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# Australian Oil – Supply and Demand

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## Abstract

This document provides forecasts of both supply of and demand for oil in Australia out to 2040. It does so using models and projections of key elements for supply and demand. The models allow testing of the effect of changing assumptions about the future path of these key elements for the future supply-demand balance for Australian oil.

## 1.Australian Existing Field Oil Supply

A model of oil production from current fields in Australia can be constructed using a relationship between past discovery and current production. Table 1 sets out the calculations from the eleven steps to a forecast of production from Australia's existing oil fields.

1) First, annual production (P) and cumulative Production (CP) are smoothed with 3 year averages, generating SP and SCP.

2) The fractional growth in production (SP/SCP) is calculated and plotted against last year's cumulative production, as shown in Figure 1.

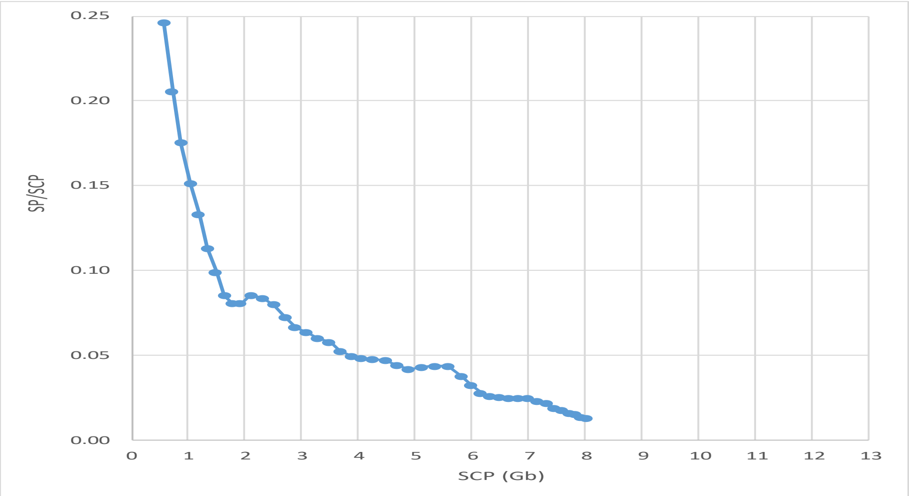


Figure 1: Australian cumulative production growth curve

3) The plot is then examined and a best guess at an ultimate cumulative production (U) is made. In this case, it is 9.6 Gb.

4) Discovery (D) is smoothed with an 11 year moving average and cumulative discovery (CD) is smoothed with progressively 5, 11 and 31 year moving averages (due to the abrupt start to discovery and production).

5) The fractional growth in discovery (SD/SCD) is calculated and plotted against last year's smoothed cumulative discovery (shown in Figure 2).

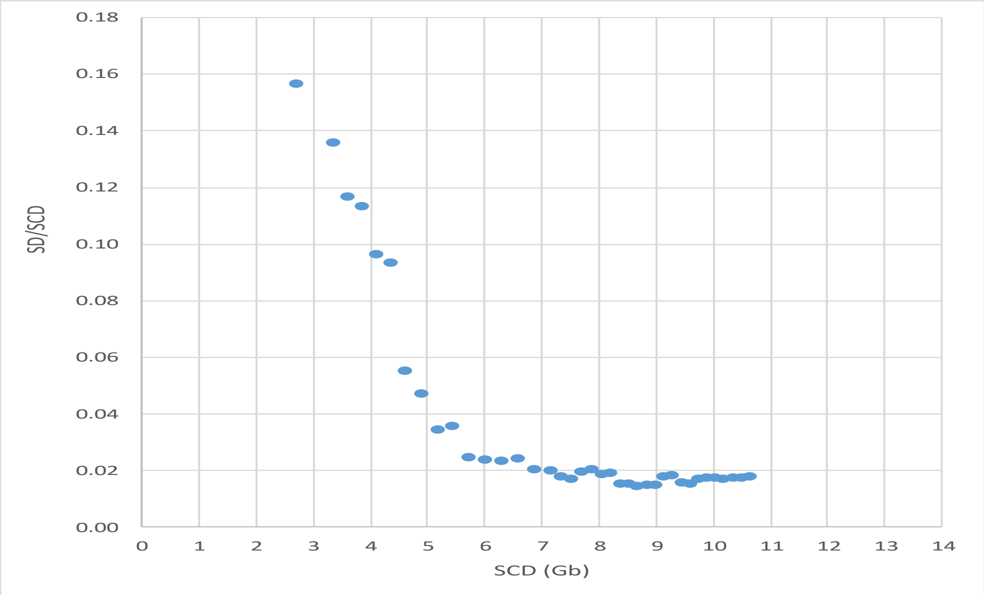


Figure 2: Australian cumulative discovery growth curve

6) The plot is examined and a best guess at an ultimate discovery (UD) is made. In this case it is 13 Gb.

7) Cumulative discovery in 2006 is then projected to UD by bringing SD estimated for 2006 to 0 in 2033. For Australian oil, the projection of the cumulative discovery curve is shown in Figure 3.

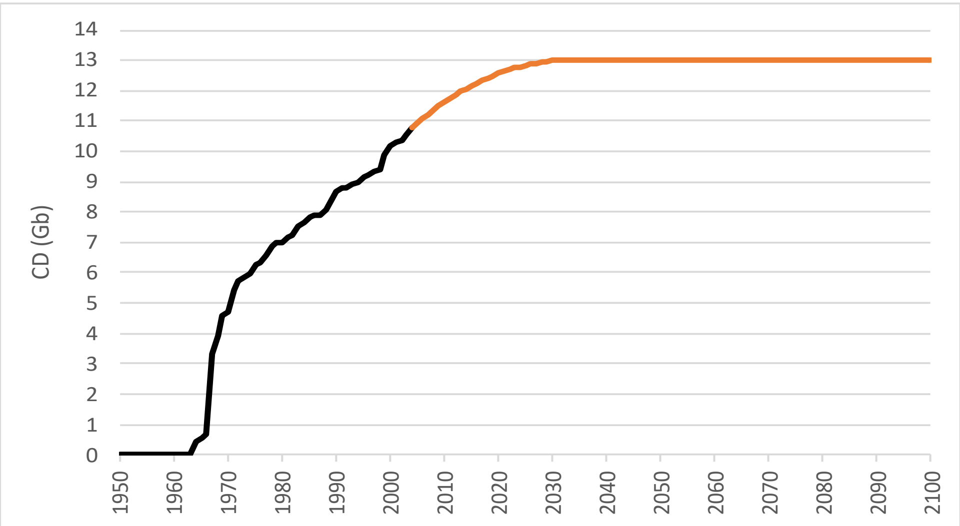


Figure 3: Australian cumulative discovery projection

8) Next, the height of the cumulative discovery curve has to be adjusted to equal the more reliable cumulative production estimate. In this case, the adjustment is downward, amounting to multiplying by 9.6/13.0.

9) The historical stretch lag between the cumulative discovery and production curves is calculated, and plotted against the fraction of cumulative discovery. This plot for Australia is

shown in Figure 4. The stretch lag rises quickly at first and then falls to 12 years. Extrapolating the trend to 15 years at 1.0 allows the rest of the cumulative production curve to be forecast from the extrapolated cumulative discovery curve and the predicted lags.

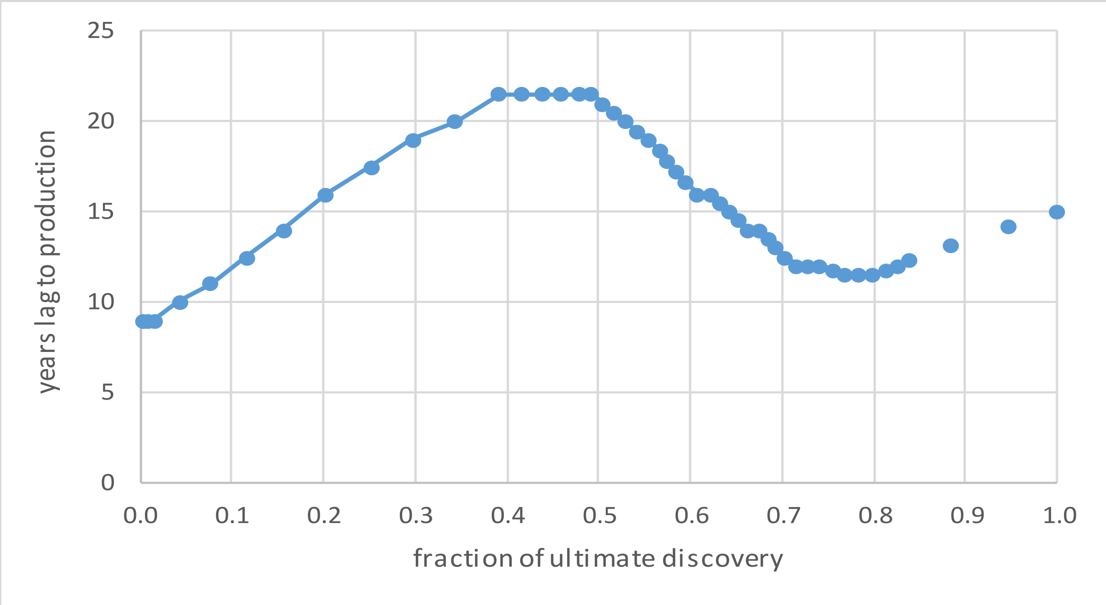


Figure 4: Australian stretch lag curve

10) The predicted cumulative production curve is smoothed with a 3 year average and then differenced to give a raw predicted annual production. This is then averaged over 3 years to give a final annual conventional oil production forecast. This is shown in Figure 5.

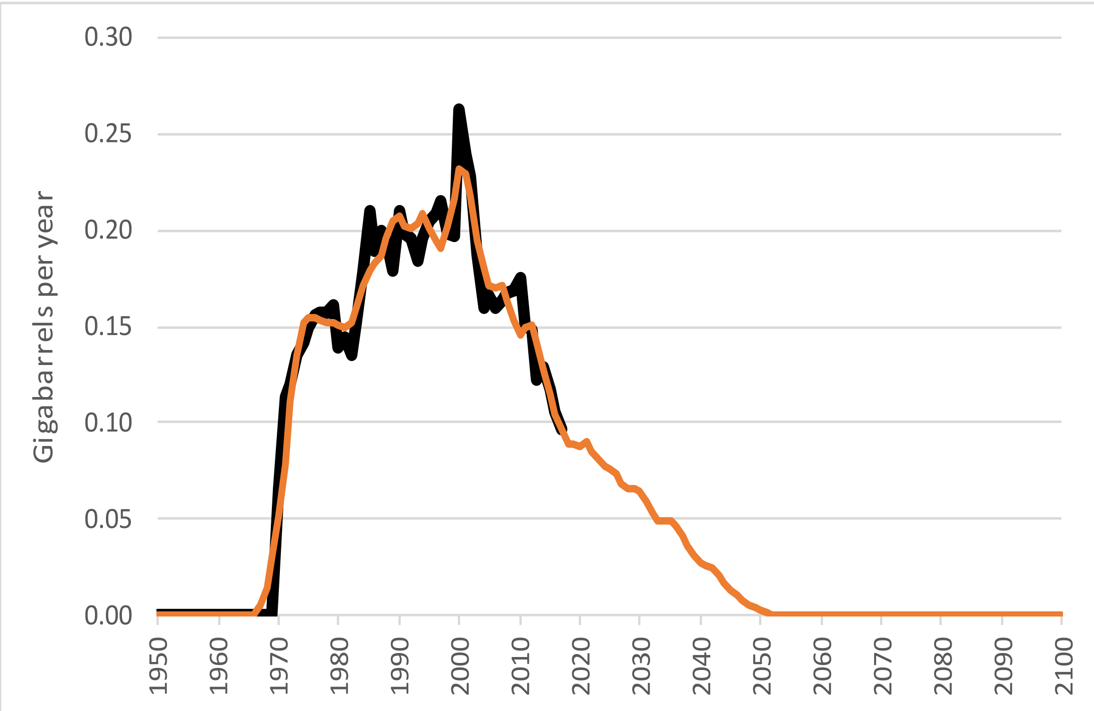


Figure 5: Actual and predicted Australian oil production from existing fields

11) Finally the cumulative discovery and production curves (actual and forecast) are plotted in Figure 6. This allows a spatial understanding of the relationship between production and discovery.

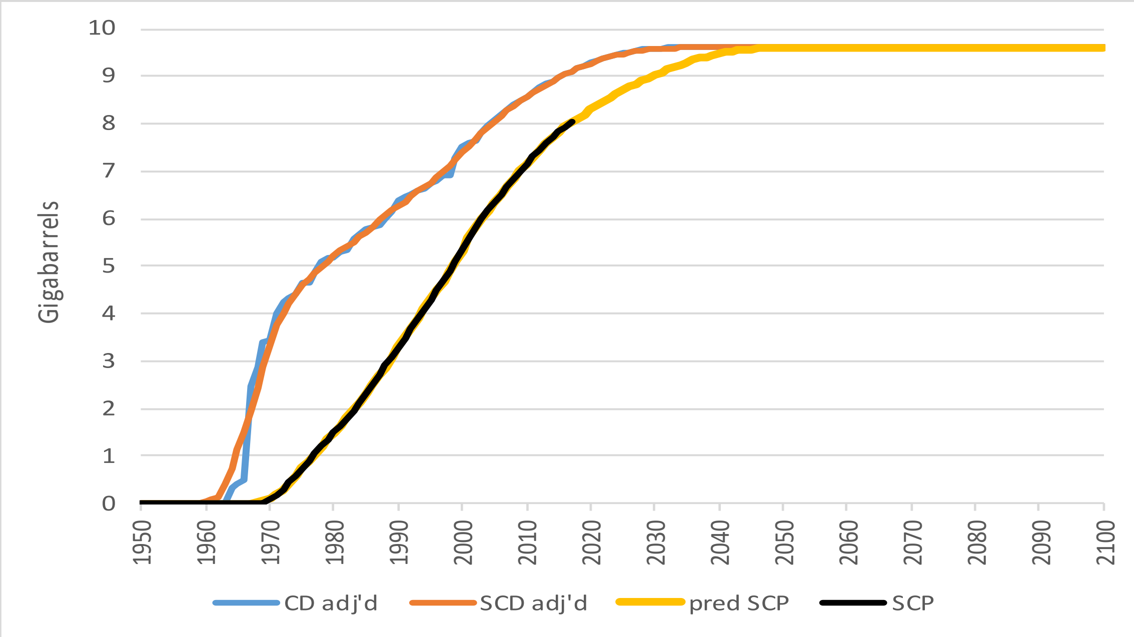


Figure 6: Australian existing-field oil cumulative discovery and production curves

## 2. Possible Additional Future Oil Supplies

However, there are two prospective sources of oil supply not yet in operation. Predicted existing field oil production, together with scenario production of Australian *deep water* and *shale* oil is shown in Figure 7. The deep water projection implies an ultimate discovery of 2.5 Gigabarrels for deep water, produced in roughly the same pattern as oil from past existing fields. Shale production is taken as a fraction of projected world non-US shale production. That fraction (0.016) is based on Australia's share of world (non-USA) shale reserves.

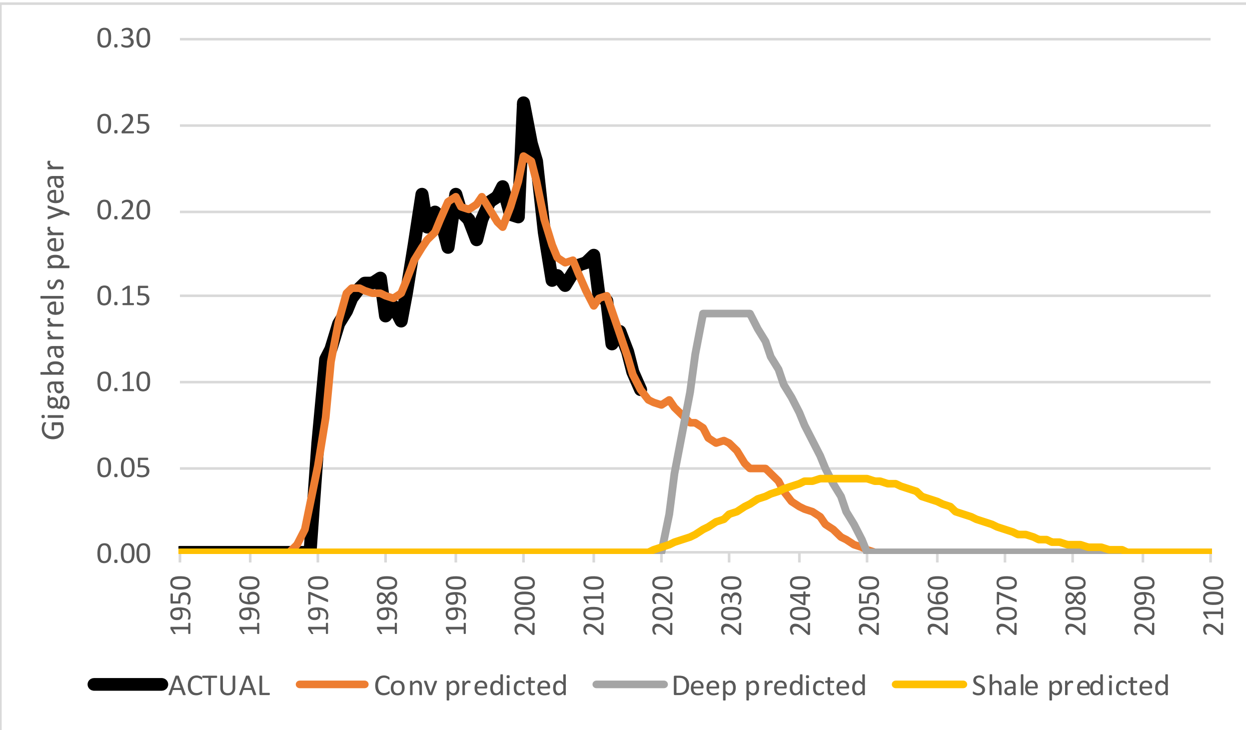


Figure 7: Australian conventional (existing), deep water and shale oil production

## 2. Australian Transport Oil Demand

The total demand for Australian oil and oil products has multiple components, but here they will be reduced to 1) *transport oil* demand, 2) *transport non-oil* demand, and 3) *other sector* oil demand, all measured in oil equivalents. Forecasts out to 2040 will be provided.

The demand from transport is modelled by 1) calculating the potential demand that would exist if no other means of propulsion than oil fuels were available, and then 2) reducing this demand by the proportion of transport using other means of propulsion, for example natural gas, hydrogen and electric vehicles.

The result is two forecast series: 1) *transport oil* equivalents from oil products (petrol, diesel, fuel oil, avtur, avgas and 20% of LPG) and 2) *transport non-oil* equivalents from non-oil products (80% of LPG, natural gas, coal, biofuel, hydrogen and electricity).

The oil equivalent total from electricity for road is calculated in two stages: 1) the oil equivalents of electricity from the grid is calculated, and then 2) these numbers are multiplied by 3.0. The last adjustment is due to the fact that electric vehicles charged from the grid have an energy efficiency of about 80 per cent, versus about 17.5 per cent for fossil-fueled vehicles. The rail electricity oil equivalent total is calculated with the same two steps.

The resulting two time series for oil equivalents used in transport are shown in Figure 9.

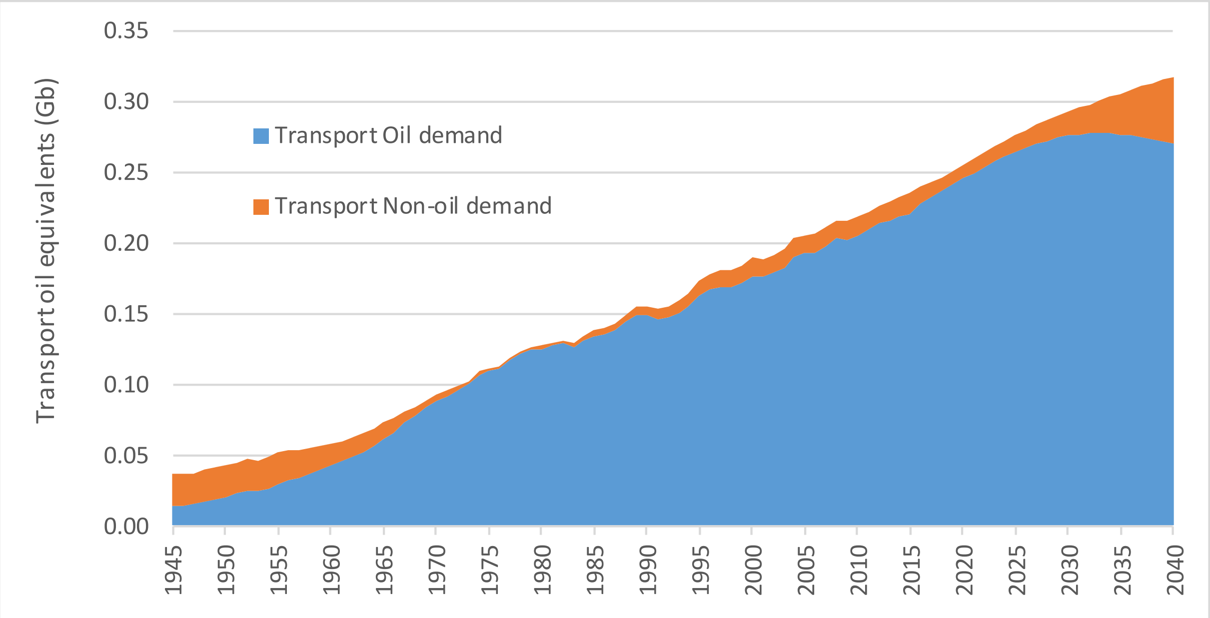


Figure 9 Transport oil equivalents and base-case forecasts

The projected increase in non-oil transport oil equivalents from 2025 on is due to a forecast increase in the fraction of the fleet being electric vehicles (from 1 per cent in 2025 to 28 per cent in 2040 under base-case assumptions).

The peaking in transport oil demand after 2030 (top of the blue line) is due to the spread of electric vehicles and new fossil fuel-efficient vehicles through the road vehicle fleet. Figure 10 shows that road is the major transport energy user, and its total oil equivalents (*including non-oil*) enters a plateau after 2025.

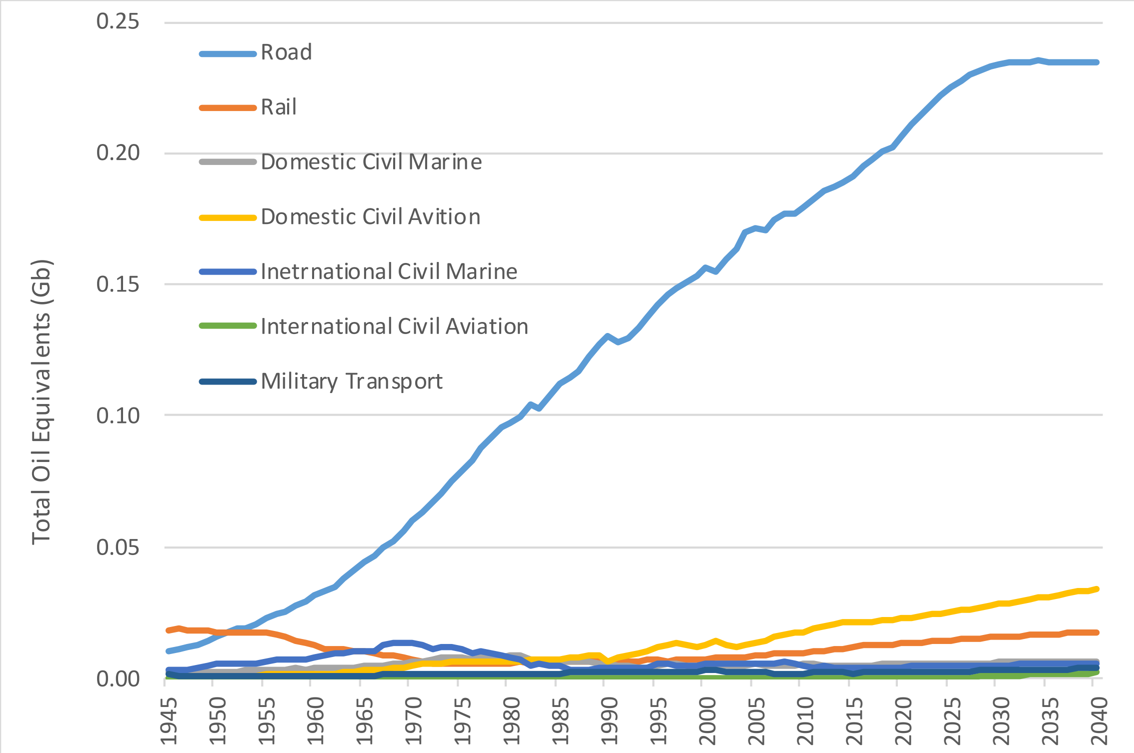


Figure 10 Total oil equivalents (oil plus non-oil) by transport mode

# 3. Australian Other Sectors Oil Demand

The demand for oil from other sectors of the Australian economy is shown in Figure 11. The forecasts are based on a straight-line projection, where exponential growth GDP is balanced by increases in the share of services in the economy and in industrial fuel efficiency.

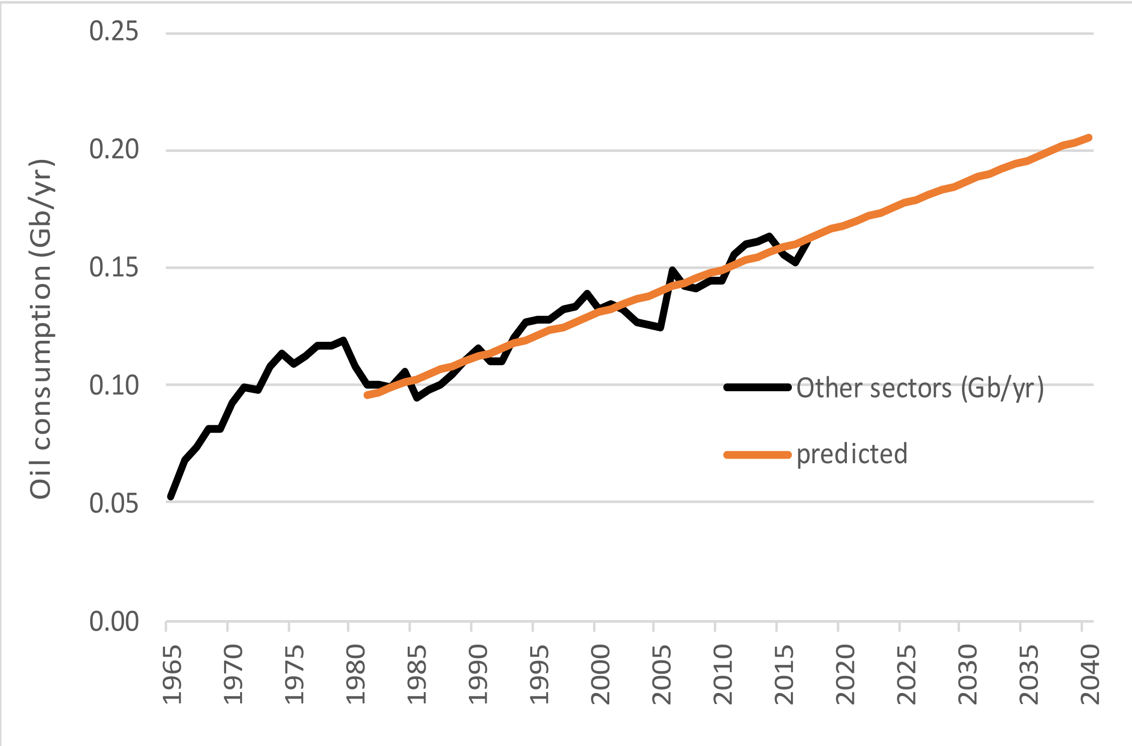


Figure 11 Other sectors oil equivalents and base-case forecast

# 3. Total Australian Oil Demand versus Supply

Adding together transport oil demand and other sectors demand gives Australian oil demand. This is shown in Figure 12 along with the basecase existing Australian supply projection from Figure 5. It can be seen that the continuing growth in other sector oil demand moderates a peak of transport oil demand, but the supply-demand gap widens.

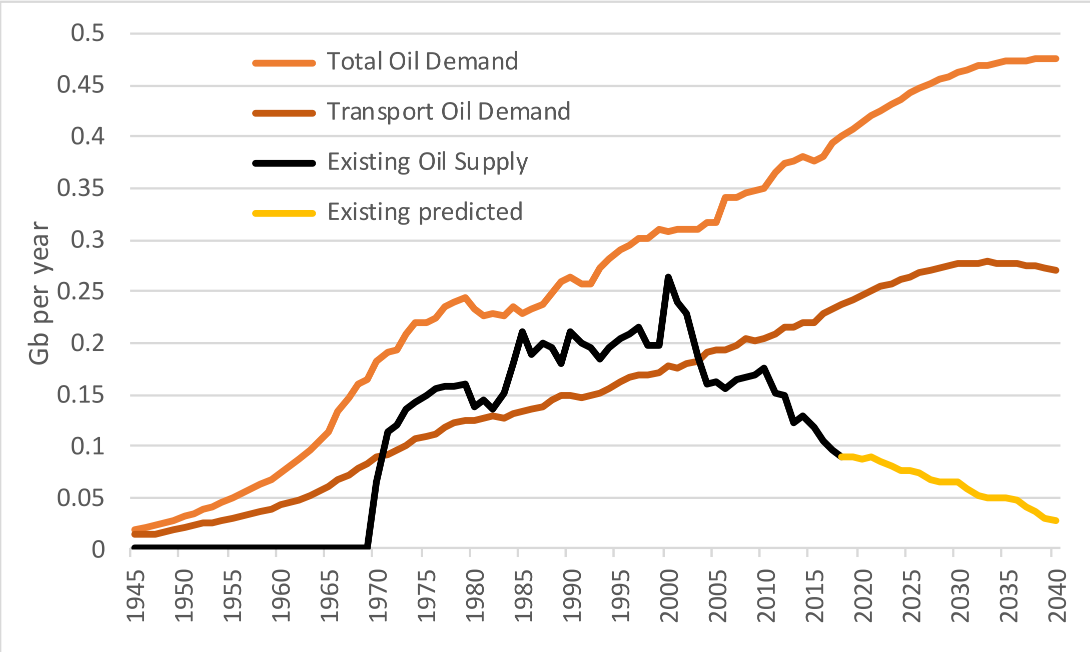


Figure 12 Australian oil supply and demand and base-case forecasts

The continuing decline in production from existing oil fields means that in the base case, Australia's import dependence grows from about 75 per cent in 2017 to about 94 per cent in 2040. Figure 13 shows net imports as a percentage of demand.

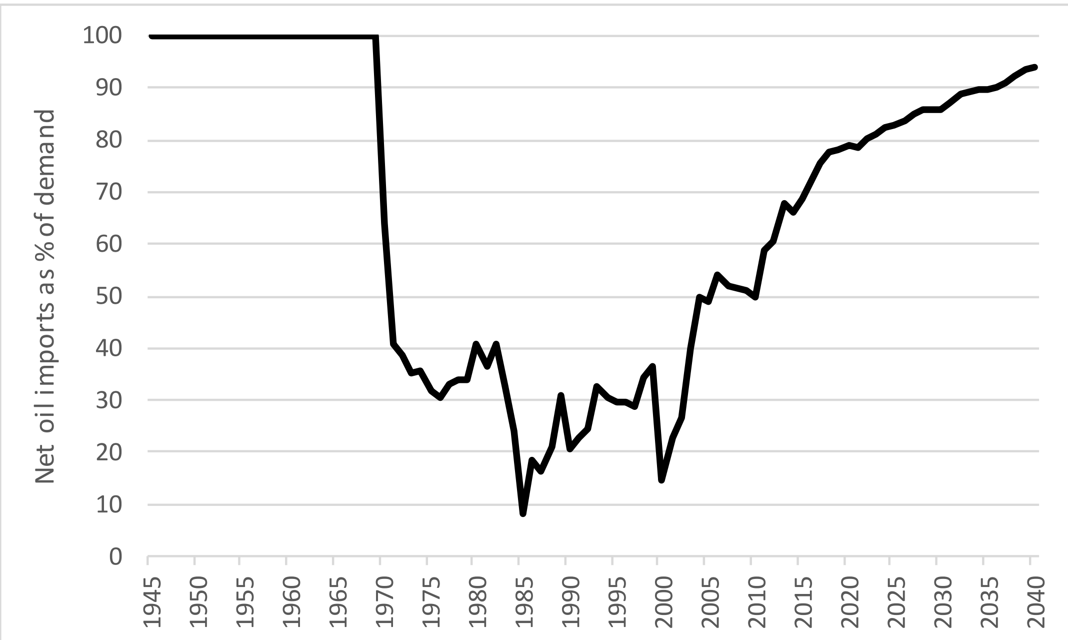


Figure 13 Australian oil supply and demand balance and base-case forecasts

## 4. Scenarios for Supply-Demand Balance

However, the base-case forecasts of demand depend crucially on what is forecast for oil supply and for transport oil needs. Two scenarios affecting the oil supply-demand balance are useful to consider:

1. What if the possible deep-water and shale production eventuates?
2. What if electric vehicle uptake is greater than assumed?

Taking **the first scenario**, Figure 14 shows the predicted existing oil supply, along with scenarios for deep water and shale oil production.

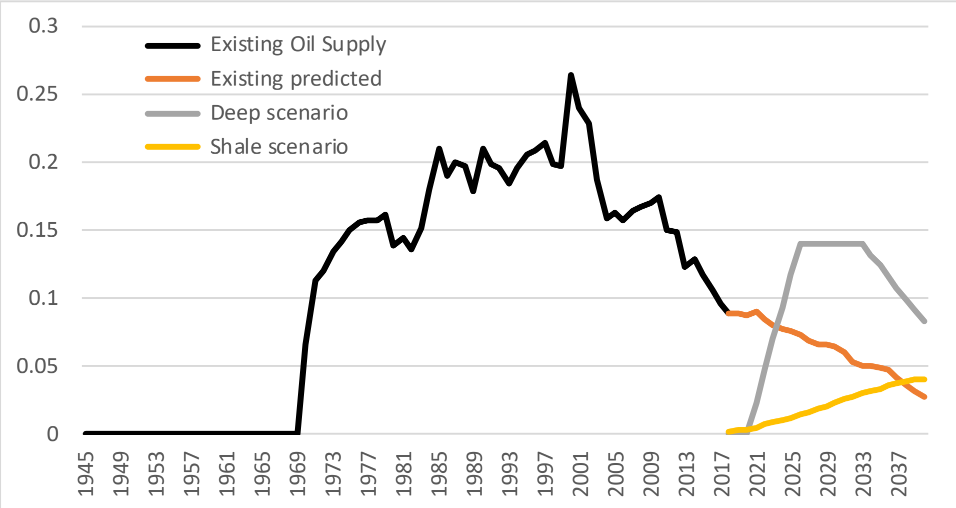


Figure 14 Deep water and shale oil production scenarios

Should the deep-water and shale production eventuate, Figure 14 shows the supply and demand scenario and Figure 15 shows the net import dependence scenario forecasts. Production rises to its previous highs in the early 2000s, but import dependence only falls this time from near 80 per cent currently to about 50 per cent, before rising to 70 per cent in 2040.

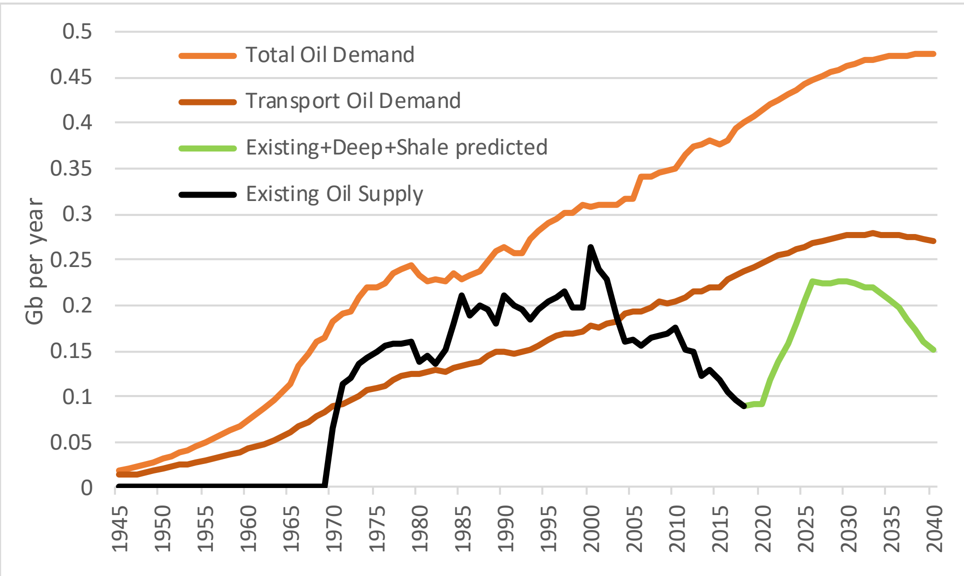


Figure 14 Australian oil supply and demand with ‘deep-water and shale’ scenario

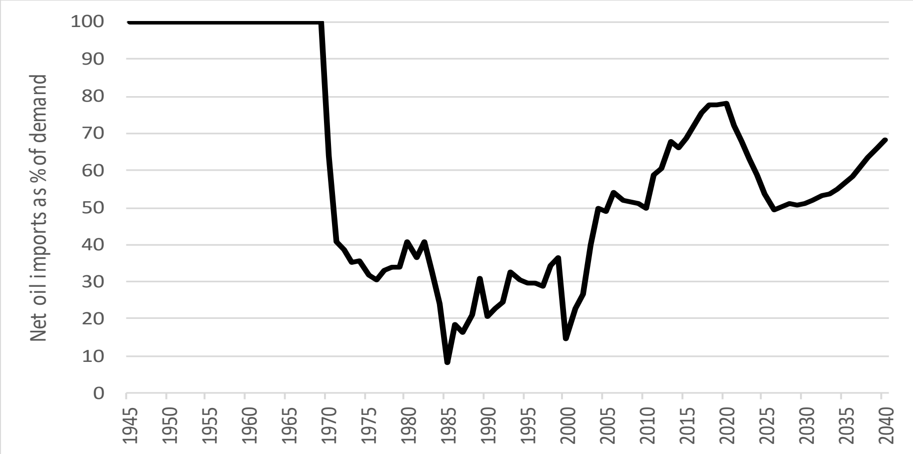


Figure 15 Australian net import dependence with ‘deep-water and shale’ scenario

In **the second scenario** (30 per cent lower EV prices), the uptake rate for EVs rises much earlier, as shown in Figure 16 (see BITRE 2019).

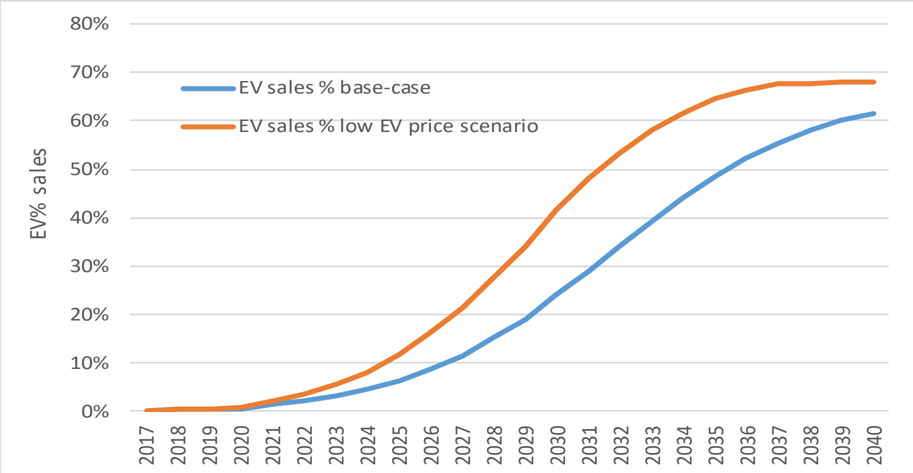


Figure 16 EV share of Light Vehicle sales, base-case and low EV price scenarios

The resulting share of electric vehicles in the *fleet* by 2040 rises from 28 per cent in the base-case to 38 per cent under the low EV price scenario – see Figure 17.

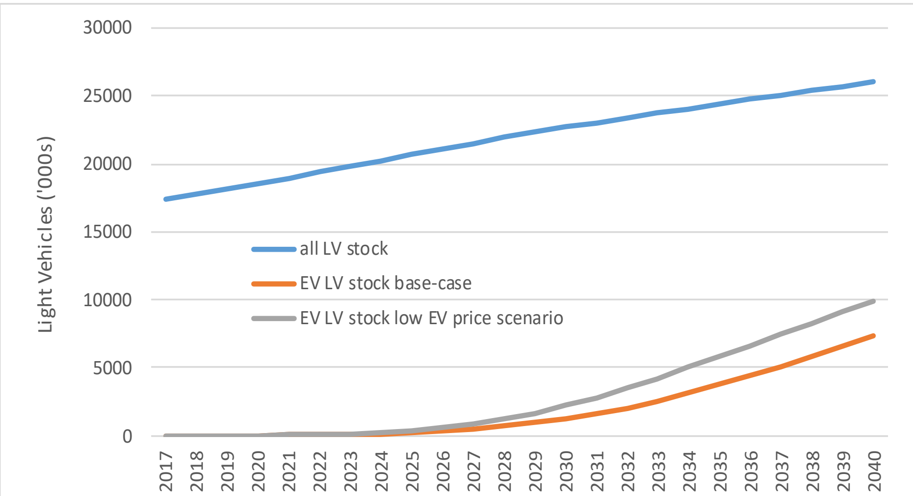


Figure 17 EV fleet numbers, base-case and low EV price scenarios

The result is that both total oil demand and transport oil demand fall by 0.016 gigabarrels per year in 2040 (see Figure 18). Import dependence stays near 94 per cent in both the basecase and the low EV price scenario (see Figure 19).

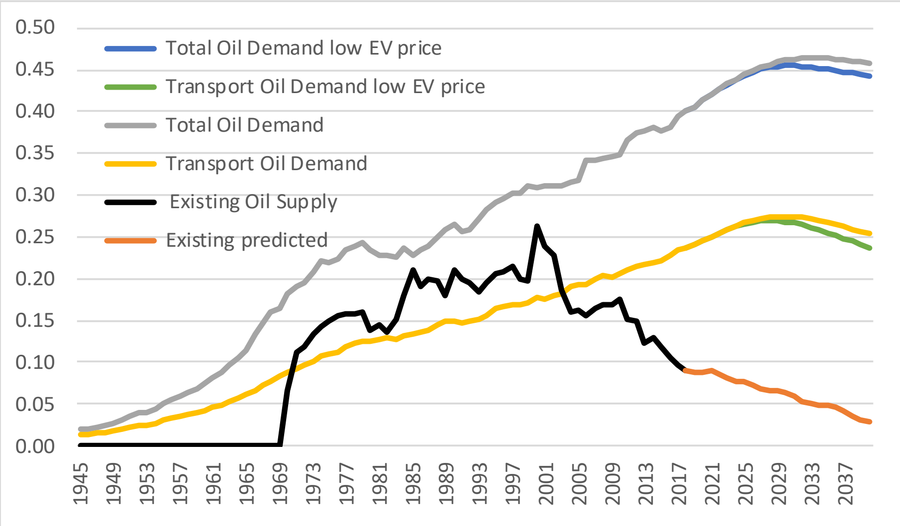


Figure 18 Australian oil supply and demand, base-case and low EV price scenarios

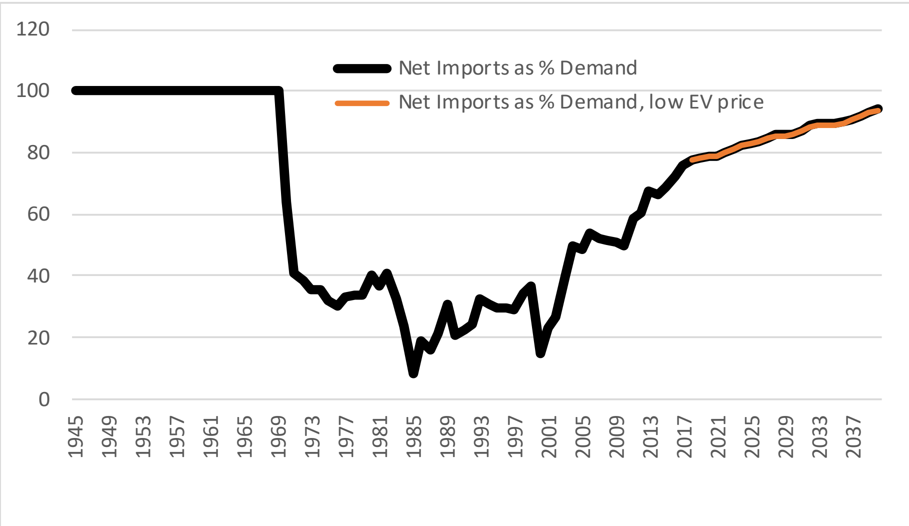


Figure 19 Australian net import dependence, base-case and low EV price scenarios

## 5. Conclusions

The modelling presented above allows a deeper understanding of the forces behind Australia's oil supply, demand and net import dependence.

The models provide solid base-case forecasts corresponding to assumed future conditions, and the forecasts can be easily revised to match different assumptions.

Such revisions include drastically different scenarios on the supply side (deep water and shale oil production) and on the demand side (a faster expansion of electric vehicle uptake).

As such, the models provide policy makers with tools to explore the implications for Australian oil security issues in the future.

## 6. References

BITRE 2019 Electric Vehicle Uptake: Modelling a Global Phenomenon, BITRE Research Report 151, Canberra.

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IEA 2018 World energy outlook 2018, International Energy Agency, OECD, Paris.

## 7. Deadline and submission

The deadline for paper submission is 19 June 2018. Papers submitted after this date may be deemed ineligible for presentation at the conference.
To submit your paper you need to use 'EasyChair' – the web based platform used to manage the paper review process. Please follow the steps closely:
Log-in to https://easychair.org/conferences/?conf=atrf2018

- If you do not have an EasyChair account you will prompted to set one up.
- Select 'New Submission' on the top left of the screen.
- Select the track for the paper – all professional practice papers are in one track, while authors of research papers need to select the relevant topic area.
- Click on 'Information' to the right of the screen for the relevant paper you wish to submit (make sure it's the right one if you have two or more papers!)
- Select the 'Add or update files' option in the top right corner.
- Upload your paper in .pdf format and press submit.

Papers will then be sent out for peer review by the relevant topic chairs.