2006; Federal Chamber of Automotive Industries 2007) and scooters are now the biggest selling category of road bikes in Australia, having increased six-fold between 2002 and 2006. During the same period, the number of motorcycles sold doubled (Federal Chamber of Automotive Industries 2007).

**Figure 46:** Motorcycle (LHS) and Scooter (RHS) sales in Australia 2002 – 2006.

Households are also responding to rising fuel prices by using public transport more frequently. By 2006 patronage on Brisbane’s buses and trains had already increased substantially as oil prices rose towards $80 per barrel (BCC 2007; McCarthy 2007). This is demonstrated in Figure 47.

**Figure 47:** The patronage of public transport services in Brisbane 1999-2006.

Source: McCarthy 2007
Patronage of the public transport system in SEQ has continued to increase well above the expectations of the Translink Transit Authority as shown in Figure 43. Streeting and Barlow (2007) estimated that rising fuel prices contributed 2.2 per cent of the 9.7 per cent growth in Translink’s patronage in 2004-05 and 2.1 per cent of the 11.6 per cent growth in patronage in 2005-06.

**Figure 43:** Patronage of public transport in South East Queensland 1999-2009

The Queensland Rail city train service from Sunshine Coast stations to Brisbane had also experienced increasing patronage of 5 per cent according to a Queensland Rail spokesman. He said “the combined effects of rising interest rates and petrol prices are expected to continue to drive growth in patronage in the short and longer term” (Benger 2008). The early morning commuter trains were at capacity by the time they had reached Caboolture with many commuters having to stand or sit in the aisles.

**Figure 44:** Front page headline in the Sunshine Coast Daily, 28 May 2008.
This assessment has highlighted how dependent the Sunshine Coast population is on the car; the impact on the household budget that rising fuel prices have; and how household vulnerability may be spatially distributed. The response that households made to rising fuel prices between 2004 and 2008 provides a window into how households on the Sunshine Coast may respond in future. It is important to understand that there are two components to the nature of the Sunshine Coast households vulnerability to rising fuel prices. The first is the direct impact that rising fuel prices have on the households transport costs. The impacts of rising fuel prices on the economy, and sectors of the economy, will in turn indirectly affect the size of the households total budget. The exposure of the household to both those pressures has, and will result in the adoption of adaptation strategies by the family including:

- Purchasing more fuel efficient cars, motorcycles (and scooters);
- Switching some trips to public transport; and
- Cutting back on discretionary spending to continue funding car fuel purchases.

If oil prices continue to rise and be volatile it will create an even greater imperative for households to adopt more radical strategies to contain their transport costs which may include:

- Relocating closer to public transport;
- Relocating closer to their work;
- Working from home on a full-time or part-time basis; and
- Compressing the working week into 4 days instead of five.
7. Peak Oil Implications for Council

7.1 Assessment of the Sunshine Coast Council’s vulnerability

The following Sunshine Coast Council activities are exposed to rising and volatile oil prices:

- Road transport: Council’s fleet of vehicles and plant use petrol, LPG or diesel. Most Councillors and staff travel to work by car;

- Waste Management: The Waste Management contract requires large diesel trucks to pick up waste from households and transport it to landfills;

- Airport: The future vulnerability of airlines will indirectly affect the capacity for Sunshine Coast Airport to generate revenue for the regional economy; and

- Road Construction and Maintenance: Council sources asphalt to construct and maintain Council roads from plants that use large supplies of bulk LPG;

- Financial management: Council will need to manage the impact of future oil price shocks and carbon price rises in its financial management.

7.1.1 Council Fleet Fuel Consumption

Sunshine Coast Council has approximately 2,750 fleet items. Of these, 750 are light vehicles and approximately 300 are heavy vehicles that consume large amounts of diesel. It is estimated that the Council will purchase approximately 1.5 million litres of diesel and 1.0 million litres of ULP in 2008-09 across the entire north, central and south regions.

A study of Council’s central region indicated that while total fuel consumption had increased in the past three financial years, a policy of substituting petrol and LPG vehicles with diesel vehicles had resulted in decreased petrol and LPG and increased diesel consumption (see Figure 44).

**Figure 44:** Consumption of petrol/diesel/LPG in SCRC – Central from 2007 to 2009.
Rising fuel prices will also impact on Council’s waste contractors who collect waste and transport it to landfills. These contractors consumption of diesel fuel is approximately 3 million litres per annum.

7.1.2 Other oil derived products used by Council

The Sunshine Coast Regional Council also uses large quantities of asphalt for the construction and maintenance of roads. LPG and bitumen is used in the production of asphalt. Both of these products are derived from oil and their price is linked to the oil price. Bitumen consumption for the past three financial years for Council’s central region has been 1,592 tonnes (2006-07), 842 tonnes (2007-2008) and 892 tonnes 2008-2009). LPG consumption for the past three financial years for Council’s central region has been 450,425 litres, 290,571 litres and 298,191 litres. The reduction in consumption of both bitumen and LPG has been primarily the result of significant maintenance programs on the asphalt plant being undertaken in the past two financial years.

7.1.3 Council’s Financial Management

Rising and volatile fuel prices will impact directly on the economy as a whole. The notion that oil shocks can constrain economic growth or even induce economic recession suggests that Council must be prepared for the potential impact on its financial management. As the oil shock of 2008 and the recession of 2009 have demonstrated, prudent financial risk management that addresses rising and volatile oil prices is required.
7.2 Sunshine Coast Council Departmental functions

7.2.1 Regional Strategy and Planning Department

The Regional Strategy and Planning Department will lead Council in addressing the region’s energy transition. This will have implications for:

- **Environment Policy Branch**: The Environment Policy branch will lead the Council in addressing the energy transition.

- **Social Policy Branch**: The Social Policy branch is responsible for the Housing Affordability Strategy, Community facility planning and open space planning, which will be a key element in addressing the socio-economic accessibility issues that an energy transition may present for the community.

- **Strategic Planning Branch**: Strategic Planning is the branch responsible for the new Planning Scheme, the preparation of master plans for new greenfield developments, and place making.

- **Infrastructure Policy Branch**: The Infrastructure Policy branch is responsible for priority infrastructure and utility planning (including electricity, gas, water/sewerage and telecommunications).

- **Integrated Transport Policy Branch**: The Integrated Transport Policy branch is responsible for the Sustainable Transport Strategy for the Sunshine Coast region.

- **Development Services Branch**: The Development Services branch is responsible for land use application assessments and in particular assessing master planned communities and new subdivisions in the region.

Council’s exposure to the energy transition is addressed in the *Climate Change and Peak Oil Strategy* and actions are identified that are relevant to the Regional Strategy and Planning Department.

7.2.2 Infrastructure Services Department

The Infrastructure Services Department functions impacted by energy transition include:

- **Fleet Management Branch**: Responsible for Council’s fleet of vehicles. As the largest users of oil derived fuels, fleet management will be critical to reducing Council’s fuel consumption.

- **Waste and Resource Management Branch**: Responsible for preparing the Waste Strategy for Council, tendering for waste contracts, and the day to day functions of the regions landfills.

The following branches in the Infrastructure Services Department will need to incorporate the implications of an energy transition in their planning functions particularly in the use of bitumen, asphalt and energy efficiency.

- **Transport and Engineering Services Branch**: Responsible for transport forward planning and place design.
Civil Works Services Branch: Responsible for the building and maintenance of roads, bridges and other infrastructure.

Building and Facilities Services Branch: Responsible for the management of Council’s buildings.

Business and Major Project Services Branch: Responsible for the scoping and planning of major project delivery.

In the Climate Change and Peak Oil Strategy actions are identified that are relevant to the Infrastructure Services Department.

7.2.3 Finance and Governance Department

The Finance and Governance Department functions that will be impacted by energy transition include:


Commercial and Procurement Branch: Responsible for tendering and procuring contracts and services. Procurement of green-power electricity or biodiesel contracts may be important in an oil-constrained era.

Sunshine Coast Airport Management Team: Responsible for managing the airport, including the day to day operations and long-term strategic planning of the airport and ancillary services. Planning for an oil constrained era will be an important part of their strategic planning.

Quarries and Asphalt Plants Business Unit: As the largest users of bitumen and bulk LPG this unit must start preparing for the energy transition by researching potential alternatives to bitumen and asphalt in road construction and hard surface applications.

In the Climate Change and Peak Oil Strategy actions are identified that are relevant to the Finance and Governance Department.

7.2.4 Organisation Performance Department

The Organisation Performance Department functions impacted by energy transition include:

Information and Telecommunication Services Branch: Responsible for the computer and telecommunication services of Council. Web-based conferencing and work from home capability is the domain of this branch, while PowerDown campaigns and purchase of energy-efficient IT equipment will help reduce electricity consumption.

Human Resources Branch: Responsible for employing staff and negotiating the conditions of work in contracts and awards. Staff working conditions relating to place of work need to be reviewed in preparing Council for the energy transition.
In the *Climate Change and Peak Oil Strategy* actions are identified that are relevant to the Organisation Performance Department.

### 7.2.5 Executive Office and Community Services Department

The Executive Office will provide leadership, supporting Council’s energy transition and community engagement efforts. It may partner with the Community Partnerships Branch in the Department of Community Services to involve community in the energy transition.

In the *Climate Change and Peak Oil Strategy* actions are identified that are relevant to the Executive Office and Community Services Department.

### 7.2.6 Water

The Department of Water will cease to be an entity within Council in 2010. Its Planning and Sustainability branch will need to be aware of Council’s preparations for an energy transition.
### 7.3 Policy Context

The context within which Sunshine Coast Council prepares to address the next energy transition is shown in the table below. It also describes the Peak Oil recommendations of various committees and government departments in the absence of any national legislative direction for State and Regional Government.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Document</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>International Agencies</strong></td>
<td></td>
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</tr>
<tr>
<td>International Energy Agency</td>
<td><em>World Energy Outlook 2008</em></td>
<td>There is a need for an ‘Energy Revolution’ and governments must act now. There is a high risk of under investment in oil supply infrastructure which is likely to lead to a global oil supply ‘crunch’ by 2015.</td>
</tr>
<tr>
<td>US Department of Energy</td>
<td><em>Hirsch Report 2005</em></td>
<td>Peak Oil represents an unprecedented risk management problem for government. Technologies exist to mitigate the problem but more than a decade will be required to significantly mitigate the impacts.</td>
</tr>
<tr>
<td><strong>Australia</strong></td>
<td></td>
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</tr>
<tr>
<td>Federal Govt – Senate Committee</td>
<td><em>Inquiry into Australia’s Future Oil Supply and Alternative Transport Fuels 2007</em></td>
<td>The possibility of a peak of conventional oil production before 2030 should be a matter of concern. Exactly when peak oil occurs is not the important point. In view of the enormous changes that will be needed to move to a less oil dependent future, Australia should be planning for it now.</td>
</tr>
<tr>
<td>Qld Govt Oil Vulnerability Taskforce</td>
<td><em>Qld’s Vulnerability to Rising Oil Prices 2007</em></td>
<td>The peaking of world oil production is likely in the next 10 years. Queensland must adopt an Oil Vulnerability Mitigation Strategy and Action Plan as a matter of priority in order to minimise the foreseeable consequences of substantial liquid fuel price rises.</td>
</tr>
<tr>
<td>Qld Department of Transport</td>
<td><em>Qld’s Oil Vulnerability Mitigation Strategy and Action Plan is currently in preparation.</em></td>
<td></td>
</tr>
<tr>
<td>Qld Department of Infrastructure and Planning</td>
<td><em>SEQ Regional Plan 2009-2031</em></td>
<td>The SEQ Regional Plan directs Regional Government through its policy 1.5 ‘Responding to Oil Supply Vulnerability’ that Regional Government must address the risk of changes in the supply and price of oil in their planning.</td>
</tr>
<tr>
<td><strong>Sunshine Coast Regional Council</strong></td>
<td></td>
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</tr>
<tr>
<td>Sunshine Coast Regional Council</td>
<td><em>Corporate Plan 2009-2014</em></td>
<td>The theme ‘Ecological Sustainability’ requires that the ‘Impact of Climate Change’ be addressed, including energy transition.</td>
</tr>
<tr>
<td>Regional Strategy and Planning Department</td>
<td><em>Climate Change and Peak Oil Strategy 2010-2020</em></td>
<td>This Peak Oil Background Study informs this Strategy.</td>
</tr>
</tbody>
</table>
8. Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>Adaptation</td>
<td>Adjustments in human or natural systems, including changes in behaviour, institutional structure or policy, which are responsible to actual or expected climate changes and have long-term implications</td>
</tr>
<tr>
<td>Adaptive Capacity</td>
<td>Describes the ability of built, natural, and human systems to accommodate changes in climate (including climate variability and climate extremes) with minimal potential damage or cost.</td>
</tr>
<tr>
<td>Alternative Energy</td>
<td>Energy derived from non-traditional sources (e.g., solar, hydro-electric, wind, compressed natural gas).</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Biodiversity commonly refers to a variety of species and ecosystems on earth and the ecological processes of which they are a part.</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>This is a naturally occurring gas and is expressed as CO₂. It is also a by-product of burning fossil fuels and biomass, as well as land use changes and other industrial processes and is the principal human-induced greenhouse gas that affects the earth’s atmosphere.</td>
</tr>
<tr>
<td>Carbon Dioxide Equivalent</td>
<td>Greenhouse gases have differing radiative properties. Emissions are expressed in terms of their global warming potential or specifically as CO₂ equivalents (CO₂e). For example, methane is 21 times more potent than CO₂ as a greenhouse gas, and so one tonne of methane is expressed as 21 tonnes of CO₂e emitted.</td>
</tr>
<tr>
<td>Carbon Footprint</td>
<td>A carbon footprint is an inventory of all greenhouse gases.</td>
</tr>
<tr>
<td>Carbon Neutral</td>
<td>A voluntary mechanism where an activity, event, household, business or organisation is responsible for achieving zero carbon emissions by balancing a measured amount of carbon equivalent (CO₂e) released with an equivalent amount sequestered or offset. Best practice for organisations and individuals seeking carbon neutral status entails reducing and/or avoiding carbon emissions first so that only unavoidable emissions are offset.</td>
</tr>
<tr>
<td>Carbon Pollution Reduction Scheme</td>
<td>The main way the Federal Government proposes to achieve Australia’s greenhouse gas emissions reduction target under the Kyoto Protocol is via a Carbon Pollution Reduction Scheme. This scheme has two distinct elements: the cap on carbon emissions and the ability to trade carbon permits. In general the Federal Government will set a cap on the total amount of carbon pollution allowed in the economy with permits issued up to that annual cap. Industries that emit more than 25,000 tonnes of greenhouse gases on specified thresholds annually will be required to obtain a pollution permit for every tonne of greenhouse gas that they emit – providing a strong incentive for emitters to reduce pollution.</td>
</tr>
<tr>
<td>Climate</td>
<td>The average and variations of weather in a region over long periods of time. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, rainfall, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.</td>
</tr>
<tr>
<td>Climate Change</td>
<td>This is a descriptive term which encompasses both natural and human induced changes to the climate.</td>
</tr>
<tr>
<td>Climate hazards</td>
<td>These are significant natural hazards influenced by weather and climate such as cyclones, storms and floods. Many natural hazards are climate hazards, with key exceptions being earthquakes and tsunamis.</td>
</tr>
<tr>
<td>Conventional Oil</td>
<td>A term which refers to crude (or unrefined) oil that is extracted from underground or under the sea floor. Conventional oil currently makes up approximately 85 per cent of all liquid fuel production, the other 15 per cent being unconventional oil.</td>
</tr>
<tr>
<td>‘Duty of care’</td>
<td>‘Duty of care’ is a standard of reasonable care provided while performing any acts that could foreseeably harm others.</td>
</tr>
<tr>
<td><strong>Ecosystems</strong></td>
<td>Natural units consisting of all plants, animals, humans and micro-organisms (biotic) in an area functioning together with all of the non-living physical factors (abiotic) of the environment.</td>
</tr>
<tr>
<td><strong>Energy Transition</strong></td>
<td>Energy transition is the period of time when the mix of energy sources used to power a country’s economy changes. The next energy transition for the Sunshine Coast is preferably towards renewable energy that powers a localised and low carbon economy.</td>
</tr>
<tr>
<td><strong>Global Warming</strong></td>
<td>This is the hypothesis that the earth’s temperature is being increased, in part, because of emissions of greenhouse gases associated with human activities, such as burning fossil fuels, biomass burning, cement manufacture, cow and sheep rearing, deforestation, and other land-use changes. Global warming and climate change are not interchangeable. Global warming refers to the increase of the Earth’s average surface temperature, due to a build-up of greenhouse gases in the atmosphere, while climate change is a broader term that refers to long-term changes in climate, including average temperature and precipitation.</td>
</tr>
<tr>
<td><strong>Global Circulation Model</strong></td>
<td>Global circulation models (GCMs) are complex computer programs that consider a range of factors to mathematically simulate global climate. They are based on mathematical equations derived from our knowledge of the physics that govern the earth–atmosphere system. Global circulation models may also be referred to as Global Climate models.</td>
</tr>
<tr>
<td><strong>Greenhouse Gases</strong></td>
<td>The term greenhouse gases refer to a number of gases that contribute to the greenhouse effect. While carbon dioxide is the most commonly known greenhouse gas, other greenhouse gases include methane (CH₄), Nitrous Oxide (N₂O), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆) and hydrofluorocarbons (HFCs). Changes in the concentration of greenhouse gases in the atmosphere have been attributed to the key influence driving climate change via a process called the enhanced greenhouse effect.</td>
</tr>
<tr>
<td><strong>Gross Regional Product/ Gross State Product/ Gross Domestic Product</strong></td>
<td>Terms which refer to the market value of all final goods and services produced within a Region, State or Nation in a given period of time.</td>
</tr>
<tr>
<td><strong>Impacts (of climate change)</strong></td>
<td>The effects of climate change on natural, productive and human systems.</td>
</tr>
<tr>
<td><strong>International Transition Towns Movement</strong></td>
<td>International grassroots initiative that encourages the formation of local transition towns that, through community engagement, can build community resilience in response to the challenges of peak oil, climate change.</td>
</tr>
<tr>
<td><strong>IPCC</strong></td>
<td>The Intergovernmental Panel on Climate Change (IPCC) is a United Nations scientific body that provides authoritative scientific information from approximately 4,000 of the world’s leading climate scientists principally in the atmospheric sciences, but also comprising social, economic and other environmental components potentially impacted by climate change. It provides scientific information from global climate modelling systems.</td>
</tr>
<tr>
<td><strong>Kyoto Protocol</strong></td>
<td>The Kyoto Protocol is a set of rules under the United Nations Framework Convention on Climate Change. The Convention was a major step forward in tackling the problem of global warming. Australia became a full member of the Kyoto Protocol in March 2008.</td>
</tr>
<tr>
<td><strong>Liquids</strong></td>
<td>Refers to ‘liquid fuels’, a commonly used term which refers to both ‘conventional’ oil as well as ‘unconventional’ oil.</td>
</tr>
<tr>
<td><strong>Locational Vulnerability</strong></td>
<td>An assessment that determines which residential locations will be the most vulnerable to rising fuel prices and increasing transportation costs.</td>
</tr>
<tr>
<td><strong>Low Carbon</strong></td>
<td>A low carbon economy or low fossil fuel economy is a concept that refers to an economy which has a minimal output of greenhouse gas.</td>
</tr>
<tr>
<td><strong>Low Oil</strong></td>
<td>A low oil economy refers to an economy which has a minimal use of oil.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
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<td>-------------------------------------------</td>
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</tr>
<tr>
<td>Methane (CH₄)</td>
<td>This one of the six GHGs to be mitigated under the Kyoto Protocol, it has a relatively short atmospheric lifetime of 10 ± 2 years. Primary sources of CH₄ are landfills, coal mines, paddy fields, natural gas systems, and livestock (e.g. cows and sheep). It has a global warming potential of 21 (100 year time horizon).</td>
</tr>
<tr>
<td>Mitigation</td>
<td>Activities that are undertaken to reduce greenhouse gas emissions.</td>
</tr>
<tr>
<td>National Greenhouse and Energy Reporting System</td>
<td>A nationally consistent framework for greenhouse gases and energy reporting within the National Greenhouse and Energy Reporting Act 2007. This provides the foundation for the Carbon Pollution Reduction Scheme.</td>
</tr>
<tr>
<td>Nitrous Oxide (N₂O)</td>
<td>One of the six greenhouse gas emissions to be curbed under the Kyoto Protocol, N₂O is generated by burning fossil fuels and the manufacture of fertilizer. It has a global warming potential 310 times that of CO₂ (100 year time horizon).</td>
</tr>
<tr>
<td>No Regrets</td>
<td>A term used to describe actions that result in greenhouse gas limitations and abatement, and that also make good environmental and economic sense in their own right.</td>
</tr>
<tr>
<td>OECD</td>
<td>The Organisation for Economic Co-operation and Development (OECD) is part of the system of Western international institutions developed after World War II and is the main forum for monitoring and evaluating economic trends and developments in its 30 member countries. Australia joined the OECD in 1971.</td>
</tr>
<tr>
<td>Oil Supply ‘Crunch’</td>
<td>Refers to the increasing upward pressure on global oil prices as a result of increasing demand for oil globally not being matched by increasing oil supplies globally.</td>
</tr>
<tr>
<td>Oil Vulnerability (assessment or analysis)</td>
<td>Is the examination of the susceptibility of an economy, industry sector or household to harm from peak oil. Vulnerability is a function of an economy, industry sector or household's sensitivity to rising oil prices and its capacity to adapt.</td>
</tr>
<tr>
<td>Offsets</td>
<td>Reductions or removals of greenhouse gas emissions that are used to counterbalance emissions elsewhere in the economy.</td>
</tr>
<tr>
<td>Peak Oil</td>
<td>The term Peak Oil is when the rate of global oil production reaches a peak i.e. it is the point at which the extraction of conventional crude oil from all oil fields in the world is at its maximum rate and signals when the rate of oil being produced will begin to decline.</td>
</tr>
<tr>
<td>Precautionary Principle</td>
<td>A term used to describe an approach where the lack of full scientific certainty is not used as a reason for postponing cost-effective measures where there are threats of serious or irreversible damage.</td>
</tr>
<tr>
<td>Regional Energy Production Opportunities</td>
<td>An assessment of the potential for energy production options that would be economically viable on the Sunshine Coast. This would include the production of both alternative liquid fuels and electricity.</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>Renewable energy is energy generated from natural resources such as sunlight, wind, rain, tides, geothermal heat, which are renewable (naturally replenished).</td>
</tr>
<tr>
<td>Resilience</td>
<td>This is the ability to absorb disturbances, to be changed and then to reorganise and still have the same identify (retain the same basic structure and ways of functioning). It includes the ability to learn from the disturbance.</td>
</tr>
<tr>
<td>Risk</td>
<td>The probability that a situation will produce harm under specific conditions. Risk is generally defined as a combination of the likelihood of an occurrence and the consequence of that occurrence.</td>
</tr>
<tr>
<td>Scenario</td>
<td>A term used to describe a plausible description of how the future may develop, based on a coherent and internally consistent set of assumptions about key relationships and driving forces (e.g. rate of technology change).</td>
</tr>
<tr>
<td>Sector</td>
<td>A general term used to describe any resource, ecological system, species, management area, activity, or other area of interest that may be affected by climate change.</td>
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<tr>
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</tr>
<tr>
<td>Sensitivity</td>
<td>The degree to which a built, natural, or human system is directly or indirectly affected by changes in climate conditions (e.g. temperature and rainfall) or specific climate change impacts (e.g. sea level rise, increased water temperature).</td>
</tr>
<tr>
<td>SimCLIM</td>
<td>A climate change model where outputs and projections are generated by adjusting local climate variables in accordance with the patterns associated with a selected global circulation model and climate change scenario. Hadley GCM was used as the basis for the local projections in the Strategy.</td>
</tr>
<tr>
<td>SRES scenarios</td>
<td>These are emission scenarios developed by Nakićenović and Swart (2000) and used, among others, as a basis for some of the climate projections shown in Chapter 10 of the Fourth Assessment Report (AR4) produced by the IPCC (IPCC 2000).</td>
</tr>
<tr>
<td>Systems</td>
<td>This refers to the built, natural, and human networks that provide important services or activities within a community or region. Built systems can refer to networks of facilities, buildings, and transportation infrastructure such as roads and bridges. Natural systems can refer to ecological networks of fish, wildlife, and natural resources like water. Human systems can refer to networks of public health clinics, courts, and government.</td>
</tr>
<tr>
<td>Weather</td>
<td>The weather is a set of all extant phenomena in a given atmosphere at a given time. It also includes interactions with the hydrosphere. The term usually refers to the activity of these phenomena over short periods (hours or days), as opposed to the term climate, which refers to the average atmospheric conditions over longer periods of time.</td>
</tr>
<tr>
<td>Unconventional Oil</td>
<td>Refers to oil shales; oil sands-based synthetic crude and derivative products; coal-based liquid supplies; biomass-based liquid supplies; and liquids arising from chemical processing of natural gas.</td>
</tr>
<tr>
<td>Vulnerability</td>
<td>This is the susceptibility of a system to harm. Vulnerability is a function of a system’s sensitivity and the capacity of that system to adapt.</td>
</tr>
</tbody>
</table>
9. Acronyms

APPEA  Australian Petroleum Production and Exploration Association
ASPO   Association for the Study of Peak Oil and Gas
CERA   Cambridge Energy Research Associates
CSIRO  Commonwealth Scientific and Industrial Research Organisation
IEA    International Energy Association
LPG    Liquid Petroleum Gas
OECD   Organisation for Economic Cooperation and Development
QANTAS Queensland and Northern Territory Airline Service
VIPER  Vulnerability Index for Petroleum Expenditure Risk
VAMPIRE Vulnerability Assessment for Mortgage, Petroleum, and Inflation Risks and Expenditure
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