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Final
Australia's Emergency Liquid Fuel Stockholding Update 2013: Australia's International Energy Agency Oil Obligation.
'Main Report'

Prepared for the Department of Industry, Canberra

23 October 2013

This report was produced using data, forecasts and price information current at the time of writing (2013). It should be noted that these inputs are likely to change over time and users of this report should refer to report updates where available or consider the age of the report when reviewing the results presented.

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Disclaimer

Executive Summary

This report examines Australia's commitment under the International Energy Agency (IEA) Treaty and costs of options to restore it to compliance with oil stockholding commitments. Australia is a member of the IEA where, as a signatory to the Agreement on an International Energy Program (the "IEP Agreement"), it benefits from the coordination of crude oil and petroleum product supply in the event of a major disruption to international oil markets. Under the IEP Agreement, member countries accepted a treaty commitment to hold crude oil and petroleum product stocks equivalent to a minimum of 90 days of their previous year's daily net import demand, and participate in collective actions initiated by the IEA during a liquid fuel emergency.

In the last few years Australia has breached the minimum inventory commitment set by the IEA. With local production of crude and condensate falling and petroleum demand increasing, the commercial stocks held by market participants are no longer sufficient to cover the minimum commitment.

In 2012, Hale & Twomey wrote a report (*National Energy Security Assessment (NESA) Identified Issues: Australia's International Energy Oil Obligation* - the 2012 Report) for the then Department of Resources, Energy and Tourism (RET) which investigated stockholding models Australia could use in order to become compliant with its inventory commitment. These models were as follows.

- Model 1: Government holds emergency stock using ticket contracts both overseas and in Australia.
- Model 2: Government holds physical emergency stock in dedicated storage facilities in Australia and uses ticket contracts to hold emergency stock overseas.
- Model 3: Industry has an obligation to hold stocks to a certain level (physical and tickets) and then the government manages the rest of the emergency stock requirement to meet the commitment (physical and tickets).
- Model 4: Industry has an obligation to hold sufficient stock to a meet the total emergency stock requirement using a mix of physical and ticket stock.

This report updates the proposed models taking into account:

- A revised (lower) forecast of the compliance gap between commercial inventories and the 90 days of daily net import commitment;
- Modification of the proposed models to address issues identified in the 2012 Report;
- Potential rule changes that Australia could propose to the IEA that would reduce, or slow the increase in, the amount of oil stock Australia would need to hold (including counting stock on the water); and
- Updated cost information, including the development of cost estimates specifically related to dedicated emergency storage facilities in Australia.

The revised forecast is predicting a smaller emergency stock requirement to meet compliance in the medium to long term; however the trend is similar to that identified in the 2012 Report – Australia does not currently comply with its IEA stock commitment and the forecast indicates the non-compliance gap is only going to increase.

While the changes in this report lead to lower costs for compliance in all stockholding models (when compared to the 2012 Report), the updated emergency stock requirement forecast is still substantial. By 2024 it is forecast that Australia would need the same volume of emergency stocks as the total commercial stocks in the country (i.e. double stocks currently held). This raises a number of issues including:

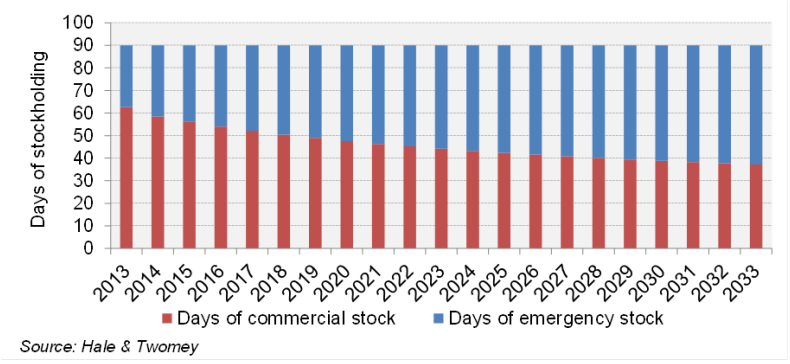
- The appropriateness of investing so many resources in emergency stocks;
- The capability to construct the number of storage facilities required without impacting on normal commercial storage investment; and
- The risk of stranded assets should there be significant new petroleum discoveries within Australia reducing the volume of emergency stocks needed along with the associated storage facilities.

The four stockholding models that Australia could use to hold emergency stocks have been further developed and costs re-estimated using updated cost assumptions. The key findings are:

- There is a risk with the 'all ticket' stock model (Model 1), that there won't be sufficient ticket stock available, or if it is made available it will be so expensive that holding physical stock would be cheaper;
- Models 2, 3 and 4 are all capable of reaching compliance should enough resources be put into constructing storage facilities; however doing this too quickly may result in higher costs and could have a substantial impact on the commercial market;
- If Model 4 is chosen (industry obligation), industry should be allowed to establish a central stock agency to manage the stockholding obligations for a fee. This should allow the emergency stock to be funded at a lower cost of capital and without affecting the companies' balance sheets; and
- With the above change to Model 4, the cost of Model 4 should now be similar to Models 2 and 3. The decision between these models comes down to the choice of responsibility for the obligation (government or industry) and the ownership of the central stock agency.

Update of forecast for emergency stock to address the compliance gap

The current compliance gap is similar to that calculated in 2012, with commercial stocks covering between 60 and 70 days of daily net imports leaving a gap of 20 to 30 days. The forecast is for the gap, referred to in this report as the requirement, to grow at a lower rate than previously forecast; by 2022, for example, the compliance gap is now expected to be 4,693kt (45 days) rather than 6,631kt (63 days) forecast in the 2012 Report. The requirement continues to grow beyond the 2033 forecast period until total stocks held meet 90 days of consumption. From that point the stock requirement would only grow if demand increases.



Source: Hale & Twomey

The annual increase in the emergency stock requirement is substantial – to put it into context, Australia would need to increase its emergency stock by the average amount of stock held in one of its refineries (~360 mlpa) every year between 2014 and 2024 to remain compliant.

Model overview: Comparative analysis and modifications since the 2012 Report

The 2012 Report developed four models to cover the full range of stockholding options that could be considered by Australia to meet its obligation. The models use either all ticket stock or a mix of ticket and physical stock, with the responsibility for holding emergency stock either being with the government or industry, or a combination of both.

Tickets are used in all models to manage the annual variability in the commitment.

Table 1: Model comparison - 2013 update

	Model 1	Model 2	Model 3	Model 4
Responsibility	Government	Government	Government & Industry	Industry
Stock type	Tickets only	Physical & tickets	Physical & tickets	Physical & tickets
IEA tonnes required - 2024 estimate - 2033 estimate	 5,184kt 7,159kt	 5,184kt 7,159kt	 5,184kt 7,159kt	 5,184kt 7,159kt
Funding	Budget or levy	Budget or levy	Budget or levy + industry pass through	Industry pass through
2024 cost estimate - capital spend by 2024 - annual cost - cost cents per litre	 n/a $613m 1.0	 $6,834m $599m 1.0	 $6,834m $599m 1.0	 $6,834m $599m 1.0
Total cost to 2033 including ramp up to compliance	$10,541m	$9,665m	$9,173m	$8,460m
Stock location - physical - tickets	 n/a Offshore & Aust.	 Australia Offshore	 Australia Offshore & Aust.	 Australia Offshore & Aust.
Stock split 2024	All tickets 5,630kt	Tickets: 850kt Physical: 4,780kt	Tickets: 850kt Physical: 4,780kt	Tickets: 850kt Physical: 4,780kt
Ability to meet IEA requirements	Uncertain – volume may not be available	Yes if sufficient resources put into building facilities	Yes if sufficient resources put into building facilities	Yes if sufficient resources put into building facilities
Time to secure first stock	1 – 1.5 years	1 – 1.5 years	1 – 1.5 years	4 - 5 years
Earliest time to full compliance with 2014 decision	2020 (6 years if feasible)	2021 (7 years)	2023 (9 years)	2024 (10 years)
Flexible to meet changing target	Yes (as long as volume available)	Yes	Yes	Yes
Impact on national oil market operation	Low	Moderate	Moderate	Moderate
Complexity to implement	Low	Moderate	High	High

Source: Hale & Twomey

Even with a lower requirement for emergency stock, it is still questionable whether Model 1 is feasible, as the volume of stock needed to fill the compliance gap may not be available through the ticket market. Encouraging a domestic ticket market with longer term contracts would be a sensible component of this model, both to encourage volume and to provide additional stock in Australia that would be available for use in a disruption almost immediately, and without dependence on shipping.

Options for developing new ticket markets in non-IEA countries in this region could also be investigated. While outside the current IEA rules there may be opportunity to establish such markets in a way that would be approved by the IEA. This would provide a more logical location for Australia to hold stock than in Europe, as they would be within the currently supply envelope.

The main issue with Model 1, along with stock availability, is the likely cost. There is a risk that the price of ticket contracts could be pushed up to, or even above, the cost of investing in long term physical stock holdings. Other than for very short term requirements there is no point in paying more for ticket contracts than for holding physical stock. Even if Model 1 was initially chosen as the preferred model, there is a risk that Australia would be pushed towards one of the other models through cost pressures.

Models 2 and 3 are similar to the work in the previous report. However the 2012 Report identified a number of limitations with Model 4 that needed addressing including:

- It is difficult to rely solely on an obligation to manage compliance with a stock requirement that will change annually;
- There is a risk of changing the market dynamic and industry participants due to the substantial capital the industry would need to invest; and
- Industry sets a higher cost of capital return thresholds on any capital it invests – this will lead to a higher annual cost to provide the return needed on the capital invested.

This report (2013) finds that these issues could be avoided by the way in which this model is implemented. If the stock obligation is passed to a non-profit central agency which has the responsibility for holding emergency stock, the obligation effectively becomes a fee paid to the agency (which is then passed through to the market in the cost of product supply). The agency is then responsible for raising capital (through borrowing) and, as it will effectively have a guaranteed income (due to legislation putting the obligation in place), it should be able to borrow at a lower cost. As a centralised body it will also have greater ability to manage how Australia responds to changes in the stockholding target. Most countries that use an industry stockholding obligation have a central stockholding agency to facilitate emergency stock holdings.

Using a central stock agency to manage emergency stocks addresses the main concerns with Model 4 and effectively makes Models 2, 3 and 4 similar in cost, with the differences being the process of implementation and responsibility (e.g. in Model 3 the central agency would be government owned whereas in Model 4 it would be private). In this analysis the costs for Models 2, 3 and 4 are estimated to be the same as they have the same assumptions for return requirements and ticket/physical stock split. With the change to Model 4, the assessment of the impact on the national oil market is reduced from high to moderate.

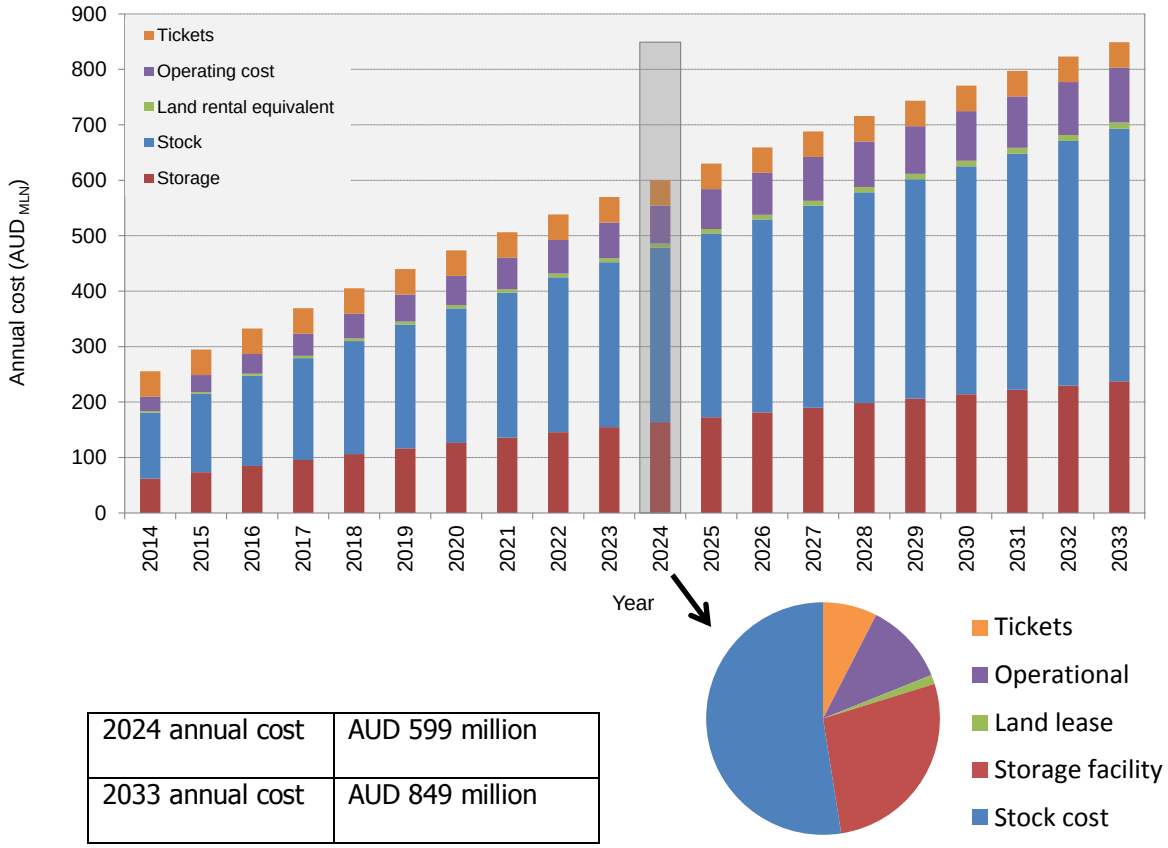
Cost analysis update

The cost of each of the models is assessed over the next 20 years in real terms (2013 dollars). It assumes that there is sufficient emergency stock held to be compliant amidst the peaks and troughs of the normal commercial stockholding cycle, and that stock is added each year as the daily net import requirement increases.

The cost for constructing large storage facilities has been recalculated by commissioning engineering estimates for specific large storage scenarios. These facilities are a lower cost per unit stored than normal commercial facilities as they are less complex and have benefits of scale. The new estimates should be more accurate than those used in 2012 and are around 10% lower.

In this report, given the time to implement the stockholding models, the specific year chosen for financial analysis is 2024, which is expected to be about 10 years from the time the chosen strategy would have started to be implemented.

The chart shows the cost profile for 20 years from 2014 split between the cost components. The estimate assumes moving straight to compliance in 2014 and then adding stock and storage capacity each year (and therefore cost) to remain in compliance as the daily net import requirement increases.



2024 annual cost	AUD 599 million
2033 annual cost	AUD 849 million

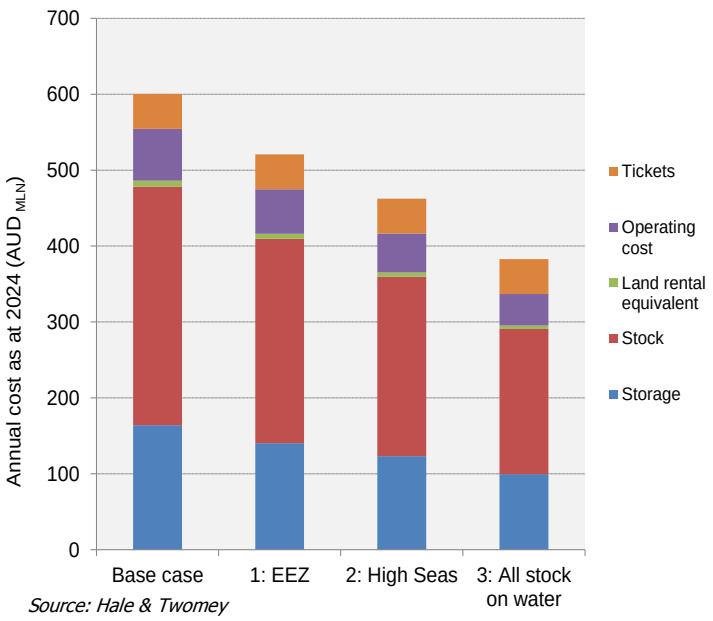
Source: Hale & Twomey

The annual costs include revenue to provide a return on capital invested in stocks and storage facilities. In capital terms, while AUD 2.5 billion is required to return Australia to compliance next year (if it was feasible to do this) over AUD 400 million of new capital needs to be invested each year so that by 2024 (when according to the model scenarios Australia could be compliant) a total of AUD 6.8 billion would have been invested in storage facilities and stock. The annual cost can also be expressed in cents per litre on petroleum sales assuming most product types are charged. In 2024 the cost for each of the models is 1.0 cent per litre.

Cost variation including stock on the water

Australia has long maritime supply chains with crude and product imports travelling by sea for an average of 15 days. This means a significant portion of stock that Australian companies own is on the water. This stock is currently not included in the IEA inventory calculation for determining Australia's stock levels.

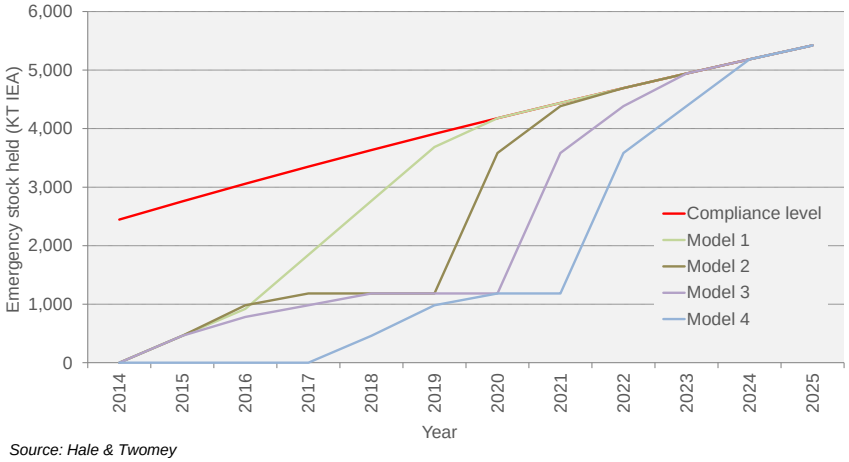
The stock on water volumes have been modelled and split between stock on the high seas and stock within Australia's Exclusive Economic Zone. If it was included, this would reduce the amount of emergency stock required to meet the target, although even in 2013 inclusion of all stock on water is not enough to bring Australia into compliance. The chart shows the impact on annual costs for 2024 when stock on water is included compared to the base case (the base case is the case analysed in the previous section).



Source: Hale & Twomey

Time to compliance

Model 1 gives the fastest time to compliance if the volume is available on the ticket market – around six years from when a decision is made on which model will be used. Model 4 would take longest due to the need to develop and put in place the legislation and rules required for the industry obligation. This would take at least 10 years.



Source: Hale & Twomey

The minimum time to compliance for Models 2, 3 and 4 (7 to 10 years) assumes considerable resources are put into building very large emergency storage terminals in different states concurrently. For all models, by 2024 around 5,300 million litres of new storage is needed, a 60% increase on Australia's current storage capacity. It needs to be considered whether this is an efficient use of resources; it may be preferable to spread emergency storage investment over a longer period even if that means a longer time to compliance. This could be more cost efficient for construction contractors as it will smooth workforce requirements. Dedicating so many resources to emergency storage also risks impacting on storage construction activity that might be needed for the commercial market.

Model selection

Selection of the stockholding model most appropriate for Australia should not be influenced by the decision on the level of emergency stock Australia should hold (level for compliance or some other level). Rather it is a decision on which model is most appropriate for the Australian Government, the petroleum industry and the consumer.

Given the changes to Model 4 there is now no cost driver if choosing between Models 2, 3 and 4. With the uncertainty over the ticket volume availability (and cost), it would be sensible to consider one these models should holding physical stock become a necessity.

Essentially the attributes for models holding physical stock will be similar. In all cases a central agency with responsibility for establishing emergency stockholdings should be established. Key decisions will be around who should have ownership of this agency and whether the agency is given the obligation directly or via an initial obligation on industry.

There are European countries that have emergency stockholding systems in line with Model 2, Model 3 and Model 4. If more detail is required on a particular model, information could be obtained from a country using that particular model.

Table of Contents

Glossary

Annual cost	The cost of stockholding in a specific year - covering all costs including a return component for the capital invested in storage facilities and stock, land rental and storage facility operating costs.
Aurecon	Professional engineering consulting firm that was used to develop cost estimates for emergency storage facilities in the *Oil Storage Options & Costs* (2013) report.
Base case	The cost for the revised emergency stock forecast using the base cost assumptions.
bbl	Barrel (measure of petroleum volume = 159 litres).
Collective action	Actions undertaken by the International Energy Agency to respond to oil market disruptions. Responses include the joint release of oil stocks, demand restraint, fuel switching and surge production.
Commingled stocks	Where emergency stocks are held in the same facilities (and possibly the same tanks) as commercial stocks
Commercial stocks	Stocks held by commercial operators to manage their business, including managing normal supply chain disruption.
cpl	Cents per litre.
Cubic metre	1,000 litres.
Emergency stocks	Stocks held by countries specifically to manage major supply chain disruption either globally or locally if outside the control of commercial companies.
Exclusive Economic Zone (EEZ)	A marine zone detailed under the United Nations Convention on the Law of the Sea (UNCLOS) as being no further than 200 nautical miles from the baselines from which a coastal State's territorial sea is measured.
IEA tonnes	Stock measure of tonnes as reported by the IEA, once the defined yields and allowance for heel volume (defined under 'Tank heels' below) has been taken into account. A country's net import target is defined in IEA tonnes.
IEP Agreement	International Energy Program Agreement ('the Treaty').
kt	One thousand tonnes.
mlpa	Million litres per annum.
OECD	Organisation for Economic Co-operation and Development.
Operating cost	The costs involved in holding emergency stock including the storage facility maintenance and operational costs, insurance and product quality maintenance.
Tank heels	Volume in the bottom of a tank below the normal tank draw offs (therefore not accessible in normal tank operation).
Ticket stock	An oil stockholding arrangement under which a seller agrees to hold (or reserve) an amount of oil on behalf of a buyer in return for an agreed fee.

1.0 Introduction

This report updates earlier work on emergency liquid fuel storage from *the National Energy Security Assessment (NESA) Identified Issues: Australia's International Energy Oil Obligation* report (2012 Report) produced by Hale & Twomey (H&T) for the then Department of Resources, Energy and Tourism (RET) in 2012.

This is the Main Report, and brings together work from a series of supplementary reports on stockholding model options that would enable Australia to comply with its oil stockholding commitments as an International Energy Agency (IEA) member. Costs for each stockholding model are provided, along with analysis on the impact of various assumptions, such as the inclusion of stock on the water in inventories or holding sufficient stock to appropriately contribute to a global supply emergency.

2.0 Background

Australia is a member of the IEA where, as a signatory to the Agreement on an International Energy Program (the "IEP Agreement"), it benefits from the coordination of crude oil and petroleum product supply in the event of a major disruption to international oil markets. Under the IEP Agreement, member countries accepted a treaty commitment to hold crude oil and petroleum product stocks equivalent to a minimum of 90 days of the previous year's daily net import demand, and participate in collective actions[1] initiated by the IEA during a liquid fuel emergency.

In the last few years Australia has not achieved the minimum inventory commitment set by the IEA. With local production of crude and condensate falling and petroleum demand increasing, the commercial stocks held by market participants are no longer sufficient to cover the minimum commitment which is based on 90 days of the daily net imports.

The IEA includes 28 member countries and was founded in response to the 1973/4 oil crisis. The majority of members are in Europe as shown in Figure 1. Australia, Japan, New Zealand and the Republic of Korea (South Korea) are the only IEA members in the Asia-Pacific region.

Figure 1: IEA membership map

[1] IEA collective actions cover a range of options including the joint release of stock as an initial response to market disruption. Other responses include demand restraint, fuel switching and surge production. The actions chosen are tailored to each situation, involve widespread consultation and co-operation and can be instigated rapidly.

The majority of IEA member governments hold emergency stocks, although there are a wide variety of approaches to holding physical stock and obtaining storage facilities. Some governments have developed and own storage facilities; others lease storage from the market and leave it to private providers to own and manage the facility. In this case, storage facilities are normally secured through a tender process (which is applicable for both existing and new facilities).

With regard to physical stock, many governments own the oil even if the storage is leased, unless they devolve the obligation to hold stock to the petroleum industry operating within the country. Even where industry is responsible for holding stock, there is usually some approved central structure (e.g. stock agency) to ensure the facilities and stock are developed and held in the most efficient way.

Some IEA countries fund emergency stock from the general government budget, particularly non-European countries. However, many of these countries established reserves over a long period when petroleum prices were at lower levels. Direct funding via a consumer levy is common in Europe, and most IEA countries tax petroleum in some way. The levy provides an annual income stream to the government or stock agency. Large upfront costs associated with initial fuel purchases are funded by loans to the stock agency, which are repaid through the levy income.

This Report looks at four stockholding models that might be suitable to help Australia meet its IEA commitments. These were developed in 2012 from the combination of options available depending on the stock type held and the responsibility for holding stock. The stock types analysed in 2012 and in this report include ticket stock (a contract option to buy physical stock in an IEA declared emergency), physical stock held for emergency use, or a combination of each. Responsibility for holding the stock could be with the government or a government agency, devolved to industry through stock obligations or a combination of both.

Table 2: Stockholding model options

	Ticket Stocks	Tickets and physical stocks	Physical Stocks
Government owned	Model 1 New Zealand	Model 2 Ireland, Germany	Covered in Model 2 US
Combined government owned and industry obligation	Covered in Model 3	Model 3 France, Netherlands	Covered in Model 3 Japan, South Korea
Industry obligation	Covered in Model 4 Luxembourg	Model 4 United Kingdom	Covered in Model 4 Austria

Increasingly complex regulation required.

Change in cost not certain but may be higher.

Increasing cost and complexity; capable of managing more volume

Source: Hale & Twomey

Table 3: 2012 Report summary of Australia's stockholding model options

	Model 1	Model 2	Model 3	Model 4
Responsibility	Government	Government	Government & Industry	Industry
Stock type	Tickets only	Physical & tickets	Physical & tickets	Physical & tickets
IEA tonnes required - 2016 estimate - 2022 estimate	 3,287,689 6,631,382	 3,287,689 6,631,382	 3,287,689 6,631,382	 3,287,689 6,631,382
Funding	Budget or levy	Budget or levy	Budget or levy + industry pass through	Industry pass through
Cost estimate 2016 - capital by 2016 - annual cost[2] - cost per litre	 $0m $264m 0.5	 $4,163m $296 - 495m 0.6 - 1.0	 $4,148m $305 - 496m 0.6 - 1.0	 $4,121m $492 - 696m 1.0 - 1.4
Cost estimate 2022 - capital by 2022 - annual cost - cost per litre	 $0m $573m 1.1	 $9,783m $840 - 1,106m 1.2 - 2.2	 $9,722m $649 - 1,107m 1.3 - 2.2	 $9,695 $1,103 - 1,582 2.2 - 3.1
Stock location - physical - tickets	 n/a Offshore/Aust.	 Australia Offshore	 Australia Offshore/Aust.	 Australia Offshore/Aust.
Stock split	All tickets	Tickets: 850kt Balance physical	Tickets: 850kt Balance physical	Tickets: 850kt Balance physical
Ability to meet IEA requirements	Uncertain – volume may not be available	Yes	Yes	Yes
Time to secure first stock	1 – 1.5 years	1 – 1.5 years	1 – 1.5 years	4 – 5 years
Possible time to full compliance	5 - 10 years if feasible	10+ years	10+ years	10 - 15 years
Flexible to meet changing target	Yes (as long as volume available)	Yes	Yes	Partially
Impact on national oil market	Low	Moderate	Moderate	High
Complexity to implement	Low	Moderate	High	High

Source: Hale & Twomey

In the 2012 report, the amount of emergency stock forecast to be required by 2022 was substantial, in excess of all currently held petroleum stock in Australia. The 2012 Report noted that while costs were given for 2016 and 2022, given the substantial volumes required, time to full compliance might take more than 10 years.

[2] Models 2 and 3 were based on a 5-10% range for return on capital employed with storage facility asset value recovered over forty years for the amount of stock needed in the year stated. Annual costs for tickets and stock and facility costs are included. Model 4 used a return on capital range of 10-15%.

3.0 Methodology

The aim of this report is to update and expand on the stockholding models developed in the 2012 Report. The update also builds on Auxiliary Reports developed as part of this project, two of which provide updates on the costs:

- The *Oil Storage Overview & Options* (2013) report provides updated costs for storage facilities and stock; and
- The *Ticket Markets* (2013) report provides updated tickets costs.

The storage section in this report (5.0) contains a cost summary for four strategic storage scenarios from the *Oil Storage Overview & Options* (2013) report. The options used in the cost build up in this report are Option 2 for crude storage and Option 3 for product storage (both large above ground storage terminals) which reflect the most efficient way to store large volumes of petroleum in above ground terminals.

The *Oil Storage Overview & Options* report also developed a cost estimate for a smaller above ground terminal expansion (Option 1) and for large scale permanent floating storage (Option 4). The smaller terminal is more expensive per unit stored and would reflect the likely cost if the emergency stock was dispersed around existing terminals. As the focus is on storing substantial volumes in all stockholding models, Option 1 was not used. The permanent floating storage cost estimate was similar to the above ground storage terminal so the choice of facility would not have a significant impact on the cost estimates.

The ticket section (6.0) contains a cost summary from the *Ticket Markets* (2013) report along with a summary of the work in that report on developing ticket markets in non-IEA countries and the development of a ticket market within Australia. These issues are developed further in the sections on the stockholding models (7.0). In general the work done in the 2012 Report is not repeated in this report. If the reader requires more details on some of the issues summarised in this report they are referred to the relevant text in the 2012 Report.

3.1 Scope of Work

H&T was requested by the Department of Industry (the Department) to provide a methodology to undertake this report, including advice on report assessment and delivery options. The report was to revise relevant sections of the 2012 Report, including data and assumptions/conclusions where relevant.

The Department specifically sought updates to or discussion of the following:

- Operating & Maintenance costs;
- Mitigation methods for Model 4 (Industry responsibility/physical and ticket stocks);
- System redundancy, such as optimum levels of industry stockholdings and industry capacity to meet supply disruptions; and
- Storage costs.

3.2 Scope of Work adjustments

In the initial scope of work, the Department was to provide a forecast on the emergency stock requirement to H&T. As an updated forecast was unable to be completed in the required timeframe, H&T developed, in consultation with the Department, a model to produce an emergency stock forecast to inform this report. This forecast is outlined in Section 4.0.

The initial scope also included a separate report looking at the impact of including some or all of the stock on the water in Australia's supply chain in its inventory count against the IEA stock target. It was agreed between the Department and H&T that this work would better fit as part of this Main Report as it is a variation on the forecast. This work is covered in Section 9.0.

The Department and H&T also agreed to shift the split between crude and product for emergency stocks from 60% crude and 40% product to 40% crude and 60% product. Although the initial proposal is in line with the current import split between crude and product, with the closure of the Clyde and Kurnell refineries and market growth, within five years the split is expected to be less crude than product. If the Geelong refinery were also to cease refining, product imports are expected to increase towards 70% of total imports.

The discussion on system redundancy is in Section 5.1 under the title System Contingency. As the petroleum supply chain is not a real time supply chain (compared to electricity supply, for example) the term 'contingency' is more suitable than 'redundancy' when discussing how disruption is managed.

3.3 Financial methodology

In order to analyse the costs in more detail and provide a calculation tool that can be used to test various assumptions, H&T was requested to and has developed a template that can be used to analyse costs over the forecast period. Different stock requirements can be compared as well as assessing the impact from variation in the cost assumptions.

All the analysis is done using 2013 costs in real terms rather than nominal. All costs are in Australian dollars, except for ticket prices which use US dollars (as that is the primary currency used for ticket market trading).

4.0 Stockholding forecast

A stockholding forecast has been developed to establish the compliance gap between the stocks currently held (all commercial) and Australia's IEA stockholding commitment which is based on 90 days of daily net imports.

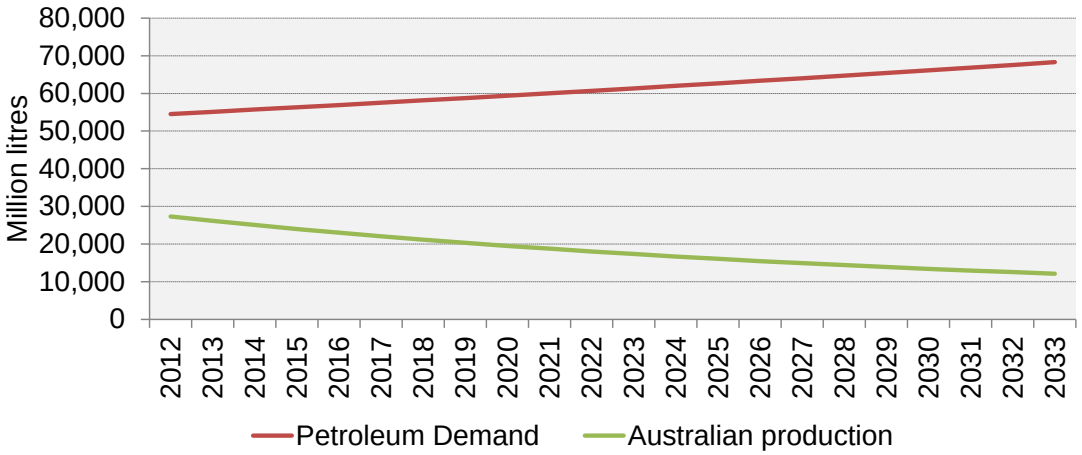
4.1 Emergency stock forecast

H&T has developed an emergency stock forecast for this Report, which determines the amount of stock (in IEA tonnes) that Australia needs to hold to be compliant with the IEP Agreement. The forecast uses the current year's daily net import (based on 2012 calendar year data) as its base, adjusting the projection based on the expected change in indigenous production and petroleum demand (sourced from December 2012 Energy Projection data). The calculation of 90 days of the daily net import is then compared against the minimum expected commercial inventory to establish the amount of additional stock (in IEA tonnes) Australia would need to hold. Any adjustment to the base year data (2012 data) impacting the calculation of the daily net import will affect the forecast by a similar amount in all following years.

The minimum expected commercial inventory used in the calculation ensures that Australia would remain compliant amidst the peaks and troughs of the normal commercial inventory cycles. Australia's commercial inventories can vary by about 700kt between maximum and minimum (~850 million litres). This means that if Australia aims for stockholding levels that will ensure 90 days compliance even when commercial inventories are at their lowest, the average month end stock level would be around 94 days and the maximum around 99 days (based on the 2013 daily net import target).

The main drivers of the net daily import target are the change in petroleum demand and the change in indigenous production of crude, condensate and natural gas liquids (NGL/LPG). Australia's net import target is expected to continue increasing, both due to increasing demand and falling indigenous production as shown in Figure 2.

Figure 2: Demand and production trend 2012-2033

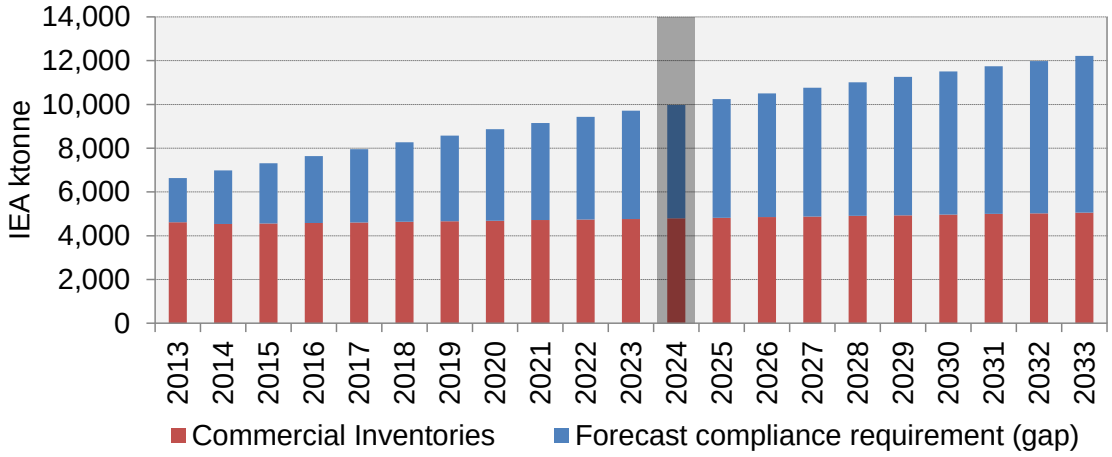


Source: H&T from Australian Petroleum Statistics and Energy Projections

While Australia's commercial inventories will increase with higher demand (as companies like to keep a certain level of days cover for security of supply), this will be at a much lower rate than the

amount of stock needed to meet the 90 day commitment. The gap or emergency stock compliance requirement is shown in Figure 3.

Figure 3: Forecast compliance requirement



Source: Hale & Twomey

The forecast is similar to the 2012 forecast in the near term but increases more slowly. The 2012 Report analysed the cost in 2016 and 2022 so the targets for these years are compared in Table 4. This report calculates the cost across all years with a focus on 2024, reflecting the earliest time Australia could be compliant under all stockholding models.

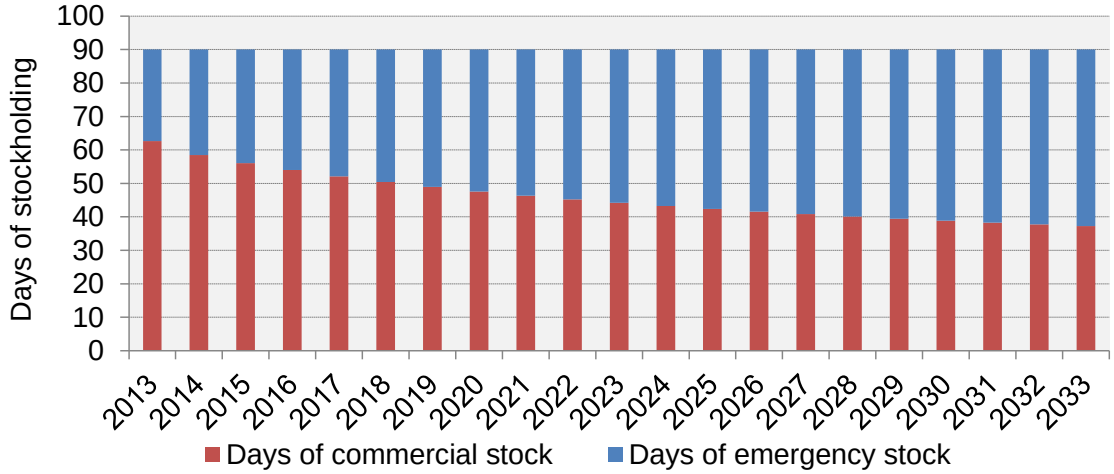
Table 4: Comparison of compliance requirement forecasts

	2016	2022
2012 forecast (IEA kt)	3,288	6,631
New forecast (IEA kt)	3,058	4,693
Change (IEA kt)	(230)	(1,938)

Under the new forecast, the emergency stock requirement would not get to the level noted in the 2012 Report for 2022 (6,631 IEA kt) until around 2030.

The IEA also reports the inventory as stockholding days against the net daily import calculation. Although the commercial stocks are expected to increase with demand, as the net daily import increases, the number of days the commercial stocks covers drops as shown in Figure 4. This requires an increasing volume of emergency stock in days cover to meet the 90 day commitment. The commercial stocks are shown for the minimum of the normal inventory cycle – the average stocks are approximately 4 days higher. The inventory impact of the closures of Clyde and Kurnell refineries has been taken into account in the commercial stock forecasts – no adjustment has been made for Geelong. A conversion of the Shell Geelong refinery to an import terminal is expected to add around 125 IEA kt to the requirement from the point of the refinery closure. This estimate is based on the net difference between expected import terminal stock compared to refinery operation, taking into account the change of stock type and the factors to adjust to measurement in IEA kt.

Figure 4: Trend in stockholding days



Source: Hale & Twomey

While increasing at a lower rate than the 2012 forecast, the compliance gap is still substantial. If Australia held enough stock to ensure compliance by 2024, its emergency stockholding is likely to exceed its total commercial stock holding.

4.2 Conversion from tonnes to IEA tonnes

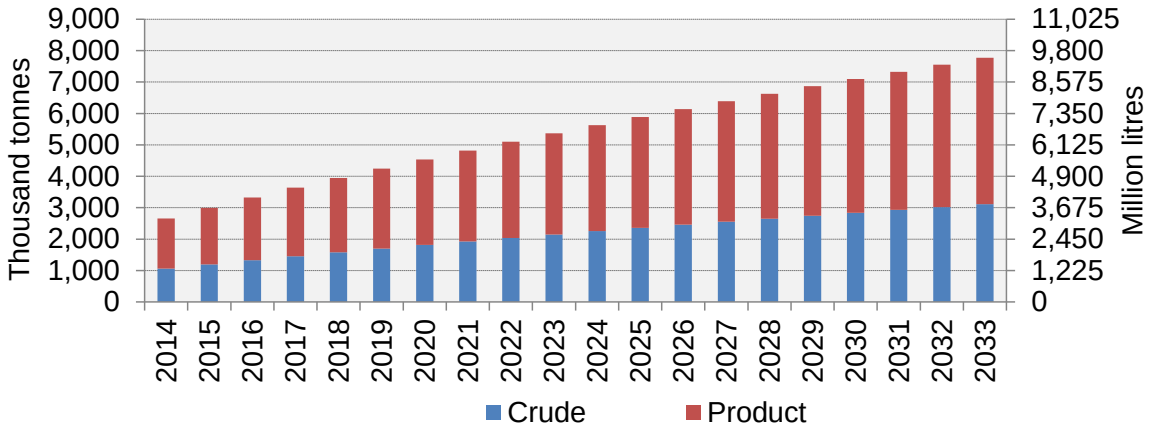
The compliance requirement calculated above is shown in IEA tonnes, as it would be reported by the IEA once it had made yield and heel adjustments to the actual stock volumes. In order to hold enough emergency stock to cover the compliance gap, the yields and adjustments the IEA makes to inventories need to be taken into account. These are as follows:

*Crude inventory in tonnes *yield*heel allowance = Crude inventory in IEA tonnes*
*Crude inventory in tonnes *0.96*0.9 = Crude inventory in IEA tonnes*
*Crude inventory in tonnes *0.864 = Crude inventory in IEA tonnes*

*Product inventory in tonnes *yield*heel allowance = Product inventory in IEA tonnes*
*Product inventory in tonnes *1.065*0.9 = Product inventory in IEA tonnes*
*Product inventory in tonnes *0.9585 = Product inventory in IEA tonnes*

Therefore in order to meet a requirement of stock holding of 1,000 IEA kt either 1,157 kt of crude or 1,043 kt of product needs to be held (or a combination of the two). For this Report the assumption is that any emergency stocks would be 40% crude and 60% product, in line with the expected import mix following the closure and conversion to import terminals of the Clyde and Kurnell refineries, and further product import growth. Based on this crude/product ratio the actual emergency stockholding needs to be about 8.5% higher than the IEA tonne compliance target. This volume is shown in Figure 5 (in tonnes and millions of litres).

Figure 5: Physical stock needed to meet compliance gap target



Source: Hale & Twomey

The above chart shows the amount of stock needed for compliance in each year. Additional stock needs to be added every year to maintain compliance. Implementation of any stockholding strategy will take time and depend on the model chosen. Time to implement is discussed in the sections on each of the models (7.0).

4.3 Forecast volumes for financial modelling

The stockholding requirement for the next 20 years is used as input for the financial model that calculates the expected stockholding costs across each year through to 2033. The cost assumptions are updated based on the cost estimates from the auxiliary reports for Storage and Ticket costs.

In this report, given the time to implement the stockholding models, the specific year chosen for financial analysis is 2024, expected to be about 10 years from an arbitrary implementation start time of 2014.

5.0 Summary of physical stock costs

Emergency stocks can be held in above ground storage terminals, permanent floating storage or underground caverns (either natural or constructed). The H&T Report, *Oil Storage Options & Costs*, investigated and estimated costs for four options in detail; three above ground scenarios and one permanent floating storage. Underground storage was not investigated in detail as it is dependent on factors such as suitable geology, which are outside the scope of this review.

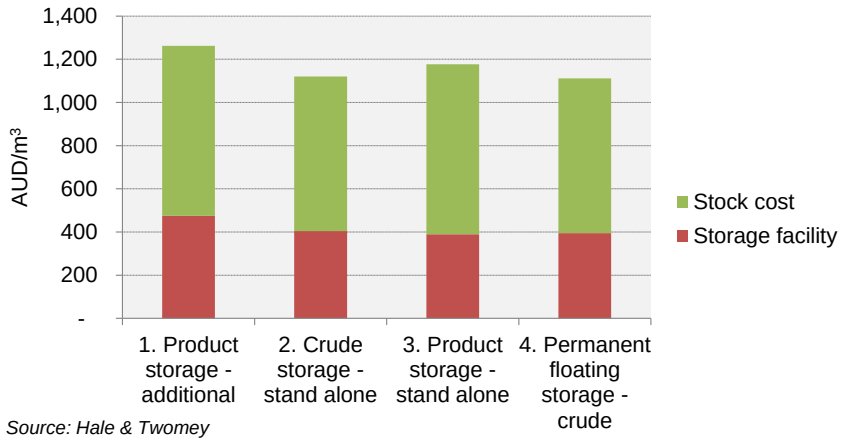
Table 5: Storage options for cost estimation

Scenario	Facility and description	Size (million litres)	Stock
1	Above ground – expansion of existing terminal	200	Product
2	Above ground – dedicated stand-alone terminal	480	Crude
3	Above ground – dedicated stand-alone terminal	500	Product
4	Permanent floating storage - purpose built facility	1,000	Crude

The sizes for scenarios 2, 3 and 4 are set at a size where the benefit of economies of scale have been captured – smaller terminals, while cheaper, will result in a higher cost per litre stored, whereas for larger terminals the cost will increase in direct proportion to the increase in storage volume. Permanent floating storage refers to a purpose-built facility on water, not oil tankers moored together.

Figure 6 shows the capital costs for the four storage scenarios per cubic metre (1,000 litres). The cost of purchasing oil stocks makes up over 60% of the total cost. In terms of facility cost there is not much difference between the cost per unit of storage of the larger tank farms and permanent floating storage. The smaller "expansion" terminal is more expensive as it is not large enough to capture all the scale benefits.

Figure 6: Capital investment per unit storage



Source: Hale & Twomey

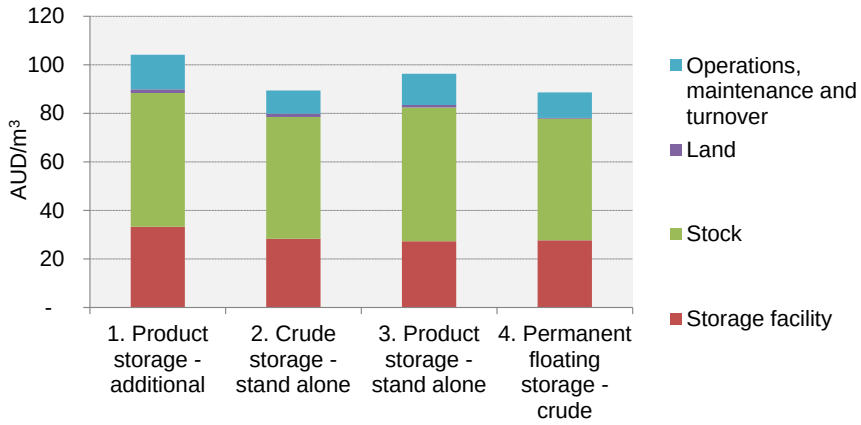
The capital costs for the storage facilities are lower per unit stored than normal commercial terminal developments, due to the scale and because many of the features of a commercial terminal such as tank wagon loading gantries are not required. These estimates do not include

related infrastructure such as jetties[3], wharf lines and links into utilities such as roads, power and water. In order to keep these costs down the facilities should be located relatively close to existing infrastructure (e.g. use existing jetties, etc.).

Figure 7 shows the total annual cost including a return component (at 7% rate of return) for the capital invested in storage facilities and stock together with the land and operational costs. The chart highlights that emergency stocks are a very capital intensive investment. In order to provide emergency stocks at the lowest possible ongoing cost, they need to be implemented in a way that allows them to be efficiently funded with a relatively low cost capital requirement.

Providing a return on the capital required to build storage facilities and purchase the stock makes up approximately 85% of the total cost (shown as the red and green components in Figure 7). Product storage is more expensive as the cost of purchasing the product is about 10% more than crude, along with higher operational costs to maintain product specification.

Figure 7: Emergency storage costs per year (@ 7% return)



Source: Hale & Twomey

5.1 System Contingency

Stocks are an integral part of the petroleum supply chain. Producers, refiners and marketers all need to hold stock to manage their operations; to build stock to sell in cargo sized quantities, to receive economic cargo quantities, to manage production variation and to manage demand variation. In effect, stocks provide most of the system contingency in the petroleum supply chain to manage disruption.

Businesses producing and supplying petroleum will make decisions on appropriate stock levels to manage their supply chain (and likely disruption) while also managing the costs associated with holding stocks. These stocks are referred to as **commercial stock**. Currently all stock held in Australia is commercial stock.

Stocks are able to provide system contingency because unlike electricity (and in many cases gas), petroleum supply disruption is not immediate. An interruption to supply will not disrupt product availability, only draw down on stocks. A company will hold the stock level it assesses as appropriate; if its stock holdings are too low it risks running out of stock and gaining a reputation amongst customers for unreliability. At the same time holding stocks is expensive and companies

[3] Scenario 4 (permanent floating storage) includes the cost of the jetty as that is an integral part of the development.

do not want to hold too much. Unlike electricity, there is no calculation of the Value of Lost Load[4]; supplying companies make the assessment on optimal stock levels internally and market competition (the possibility that another competitor might have more reliable supply) provides the discipline to keep appropriate stock levels.

There has been some significant petroleum supply disruptions in Australia over the past decade (e.g. Sydney airport jet fuel disruption in 2003, Victoria diesel disruption December 2012). Typically these major disruption events are where a number of smaller disruption events have occurred at a similar time to more than one supplying company. While in the above cases there was response from central and state governments, essentially the responsibility for correcting the disruption and avoiding repeats is with the commercial companies.

Emergency stocks are different in that they are held for responding to major disruption (especially geo-political) to international supply lines. These are very low probability, high impact events that commercial companies generally will not consider in their stock level decisions. The IEA was established to help coordinate responses between countries for these events as they are by nature global and will impact all countries (through the price impact if not by actual supply disruption).

In the event of market disruption, IEA members coordinate their response, which can involve releasing emergency stock to reduce the amount of product needed from the market. With a coordinated release of stock, the additional supply helps meet market demand with the expectation that the market would respond by mitigating some of the price rise that would otherwise occur in a major disruption. If Australia has emergency stocks in country, these would be available for release during a disruption (in line with the coordinated IEA response), reducing its requirement from the open market, thus continuing to meet local demand while playing its part in the global response. If holding ticket stock offshore, these stocks can also be released adding to the supply available to the market.

Physical emergency stocks held in country can also be used to assist domestic disruption events where an IEA event would not be triggered. For example, this might be severe disruption to a refinery where the required resupply timing means there would be supply shortages in the interim (only product emergency stocks would be useful in this example). However, as noted above, commercial suppliers are expected to manage disruption within their supply chains. Therefore there has to be strict rules about use of emergency stocks in a domestic disruption to avoid the presence of the emergency stock having any influence on suppliers' normal commercial stock decisions. A natural disaster affecting supply infrastructure is another example where it may be appropriate to release emergency stocks.

With stocks available in country, there could be public pressure to release stocks to avoid market disruption even if the event was primarily caused by failure of a particular company's supply chain. One way of managing this expectation would be to have a significant cost premium for any purchase from emergency stocks so companies would avoid such purchases except in extreme circumstances (e.g. the cost premium could reflect holding costs for the emergency storage).

[4] Value of Lost Load is the calculation in the electricity industry of the price up to which consumers are prepared to pay to avoid having their supply disrupted.

5.2 Selection of petroleum to be stored

The *Oil Storage Options & Costs* report discusses the choice between holding crude or product for emergency stockholdings. A table summarising the advantages and disadvantages of storing crude and product is included as Table 6.

While storing crude is generally cheaper than product (the cost of crude is lower and doesn't require ongoing costs to keep it on specification), with refinery closures Australia is moving from the position of being a majority crude importer (~60%[5]) to a majority product importer (~60%[6]). If Australia were to decide to hold emergency stocks, the stocks' crude/product mix should be proportionate to the amount of crude and product being imported commercially, to help protect against supply chain disruption. Based on the outlook for the mix of imports, the costs in this report are based on holding 40% crude and 60% product.

Holding product has an advantage in that it has a better yield when counted towards the IEA stockholding target. This benefit can overcome the additional cost of holding the product when the aim is to meet a given IEA target.

Table 6: Crude versus product storage

	Advantage	Disadvantages
Crude	■ More storage options (including underground and floating) ■ Storage cost is usually cheaper ■ Stock cost is cheaper ■ Does not need to be turned over to maintain quality ■ Produces all products when refined	■ Needs to be refined before useful to the local market (therefore dependent on refining system) ■ Contributes less towards IEA target as refinery loss taken into account ■ Needs to be located near a refinery if is to be used without the need for shipping
Product	■ Can be used directly (and immediately) in an emergency ■ Can be close to existing facilities to link in with existing networks ■ Contributes more to IEA target than equivalent volumes of crude (by 11%) ■ Provides security for domestic refining disruptions and possibly domestic infrastructure disruption	■ Typically uses more expensive above ground storage ■ Stock cost is more expensive (by USD10-15/bbl) ■ Needs to be monitored for quality and turned over from time to time ■ Security of supply only for the type of product held, which may not match the disrupted supply

[5] Australian Petroleum Statistics for Financial Year 2011/12.

[6] H&T modelling for Financial Year 2016/17 assuming Clyde and Kurnell refineries closed.

6.0 Summary of ticket stocks

Ticketed stock (tickets) is the name given to a stockholding arrangement under which a seller agrees to hold (or reserve) an amount of oil on behalf of a buyer in return for an agreed fee. The buyer is purchasing an option to buy physical oil that can only be exercised in an oil supply emergency declared by the IEA. The purchaser of the ticket gets the right to count the reserved stock as part of its IEA stockholding commitment, and the seller of the ticket does not count the stock in its commitment.

Tickets were developed in Europe as a flexible way for companies to manage their compulsory stock obligations which is why they are linked explicitly to being exercised in an IEA disruption event and count towards stock obligations. Tickets can be between parties in different countries as long as the respective countries have a bilateral agreement allowing such deals (also referred to as Government to Government Agreements).

The 2012 Report provided details of the ticket market and ticket contracts. All four proposed stockholding models included a portion of ticket stock. This is because tickets provide a flexible way to manage a target that will change annually and where the storage capacity needed to hold the stock is likely to be added in large increments. Ticket stock has the following characteristics:

- It is relatively short term (normally three months to a year) which is useful in managing a changing emergency stock requirement;
- It is traded openly (although not on a regulated market), giving transparency to buyers and sellers;
- It is international in nature where ticket stock can be held in other countries if the respective governments have bilateral agreements;
- It can be cost effective (in limited volumes), especially if compared with the long term commitment needed for physically holding emergency stock; and
- It is simple to manage, as the ticket seller continues to own and manage the stock on which the ticket is sold.

Two further issues have been investigated in the H&T *Ticket Market* report - an auxiliary report providing detailed analysis for use in updating the stockholding models. These issues are how Australia might hold ticket stock in countries that are not IEA members, and how a ticket market would operate within Australia. The findings are summarised below.

6.1 Developing a ticket market in non-IEA countries

Ticket contracts between entities in different countries have historically been restricted to IEA countries as they are the countries with the stock obligations[7]. For ticket stock to be counted towards a country's IEA stock reserve, the IEA rules note that there must be a bilateral agreement between the countries which is defined in the IEP:

> *A Participating Country may credit towards its emergency reserve commitment oil stocks in another country provided that the Government of that other country has an agreement with the Government of the Participating Country that it shall impose no impediment to the transfer of those stocks in an emergency to the Participating Country.*[8]

[7] In theory, stock can also be held in countries that are not IEA members but are members of the OECD.

[8] Article 3 of the Annex on Emergency Reserves to the IEP.

The IEA has recently allowed IEA member countries to hold ticket stock in non-IEA countries which are European Union members, as European Union members also have a stock obligation. The majority of IEA members are European (see Figure 1 in Background Section) and virtually all countries that allow ticket contracts to be sold are European. Europe does not form part of Australia's petroleum supply chain, so while Australia could hold ticketed stock in Europe, the logistics of bringing ticketed European stock to Australia in an emergency would be difficult and expensive.

The other three Asia-Pacific members of the IEA are New Zealand, which is also short of stock to meet its IEA commitment, the Republic of Korea (South Korea) which restricts the release of stocks in an emergency, and Japan which provides the only feasible offshore stock location in the region. It would make sense for Australia to look at developing a ticket market in some other (non-IEA) Asian countries if it can be done in a way where the IEA was prepared to count the stock held.

As ticket contracts are commercial contracts between two entities and not dependent on IEA member status, a similar commercial construct could be used to develop a ticket market that includes non-IEA member states. As with any ticket contract, the counterparty risk on the contract being honoured will need to be assessed, along with the sovereign risk that the country will honour its bilateral agreement in a supply disruption.

The non-IEA country would benefit from allowing ticket stock to be held on its territory as it would provide an income stream to its petroleum industry. It would need to evaluate how it allows tickets to be sold as it would not want the sale of tickets to affect its own supply security. This means the country is likely to require the stocks on which tickets can be sold to be additional to the normal commercial supplies to the domestic market (e.g. they are sold on traded volumes).

Australia could ticket stock in a non-IEA country without recourse to the IEA if it assessed that that was necessary to improve its supply security. However if the IEA were to agree to count stock ticketed with non-IEA members towards Australia's 90 day emergency stockholdings, it may impose some conditions on the bilateral ticketing arrangement. These conditions are not known but may include:

- A bilateral agreement between Australia and the other country (this will be a definite requirement);
- Monthly reporting of the stocks (at minimum the stock held under the agreement); and
- Acceptance by the IEA Governing Board of the non-IEA country as a suitable location for an IEA country to hold emergency stock.

6.2 Ticket market in Australia

The ticket construct for securing emergency stock can be used domestically as well as for securing offshore stock. How and when ticketing might be used domestically is dependent on the way emergency stockholdings are implemented. In the stockholding models being investigated in this report, development of a ticket market in Australia would provide a useful component of the structure in Models 1, 3 and 4.

For Model 1, the government would have the task of securing the required emergency stock through ticket contracts. While the bulk of these are likely to be offshore there would be benefit in developing an internal market to:

- Hold some of the emergency stock within Australia, providing more prompt emergency response and protection against domestic disruption;
- Potentially use excess/underutilised storage facilities within Australia that may be more cost effective than building new facilities; and
- Increase the locations where ticket stock can be held, therefore likely increasing the overall availability of ticket stock.

Models 3 and 4 use an industry obligation as part of the stockholding model. An industry obligation typically requires each market participant (companies supplying petroleum) to hold a certain minimum number of days' supply. Companies' inventory cycles depend on a number of factors including supply frequency and method, storage facility availability, market opportunities and demand variation. Using tickets allows companies to manage the short term variation in their inventories. For example if a company was doing some maintenance on a storage facility which meant they could not hold its normal stock level for a period, it could buy a ticket to ensure it continued to meet its obligation level.

The domestic ticket market in this case is primarily providing flexibility to market participants rather than a means of actually increasing physical stock holdings, although it could also do that if the central stock agency purchased ticket contracts from companies holding more than the minimum stock obligation for a period.

6.3 Ticket costs

For this report the ticket costs have been updated based on updated market information. There have been some changes to the ticket market following changes to legislation which more closely aligned the European Union compulsory stock obligations with those of the IEA at the end of 2012. In addition, the market structure of the oil markets has in general not been favourable to storing oil in the last couple of years. This is when forward prices are generally lower than current prices providing no financial incentive for companies to hold stock. This is reflected in higher ticket prices.

Table 7: Ticket cost assumptions

	2012 report (USD/tonne/month)	2013 update (USD/tonne/month)
Up to 300,000 tonnes	1.00-2.00	2.75
300,000-500,000 tonnes	3.50	3.50
500,000-1,000,000	5.50	5.50
1,000,000+	7.50 (5.00-9.00)	9.00

Source: Hale & Twomey

The price for volumes above 1 million tonnes has been increased to USD 9.00/tonne/month from the USD 7.50/tonne/month used in the 2012 Report. While this is well above where ticket contracts are currently trading, like any commodity market if a large new buyer comes into the market, prices will rise. Ultimately the price will rise to the cost of providing more supply, hence the assumption of a similar cost of holding physical stock for large volumes. Exactly how much volume purchased would shift the market this high will not be known until Australia actually enters the market. Ticket prices could go above the level assumed above (the cost of physical stock holdings) if there is a demand spike exceeding current supply or if companies are expecting a higher return on their assets than assumed in this cost estimate.

7.0 Stockholding models analysis update

Section 2.0 covered the development of the four stockholding models in the 2012 Report and provides a summary of each of these models. This section reviews each of the models in greater depth and highlights where adjustments have been made to the models for this review.

7.1 Model 1: Government responsibility using tickets

In this model, the government takes responsibility for holding the emergency stock required to ensure the IEA commitment is met, by holding stock through the ticket contract structure. The model is described in Table 8 with benefits and risks covered in Table 9. Any changes to the model from the earlier report (in structure or focus) are also summarised.

Model description

Table 8: Model 1 description

Responsibility	Government manages holding sufficient emergency stock to meet compliance target.
Stock type	Stock held through ticket stock contracts – no stock owned by the government.
Stock location	(i) Offshore countries with bilateral agreements and (ii) within Australia.
Funding	No capital funding required. Ongoing operational costs could be funded from the general budget or a levy on fuel sales.
Costs	While holding tickets in lower volume is cheaper than physical stock, at high volume the cost may be similar or possibly higher.
Compliance	There is unlikely to be sufficient volume in current ticket market to meet volume required – new ticket markets in other countries (e.g. Singapore) would need to be developed as well as a local Australian ticket market.
Time to compliance	Stock could start to be held approximately a year after a decision was made to use tickets. If the volume was available it would still take five or six years from the decision point to build up the volumes required – 2020 for a decision in 2014.
Participation in disruption events	Once Australia has ticket stock it can fully participate in any IEA event by releasing or purchasing the ticket stock as part of an IEA coordinated response. If some ticket stock was held in Australia this would also assist in managing local disruption when appropriate.
Access and release	These rules are normally part of the ticket contract. For stock held in Australia, specific rules about when it is acceptable to release or purchase stock would need to be made.
Market impacts	There should be minimal market impact under this structure except for a levy on fuel sales if that is the chosen method of funding.

Update since 2012

While this model is as outlined in the 2012 Report, there is a change in focus in that an internal ticket market within Australia is likely to be a sensible part of the ticket market strategy, rather

than just offshore tickets. The benefits of having an Australian ticket market under this structure include:

- Giving the opportunity for underutilised facilities or facilities no longer needed for commercial supply to be put to another use (likely to be cheaper than building new facilities) – refineries being closed would be an example as the whole facility is not needed for conversion to an import terminal;
- Increasing actual stock holdings in Australia, giving protection for domestic disruption events when appropriate (e.g. natural disaster);
- Having some of the stock held domestically available for (almost) immediate delivery to the market, and not reliant on shipping to Australia; and
- Adding another country (Australia) to the locations for holding ticket stock, which should increase the total volumes available.

The *Ticket Market* report covered issues that need addressing for development of a stock ticket market within Australia. A significant change is that longer contracts would be desired by commercial operators. H&T suggested up to five year contracts; it may be that the market would like even longer contracts although in this case the contracting structure should be reviewed to examine whether it is providing the best value to the government (purchaser). For long term contracts it may be that the government should take on some different exposures compared to a normal ticket contract (e.g. stock price exposure over the contract period, or options for contract extension) in order to reduce the cost of the tickets offered.

Benefits and Risks

Table 9: Model 1 – Benefits and Risks

Benefits	Risks
■ Annual flexibility fits in with Australia's changing target ■ Likely to be lowest cost option for smaller volumes ■ Fastest implementation ■ Easier to implement and manage ■ Avoids regret investment ■ Allows full participation in IEA collective action (through release of stock)	■ Only improves domestic security if some ticket stock held within Australia ■ Dependent on other countries allowing bilateral stock holdings ■ Likely to be a limit on total volume that can be secured (at an appropriate price) ■ High volume stockholding requirement will require preparation and some years to fully implement ■ Offshore stock reliant on shipping being available if transport to Australia needed

Costs

The costs associated with this model (ticket costs) have been updated in Section 6.0. Due to the uncertainty over the size of the ticket market and the likely need to develop new markets (such as Singapore and Australia) it assumes that the cost of a ticket contract will equate to the cost of holding stock for volumes above 1 million tonnes. This cost is calculated at approximately USD 9.00/tonne/month. It could be that the cost moves above this level for tickets due to companies needing to manage the exposures such as price and the shorter term nature of the contracts. If this is the case, other models should be considered as, except in the short term, there is little value in paying more for a ticket contract than to buy and hold physical stock.

Compliance timing

While stock could start to be held in a little more than a year after this model was chosen, it would take time to build up the volume especially as new markets for ticket stock would need to be developed. At each tender round volumes could be increased. Within Australia there are likely to be longer term contracts so not all volume would be on annual contracts.

It may take five to six years following the decision to reach the volume required for compliance. As the volume availability using a ticket contract structure is unknown (depends on how many markets can be developed) there is no certainty that compliance will be achieved with this model.

Figure 8: Model 1 - Implementation timeline from decision on stockholding model

Model 1: Government Ticket Option - implementation post stockholding model decision

#	List of Activities	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6			
	Quarter (Q):	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Develop and sign bilateral G-to-G Agreements																								
2	Decide on funding approach - if levy implement legislation																								
3	Decide on contracting approach for ticket stock offers from within Australia.																								
4	Develop template ticket contract (s)																								
5	Approach interested companies and agree template contractual terms and assess suitability																								
6	Prepare tender documentation and run tender for up to 500,000 tonnes																								
7	Secure initial stock both offshore and in Australia																								
8	Explore options for additional stock holdings in non IEA countries																								
9	Run tender for up to 1,000,000 tonnes and secure more stock																								
10	Gradually increase stock levels with each tender round and as more options are developed																								

Countries using model

New Zealand is the only IEA country using a 100% ticket emergency stock under government responsibility. The New Zealand petroleum market is less than 20% the size of the Australian market so although it has a similar import dependence, the compliance gap is much smaller and easier to manage with tickets.

Luxembourg is the only other country to use 100% tickets for emergency stock but in its case this is managed by industry. Luxembourg has a very small petroleum market.

7.2 Model 2: Government responsibility using physical stock and tickets

In Model 2 the government takes the responsibility for holding the emergency stock required to ensure the IEA commitment is met, by holding stock both physically in dedicated facilities and through the ticket contract structure. The model is described in Table 10 with benefits and risks covered in Table 11. Any changes to the model from the earlier report (in structure or focus) are also summarised.

Model description

Table 10: Model 2 description

Responsibility	Government manages holding sufficient emergency stock to meet compliance target.
Stock type	Physical stock held in dedicated storage facilities as well as some ticket stock to manage variability.
Stock location	Assume that all physical stock would be held in Australia with the ticket stock held offshore in countries with bilateral agreements.
Funding	Substantial capital required for developing storage facilities and purchasing stock. To avoid need for up front capital a structure can be established which borrows the money and is then funded by a levy on fuel sales.
Costs	The costs are substantial and facility investment is a long term decision so will involve long term commitments for use (the stock can be sold if no longer required).
Compliance	If enough resources and money is put into building storage facilities, Australia could achieve compliance using this model.
Time to compliance	It is likely to take over four years to develop large scale storage facilities as well as the time to put rules in place. Holding some ticket stock in the interim would allow stocks held to gradually scale up. Earliest possible compliance is 2021 with a 2014 decision on the model.
Participation in disruption events	Australia would be able to fully participate in any IEA declared disruption either through the release of ticket stock offshore (most likely response if event was not affecting Australia's supply) or through release (sale) of physical stocks held in Australia. Physical stock could also be used to assist in managing local disruption in certain circumstances.
Access and release	For physical stock, specific rules about when it is acceptable to sell stock need to be established as well as rules around stock turnover to maintain product quality so it doesn't interfere with normal market operation.
Market impacts	Any market impacts can be minimised if the rules around release of stock, turnover of stock and the ongoing use of the facilities built for emergency storage are well defined and designed to avoid adverse market impacts.

Update since 2012

There are no significant changes to this model since the 2012 Report. As the government will hold physical stock in Australia, there is no reason for developing an internal ticket market. It can

achieve the same result more flexibly and possibly more cheaply by directly contracting with companies that have spare tankage.

As covered in the 2012 Report, under this model the government should set up an agency structure along the lines of the government owned agencies in Europe to efficiently manage the task. The agency ensures appropriate focus on the task with the ability to use expertise from industry within the structure (e.g. some Board members from industry).

Benefits and Risks

Table 11: Model 2 - Benefits and risks

Benefits	Risks
■ Provides flexibility with a reasonable portion of ticket stock to manage Australia's changing target ■ Allows prompt implementation with some ticket stock and then building physical stock over time ■ Provides both domestic security and easy participation in collective international action through release of ticket stock ■ Allows flexibility between physical stock and ticket stock depending on the state of the ticket market (availability and cost)	■ High cost of physical stock holding ■ Risk of stranded storage facilities (regret investment) if Australia were to have a major oil discovery ■ Dependent on other countries allowing bilateral stock holdings ■ Substantial amount of capital required – much of it in long term asset investment

Costs

The costs are updated with the updated estimates in Section 8.0. There is no change to the calculation method from the 2012 Report.

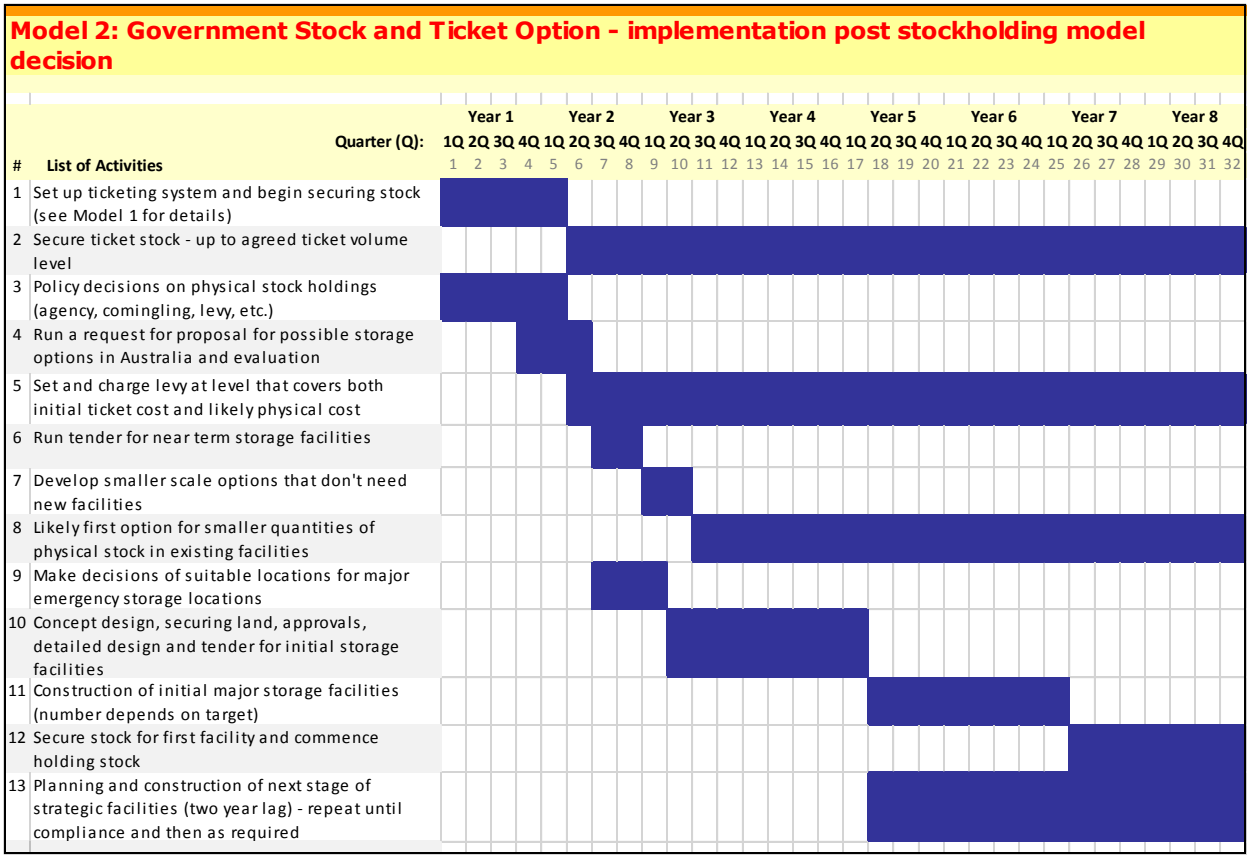
Compliance timing

As tickets are part of the stockholdings, the initial stocks could be secured approximately a year after the decision is made on this model. For physical stock a tender could be run to look for opportunities to hold emergency stock in existing facilities. Such stock could be held from around two years from the decision point.

For significant new facilities time will be needed to establish the rules and strategy for emergency stock and the most appropriate locations for the new facilities. This may take up to two years. There will then be a couple of years for concept design, securing the site, approvals and detailed design. The construction period will be another two years. Therefore it likely to be around six years from the decision point until the major new facilities are holding stock.

In the *Oil Storage Options & Costs report,* Aurecon noted large storage facilities could be built in different states at the same time. There could also be staged developments in similar locations so the workforce moves from one project to another for cost efficiency. Although it would take a lot of resources (likely to mean building three substantial storage facilities at a similar time in different states), compliance by around 2021 is a possibility if there was a decision on the stockholding model early in 2014.

Figure 9: Model 2 - Implementation timeline from decision on stockholding model



Countries using model

Ireland is an example of a country using this model; in Ireland's case the government has set up a central stock agency that is tasked with holding both physical stock and ticket stock. The government decides on the most appropriate split between physical stock and tickets. Germany is another example, although in Germany's case the use of tickets is very limited (only for the product proportion and only up to 10% of the obligation). Germany also has industry involvement with the management and operation of the central agency managing the stock.

Some countries have a government owned stock model comprising only physical stock. The United States is a clear example where the government owns and stores all the emergency stock as part of its Strategic Petroleum Reserve, and has full control over the amount held and how it is released.

7.3 Model 3: Combining Government responsibility with an industry obligation using physical stock and tickets

Model 3 has a similar stock mix to Model 2 (physical stocks and ticket stocks) but in this case the responsibility for holding the stock is shared between government and industry. The split of responsibilities between government and industry can vary as shown in the two options below.

- Establishing an obligation for industry to maintain minimum stockholding at a suitable level. The government can then meet any remaining stockholding requirement through a mixture of physical stocks and tickets (Model 2) or all tickets (Model 1).

- The government puts the total obligation on industry but allows industry to pay a government-owned central agency to take a portion of the obligation. The agency then centrally manages the stocks (this is similar to Model 4 but retains government involvement through ownership of the central agency).

The model is described in Table 12 with benefits and risks covered in Table 13. Any changes to the model from the 2012 Report (in structure or focus) are also summarised.

Model description

Table 12: Model 3 description

Responsibility	The industry has some obligation to hold minimum levels of stock with the government managing the balance of the requirement through physical and ticket stock.
Stock type	The industry would hold physical stocks commingled with normal commercial stock in order to meet the obligation level. The government stocks would be held as in Model 2 (mixture of physical stock and tickets).
Stock location	Assume that all physical stock would be held in Australia with the ticket stock held offshore in countries with bilateral agreements. Once there is an industry stock obligation there can be a domestic ticket market to assist companies in meeting their obligation through the inventory cycle.
Funding	As with Model 2, substantial capital is required for developing storage facilities and purchasing stock but this time it would be split between industry and government responsibility. As with other models, a central agency could be established which borrows money for the capital costs and which is funded through annual payments or fuel levies.
Costs	The costs are substantial and facility investment is a long term decision so will involve long term commitments for use (the stock can be sold if no longer required).
Compliance	If enough resources and money is put into building storage facilities, Australia could achieve compliance using this model.
Time to compliance	It will take up to four years to put the industry rules in place and it is likely to take over four years to develop large scale storage facilities. With government involvement some of these processes could run concurrently. Holding some ticket stock in the interim would allow stocks held to gradually scale up and 2023 is earliest possible compliance with a 2014 decision.
Participation in disruption events	Australia would be able to fully participate in any IEA declared disruption either through the release of ticket stock offshore (most likely response if event was not affecting Australia's supply) or through release (sale) of physical stocks held in Australia. Physical stock could also be used to assist in managing local disruption in certain circumstances.
Access and release	For physical stock, specific rules about when it is acceptable to sell stock would need to be established as well as the rules around stock turnover to maintain product quality so it did not interfere with the normal market operation.
Market impacts	Any market impacts can be minimised if the rules around the release of stock, the turnover of stock and the ongoing use of the facilities built for emergency storage are well defined and designed.

Update since 2012

There are no significant changes to this model since the 2012 Report. As soon as there is an industry obligation there is value in having an internal ticket market in Australia. This is more fully described in the *Ticket Market* report.

As covered in the 2012 Report, under this model the government should set up an agency structure along the lines of the government-owned agencies in Europe to efficiently manage the task. The agency ensures appropriate focus on the task with the ability to use expertise from industry within the structure (e.g. some Board members from industry).

Benefits and Risks

Table 13: Model 3 – Benefits and risks

Benefits	Risks
■ Provides flexibility as ticket stock will be used to manage Australia's changing target ■ Allows prompt implementation of some stock cover with tickets ■ Allows a constant obligation (in days sales) to be put on industry ■ Provides some improvement in domestic security and sets a baseline so that commercial stocks don't fall but will increase in line with increased sales ■ Allows participation in collective international action either through release of ticket or physical stock ■ Makes the development of a domestic stock ticket market more likely ■ Ensures all stock currently held in Australia is reported although this may also be achieved with compulsory stocks reporting	■ High cost of implementing and maintaining an obligation scheme for a small improvement in industry physical stock levels ■ Could have an uneven impact on the market participants as some companies may have higher stocks for their current supply chains (depends on supply route) ■ Dependent on other countries allowing bilateral stock holdings ■ Large impact on the budget

Costs

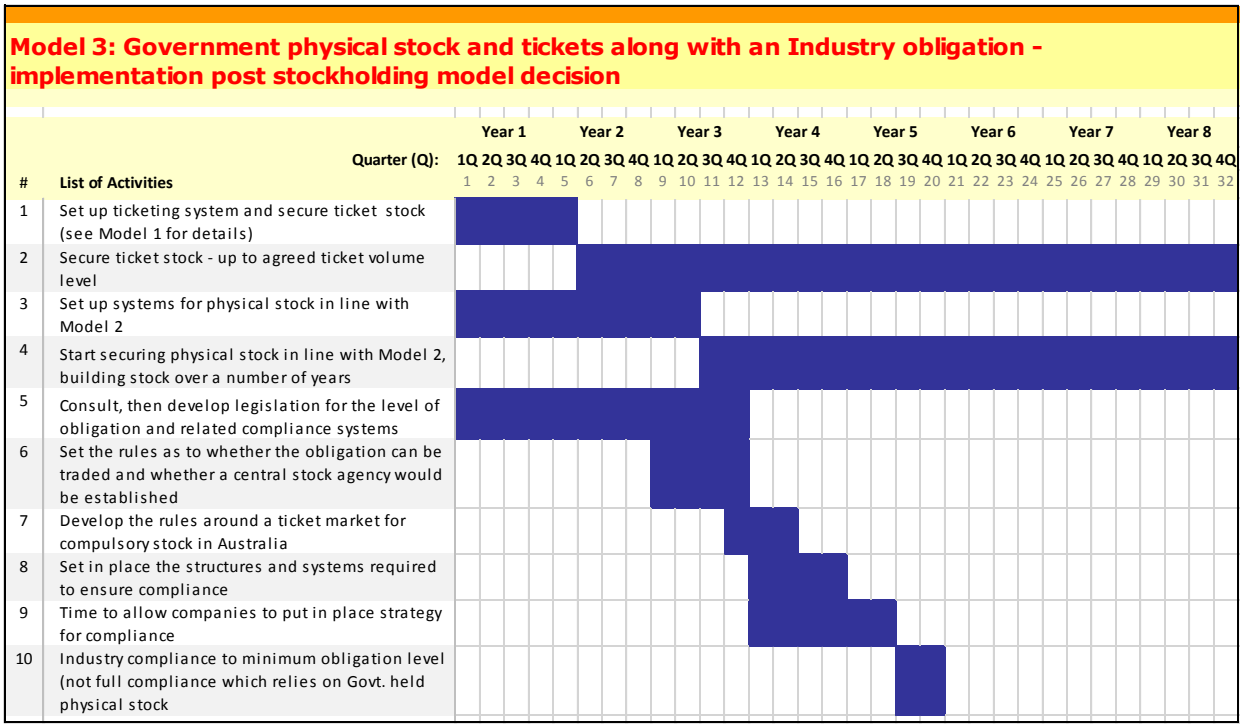
The 2012 Report assumed that industry would be able to hold a small amount of extra stock at minimal cost (no extra tankage and only taking the low points off the inventory cycle). This had a very small impact on the model cost relative to Model 2 in the analysis. The model did not take into account a different cost of capital for the industry portion of the obligation.

Given the minor impact, this model is now estimated on the same basis as Model 2. It is assumed any industry obligation will be implemented in a way that minimises the cost of capital so the same cost of capital is assumed for both cases.

Compliance timing

The timing to compliance for this model will be very similar to Model 2 as it will still be the government (or government stock agency) making the investment decisions around large new storage facilities. Given a slightly longer establishment period, around 2022 would be the earliest date for compliance assuming enough resources were dedicated to the task (with a 2014 start).

Figure 10: Model 3 - Implementation timeline from decision on stockholding model



Countries using model

The Netherlands is an example of a mixed system where industry has an obligation at a certain level and a government agency holds the balance of the requirement (with physical stock and tickets).

Japan and Korea are examples of a mixed system but without the use of tickets. The industry has a compulsory obligation in days cover and separately to this the government owns and holds strategic stocks.

7.4 Model 4: Industry obligation using physical stock and tickets

Model 4 moves the full responsibility for holding emergency stocks to industry with government's role confined to setting the rules and regulations within which the companies would need to operate. The stock held to ensure compliance would still be a combination of physical and ticket stock.

Industry obligations are normally established through all companies marketing in the country being required to hold a certain number of days stock. The model is described in Table 14 with benefits and risks covered in Table 15. Any changes to the model from the earlier report (in structure of focus) are also summarised.

Model description

Table 14: Model 4 description

Responsibility	The total obligation to hold emergency stock sufficient for compliance is put on the industry through an obligation to hold minimum levels of stock in terms of days cover.
Stock type	The industry would hold physical stocks either commingled with normal commercial stock and/or in dedicated facilities in order to meet the obligation level. Ticket stock could be held rather than physical stock if the system design allowed it.
Stock location	Assume that all physical stock would be held in Australia with the ticket stock held offshore in countries with bilateral agreements. Companies could also trade the obligation between each other with an internal ticket market.
Funding	In the 2012 Report this model was assessed with a higher rate of return required to meet the expectations of industry to invest capital in their supply chain. There are options in the design which could avoid the need for the companies to fund themselves at higher returns therefore reducing the cost. This is discussed in more detail below.
Costs	The costs are substantial and facility investment is a long term decision so will involve long term commitments for use (the stock can be sold if no longer required).
Compliance	If enough resource and money is put into building storage facilities, Australia could achieve compliance using this model.
Time to compliance	It is likely to take over four years to develop large scale storage facilities after the four years to put the rules in place. Holding some ticket stock while facilities are being built would allow stocks held to gradually scale up. The earliest date of compliance would be 2024 for a 2014 decision (10 years).
Participation in disruption events	Australia would be able to fully participate in any IEA declared disruption, although in this model they would do it by reducing the amount of stock industry needs to hold (for a period of time) rather than direct release from stocks or tickets that they own. Industry is likely to choose to release offshore ticket stock where Australia's supply is not affected. Physical stock could be used to assist in managing local disruption in certain circumstances.

Access and release	For physical stock, specific rules about when it is acceptable to sell stock would need to be established as well as the rules around stock turnover to maintain product quality so it did not interfere with the normal market operation.
Market impacts	Due to the substantial amount of investment required, if not implemented carefully an industry obligation could have significant market impacts including having companies withdraw from the market to avoid the need for substantial additional capital investment.

Update since 2012

There were a number of issues identified in the 2012 Report for Model 4. These included:

- As Australia's net import target changes due to shifts in indigenous production, it is quite difficult to manage the target accurately with an obligation in days' stock;
- If the industry participants have to find substantial capital to invest in strategic stock this could lead some to question their participation in the market (and therefore risk changing the shape of industry); and
- Industry participants directly funding the capital required are likely to require a higher return on capital including a profit element resulting in Model 4 being higher cost.

There are ways these issues can be avoided in the way this model is established. The key to avoiding the second and third issues (amount of capital and cost of capital) is to find an alternative method of funding so that it is not from companies' balance sheets. One option is as used by Japan, which provides low interest loans to companies to balance the cost of the obligation. A more common example (in Europe), and likely to be a better fit for Australia, is to allow companies to transfer some or all of their stock obligation to a central stock agency. Under this model that agency would be a private company (possibly all market participants have to be shareholders) although there would be some government oversight. There could be flexibility in the amount of obligation passed to the agency although there is likely to be benefit in making all participants transfer a portion of the obligation (levels the cost of obligation).

The stock agency is tasked with finding the cheapest options to hold stock (possibly through tenders) and as it will have better economies of scale than any individual company (in terms of volume of stocks held) it should be able to achieve the lowest cost to meet the obligation. The agency would borrow to fund the storage and stock cost with its income coming from payments from industry for it to take the obligation. The stock agency would be non-profit in order to minimise the cost involved. Industry would build the fee charged for taking the obligation into its cost of sales.

The benefit of such a structure is that the cost of the obligation should reduce to a level similar to Model 2 where the government (also via a central agency) performs this role. With the central stock agency having income backed by regulations (as companies have to meet the obligation) this should result in a low cost of capital. In addition, no profit element would need to be generated on private equity.

Having much of the obligation handled by a central agency also makes managing the changing requirement easier. The agency could use some ticket stock to manage that year to year variation.

Benefits and Risks

Table 15: Model 4 – Benefits and risks

Benefits	Risks
■ Provides flexibility as ticket stock can be used to manage Australia's changing target ■ Provides improvement in domestic security and sets a baseline so that stocks don't fall in future and increase with increased sales ■ Allows easy participation in international collective action through release of ticketed or physical stock ■ Makes the development of a domestic stock ticket market likely	■ May be high cost due to returns expected by industry unless structured with central stock agency ■ Longest period before start to secure emergency stock due to time to set up market structures and rules ■ Industry will have to manage against an obligation level that may change annually ■ May have an uneven impact in the market depending on supply route ■ Dependent on other countries allowing bilateral stock holdings ■ Substantial capital impost on an industry that is capital constrained unless structured with central stock agency

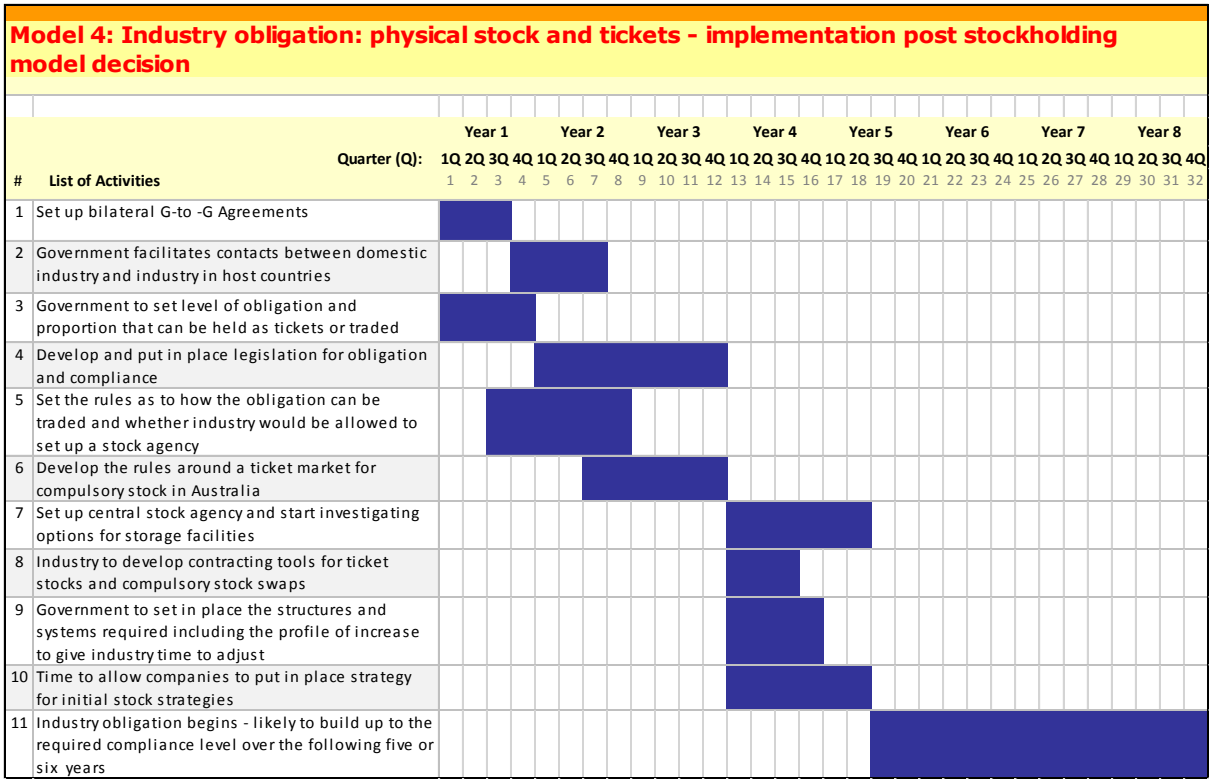
Costs

In this review we make the assumption that this model would be established with a central agency. We assume a similar cost of capital to Models 2 and 3 rather than a higher cost of capital as was done in the 2012 Report. Therefore this model now has the same cost profile as Models 2 and 3.

Compliance timing

The timing to compliance will be the longest for this model because of the time needed to establish legislation for the industry obligation. While some work could be done on site selection toward the end of the initial implementation process, actual decisions will not be able to be made until legislation is in place. Therefore this model will take, at least, 10 years before there is any chance of compliance (most likely earliest 2024 for a 2014 decision on the model). There would also not be any emergency stock held until about year six.

Figure 11: Model 4 - Implementation timeline from decision on stockholding model



Countries using model

The United Kingdom is a country where emergency stocks are managed by an obligation on the industry and the industry can use a mix of physical stock and tickets to meet that obligation. In practice much of the stock above which the companies need for commercial operation is held through bilaterally agreed ticket stock in Europe (~30%)[9]. The United Kingdom is considering its future strategy for compulsory stocks and considering allowing industry to establish a central stock agency. The structure proposed for this model is along the same lines as the model proposed for the United Kingdom.

Austria is another country that meets its compulsory stock obligation entirely through an obligation on industry with a central agency (privately owned) managing much of the stock. According to the IEA, Austria does not allow tickets as part of minimum stock obligations.

[9] Department of Energy & Climate Change: Future Management of the Compulsory Stocking Obligation in the UK (pg. 10).

8.0 Model cost analysis

In the 2012 Report the four models had costs estimated for the years 2016 and 2022. In practice, Models 2, 3 and 4 all have very similar costs if the structures are implemented in a way that allows an efficient (low) cost of capital to fund the emergency stocks. With the suggested adjustments to Model 4 resulting in a lower funding cost, there should now be little difference in these model costs. In this report we model the costs for Models 2, 3 and 4 in a single analysis, although in more detail than in the 2012 Report as we have the forecast requirement over the next 20 years, rather than just at a few fixed points.

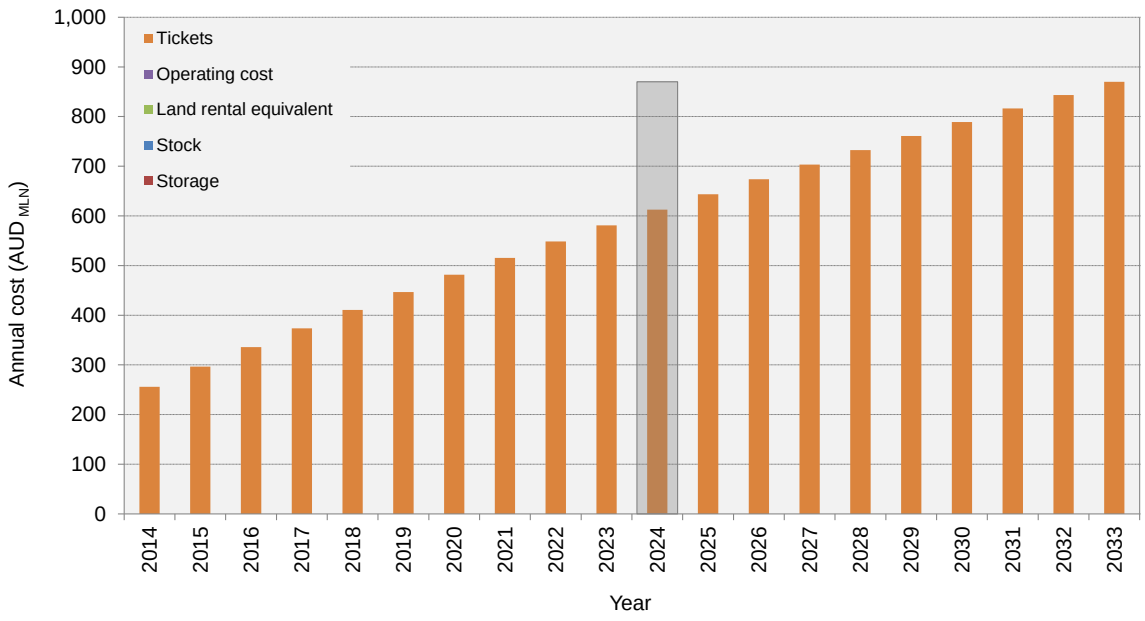
Model 1 is different from the others in that there are no capital costs involved; the model's only costs are the annual costs of paying for tickets. However given the large volumes required we have assumed the cost of the tickets ultimately moves to a similar cost to the cost of holding product. Therefore Model 1 is still likely to have a similar annual cost to the other models.

All costs in this section are in real terms and expressed in 2013 Australian dollars.

8.1 Model 1 cost

Model 1's cost increases annually, as more tickets have to be purchased each year as the stock requirement increases. The total cost for the 2024 example year is similar to the other Models as it is assumed that as the ticket requirement gets higher (over 1,000,000 tonnes), the cost is likely to be similar to holding dedicated stocks (see Section 6.3). It is possible that the costs actually get higher than physical stock holdings to cover companies dealing with the shorter term nature of ticket contracts and for managing the fuel price exposure (between start and finish of contract).

Figure 12: Model 1 cost profile



Source: Hale & Twomey

2024 annual cost	AUD 613 million
2033 annual cost	AUD 870 million

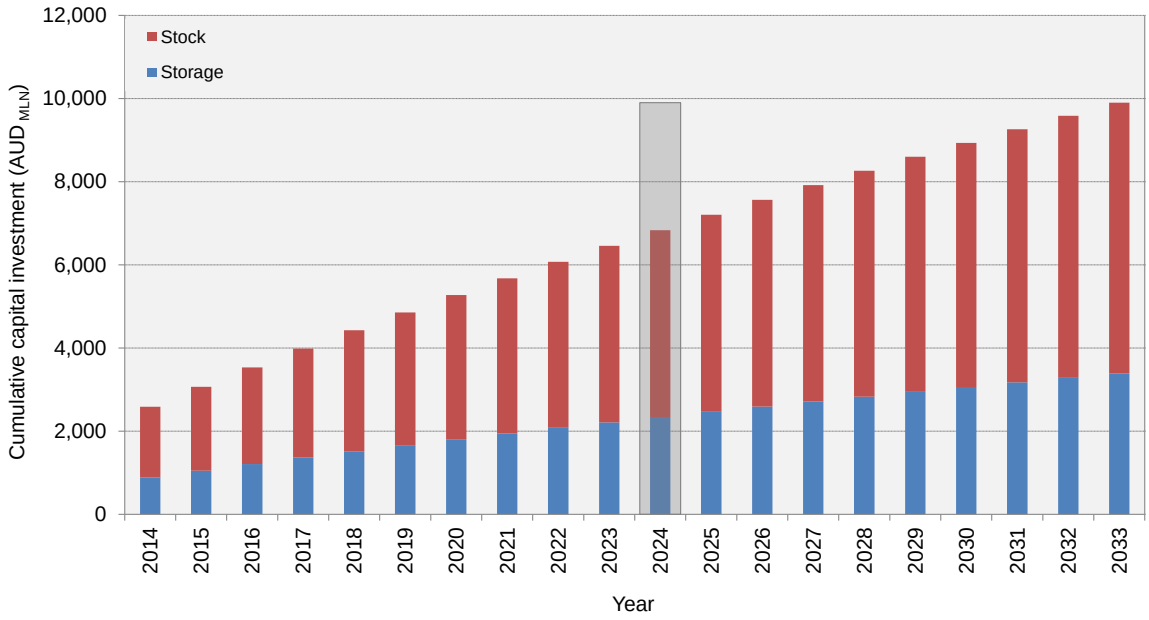
8.2 Models 2 through 4 costs

Figure 5 in Section 4.2 showed the amount of emergency stock needed to ensure Australia was compliant with the 90 day net daily import target. The cost analysis uses this data to calculate the cost per year. For all three models it is assumed that up to 850,000 tonnes of the requirement is held as ticket stock with the rest as physical stock. This ticket volume is chosen so as to avoid overwhelming the ticket market, while providing the flexibility required with storage likely to be built in increments of around 1,000 million litres (~800,000 tonnes). Having a ticket volume of greater than the storage increment will provide flexibility to avoid overshooting the emergency stock requirement.

During the 10 years until 2024, the stock requirement is forecast to increase by approximately 300,000 tonnes/year (~360 million litres). That means a new storage facility of 1,000 million litres would need to be built just under every three years.

The charts show the costs if Australia could move to compliance immediately and then stay compliant each year by securing additional stock. Figure 13 shows the amount of capital required on a cumulative basis (more capital has to be invested each year due to the increasing amount of stock) and Figure 14 shows the annual cost where there is a 7% recovery on the capital invested together with the annual operating and ticket costs.

Figure 13: Cumulative capital investment required for physical emergency stocks



Source: Hale & Twomey

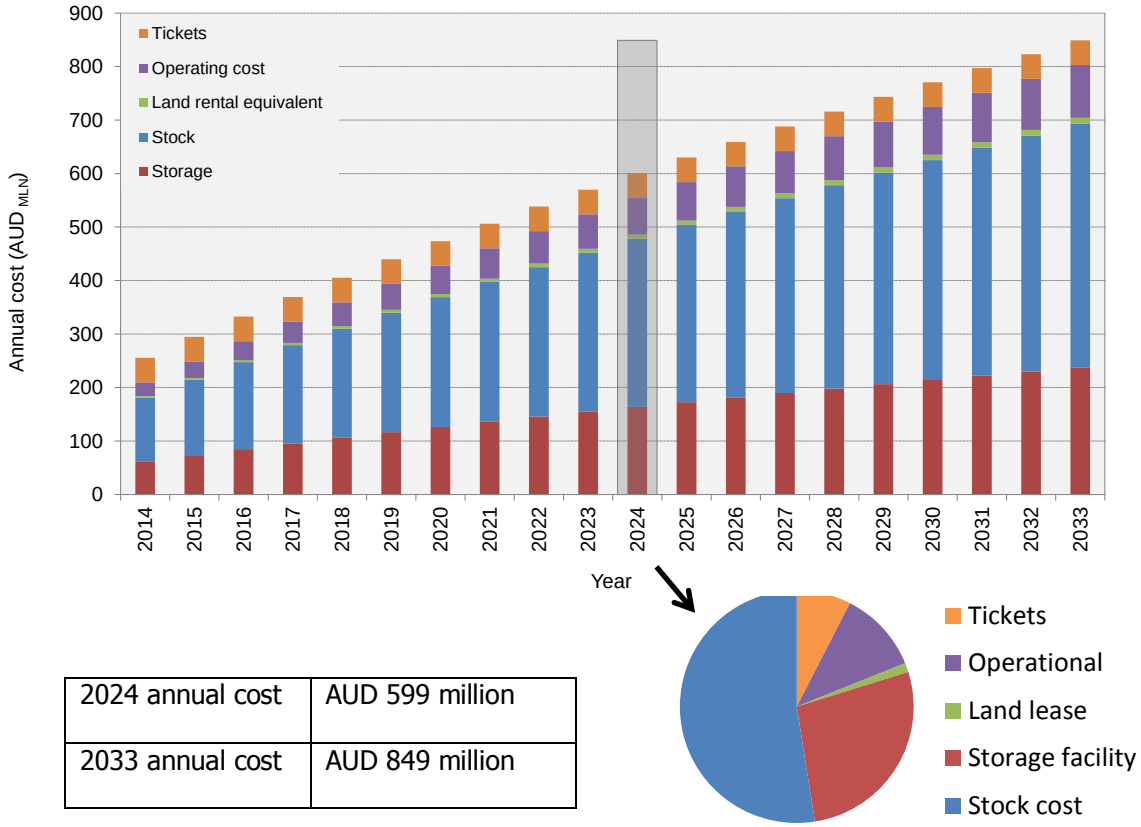
Capital spend by 2024	AUD 6,834 million
Capital spend by 2033	AUD 9,901 million

While 2.5 billion Australian dollars of capital spend would be required to return Australia to compliance next year (if such instantaneous spend was feasible), after then over AUD 400 million needs to be invested each year so that by 2024 (when Australia could be compliant) a total of AUD 6.8 billion would have been invested in the storage facilities and stock necessary for the

development of a ticket/physical emergency stock split capable of meeting the stockholding requirement.

The charge needed to generate a return on the capital invested in storage and stock makes up around 85% of the total annual cost, highlighting the importance of having an emergency stock system that results in low cost of capital funding.

Figure 14: Emergency stock cost per year (with 2024 split)



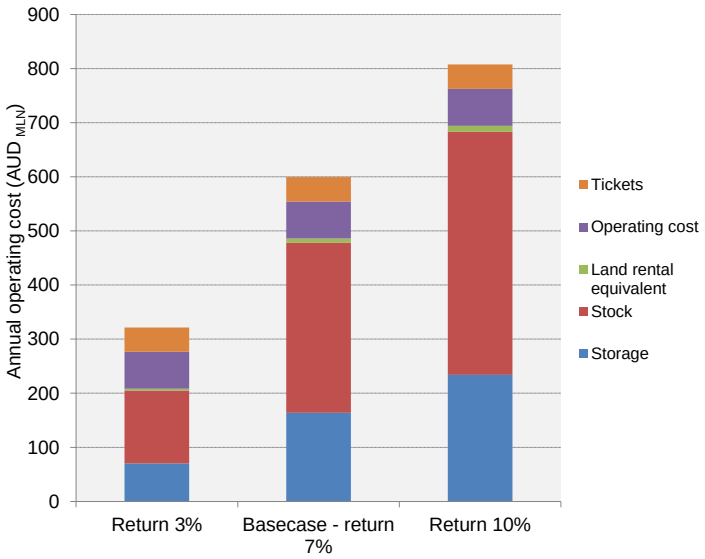
2024 annual cost	AUD 599 million
2033 annual cost	AUD 849 million

Source: Hale & Twomey

While the annual cost to meet the emergency stock requirement for 2014 is only AUD 255 million, with the increasing compliance target, the stock held needs to increase every year which results in a cost increment of approximately AUD 34 million per year so that by 2024, the annual cost would be AUD 599 million.

The initial analysis uses a 7% recovery on the capital invested in line with the recommendation from the Office of Best Practice Regulation (OBPR) for projects of this nature. It also recommended sensitivity cases of 3% (low) and 10% (high). It is noted that a private investor may require higher rates of return than these levels. Figure 15 illustrates the sensitivity of the annual cost to the return on capital assumption. The costs for 2024 are shown in with a low case (3%) and a high case (10%). The annual costs almost halve under a 3% case whereas the 10% case is 35% higher than the base case.

Figure 15: Impact of rate of return on annual costs (2024)



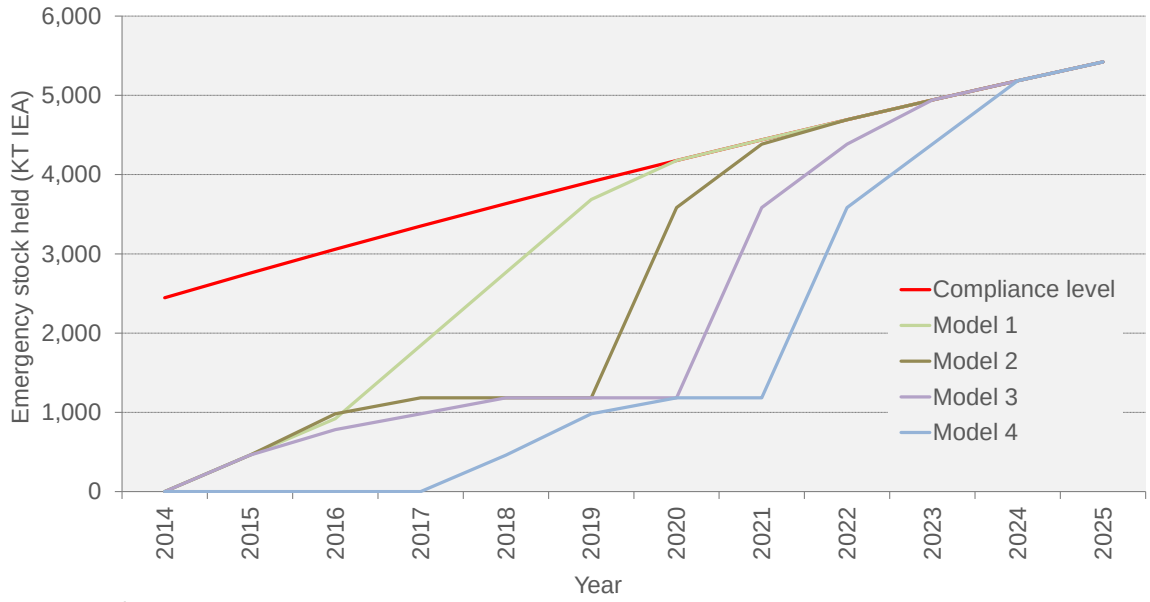
Source: Hale & Twomey

Once emergency stocks had been established, if for some reason they were no longer required, there may still be some ongoing costs associated with any of the three models that include physical storage. If stocks were no longer required all the stock could be sold - there may be a profit or loss depending on the value at the time of sale compared to time of purchase. Operating costs will largely cease, but depending on the commitments made to the storage facility owners there may be payments that have to continue to be made. If dedicated storage facilities are developed by the government or a stockholding agency they are likely to become redundant assets, given their specific design for holding emergency stocks.

8.3 Fastest time to compliance comparison

The models where the industry is involved (3 and 4) will take the most time to reach compliance as rules need to be put in place for industry to understand their obligations and the options they have for managing stocks. Figure 16 shows the profile for each of the models to achieve compliance in the shortest feasible time assuming a decision is made in early 2014 on the stockholding model to be used. The year 2024 is the earliest that all models could be compliant – Model 4 is only likely to reach compliance in 2024 at the earliest. Although Model 1 shows the fastest progress towards compliance, that comes with the caveat that compliance might not be feasible under this model if ticket volumes are limited.

Figure 16: Model time to earliest compliance comparison



Source: Hale & Twomey

Trying to achieve compliance as quickly as shown in Figure 16 might create market issues, with emergency stock facility construction using the construction services that may be needed for normal commercial terminal investments. It is also likely to be more cost efficient if the construction could be staged over a longer period than assumed in developing these timelines.

9.0 Stock on the water

In early 2013 H&T produced a *Stock on the Water Analysis* Report for RET and the New Zealand Government. This report considered how the maritime supply chain provides oil supply security for Australia and New Zealand and why some or all of the volume of Australia's and New Zealand's oil stocks on the water should be included in their oil stocks that are counted towards their IEA obligations. The study assessed the total stock on the water in the supply chains and split this between stock on the high seas and stock within Australia's Exclusive Economic Zone (EEZ)[10].

Under the IEA's measurement rules, import stock on the water is not able to be counted in a country's inventory until it has arrived at its first port of discharge.

Due to its long supply chains, a considerable portion of the stock owned by Australia companies supplying the market is on the water as shown in Table 16.

Table 16: Total Australia average stocks (2011/12)

	Crude (kt)	%	Product (kt)	%
Stock as currently reported (largely on land but also domestic cargoes)	2,490	69%	2,862	84%
Import stock on water within EEZ	405	11%	198	6%
Import stock on water on high seas	711	20%	339	10%
Total	3,606		3,399	

Source: Hale & Twomey and Australian Petroleum Statistics

In total about 31% of Australia's crude inventories and 16% of the product inventories in its supply chains are on the water so excluded from inventories reported to the IEA.

This section assesses the impact on the compliance gap, and therefore the requirement for emergency stocks, if:

1. Stock on the water inside Australia's EEZ is included in reported inventories.
2. Stock on the high seas is included in reported inventories (i.e. total stock on the water less stock inside Australia's EEZ).
3. All stock on the water in Australia's supply chains is included in reported inventories.

The analysis in the *Stock on the Water Analysis* was for 2011/12 imports. The amount of stock on the water will be impacted by market growth (more market demand means more stock in the maritime supply chain), refinery closures (a shift from crude to product) and a change in supplying locations. Changes in cargo size do not affect the average amount of stock on the water.

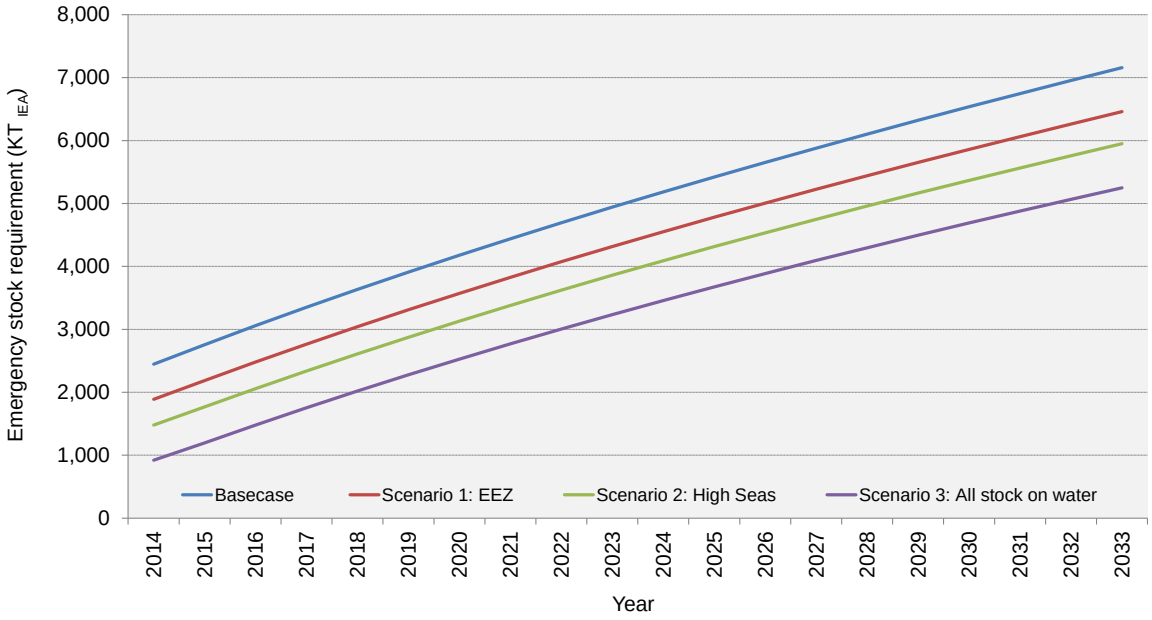
The change in stock on the water has been modelled using the H&T supply/demand model and found to correlate almost exactly with market growth. The refinery shutdowns reduce crude imports and result in more imported product – taking account of less domestic crude being refined, the different length of supply chains, and the effect of the refinery closures being in

[10] The EEZ is a marine zone detailed under the United Nations Convention on the Law of the Sea (UNCLOS) as being no further than 200 nautical miles from the baselines from which a coastal State's territorial sea is measured.

Australia's south east where the product supply chains are longer, it was found that the refinery closures had very little net impact on stock on the water, just a change in type. Therefore for the modelling in this report we assume that overall stocks on water grow in line with market growth with a shift from crude to product stock with refinery closures (impact from Clyde and Kurnell closures included in modelling).

The impact of including stock on the water is a one off – it improves the stock position in the year it is included but doesn't change the forward profile as shown in Figure 17.

Figure 17: Impact on emergency stock requirement by including stock on the water

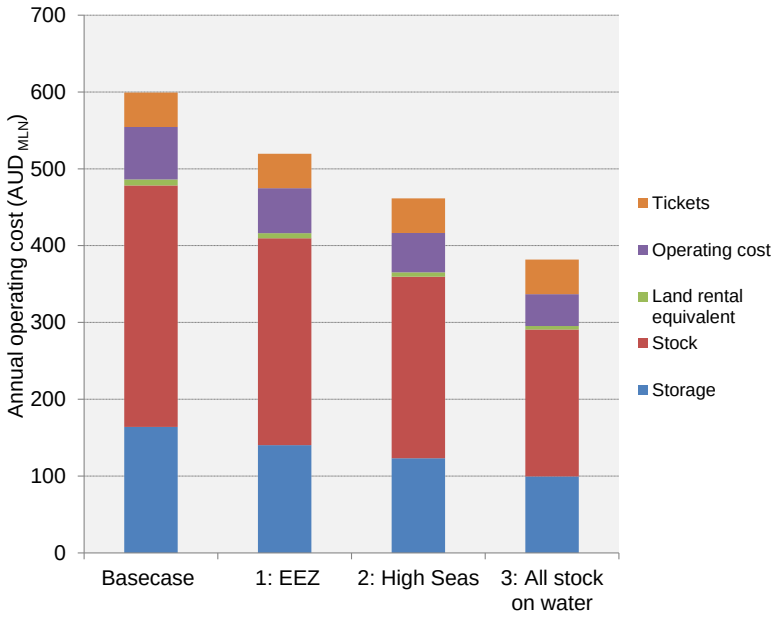


Source: Hale & Twomey

Whereas the *Stock on the Water Analysis* Report showed the inclusion of all the stock on the water made Australia compliant, this was against the 2012 daily net import requirement. The current requirement is 640 IEA kt higher than 2012, so even if all stock on the water was included in the stocks counted as part of Australia's IEA commitment, Australia would still not be compliant with its Treaty obligations.

Figure 18 shows the comparison between the cost in 2024 (full compliance) of the base case with the cost of the three potential scenarios through which stock on the water could be counted towards Australia's IEA stockholding. Approximately one third of the stock on the water is in the EEZ, so inclusion of that stock captures approximately one third of the saving (AUD 77 million) compared to the saving if all stock on the water is included (AUD 217 million).

Figure 18: Cost for stock on the water scenarios (2024)



Source: Hale & Twomey

10.0 Associated Reports

The following list includes all the reports produced by Hale & Twomey (H&T) for the Department of Industry and the then Department of Resources, Energy and Tourism (RET) relating to Australia's International Energy Agency (IEA) Agreement on an International Energy Program, along with related reports by H&T and other authors. This report is highlighted.

Main reports

National Energy Security Assessment (NESA) Identified Issues: Australia's International Energy Oil Obligation (2012 Report)

Australia's Emergency Liquid Fuel Stockholding Update 2013: Australia's International Energy Agency Oil Obligation. Main Report. (Main Report)

Auxiliary reports

Ticket Markets

Australia's Emergency Liquid Fuel Stockholding Update 2013: Ticket Markets (2013)

Stock on the Water/Maritime

Stock on the Water Analysis (2013)[11]

Australia's Maritime Supply Chain for Petroleum Trade (2013) – public report

Infrastructure - Storage

Australia's Emergency Liquid Fuel Stockholding Update 2013: Oil Storage Options & Costs (2013)

Australia's Emergency Liquid Fuel Storage. Terminal Concept Design and Cost Estimate. Aurecon. (2013) (also included in the Appendix of the above report)

Infrastructure – Refineries

National Energy Security Assessment (NESA) Identified Issues: Competitive Pressures on Domestic Refining (2012) – public report

[11] This report was produced jointly for RET and the New Zealand Ministry of Business, Innovation and Employment.