Integrity Experience Advice

Gippsland Basin – Availability Projections for Carbon Storage

June 2009

Prepared for the
Carbon Storage Taskforce

Declaration

The Australian Federal Government Carbon Storage Taskforce has commissioned Resource Investment Strategy Consultants ("RISC") to provide a model to project the availablity of Carbon Storage potential for the Gippsland Basin

The assessment of petroleum assets is subject to uncertainty because it involves judgments on many variables that cannot be precisely assessed, including reserves, future oil and gas production rates, the costs associated with producing these volumes, access to product markets, product prices and the potential impact of fiscal/regulatory changes.

The statements and opinions attributable to RISC are given in good faith and in the belief that such statements are neither false nor misleading. In carrying out its tasks, RISC has considered and relied upon information in the public domain. The information provided to RISC has included results of brief discussions between RISC and key Esso Australia staff.

Whilst every effort has been made to verify data and resolve apparent inconsistencies, neither RISC nor its servants accept any liability for its accuracy, nor do we warrant that our enquiries have revealed all of the matters, which an extensive examination may disclose. In particular, we have not independently verified property title, encumbrances, regulations that apply to this asset(s). RISC has also not audited the opening balances at the valuation date of past recovered and unrecovered development and exploration costs, undepreciated past development costs and tax losses.

We believe our review and conclusions are sound but no warranty of accuracy or reliability is given to our conclusions.

RISC has no pecuniary interest, other than to the extent of the professional fees receivable for the preparation of this report, or other interest in the assets evaluated, that could reasonably be regarded as affecting our ability to give an unbiased view of these assets.

Our review was carried out only for the purpose referred to above and may not have relevance in other contexts.

DOCUMENT CONTROL

Gippsland Basin – Availability Projections for Carbon Storage

Client Name	Carbon Storage Taskforce	**Client Representative**		Keith Spence	
RISC Coordinator	Graham Jeffery	**RISC Job No**	08.110	**Client Order No**	

Approvals

	Name/	**Signature**	**Date**
Prepared by	Graham Jeffery		
Prepared by	Stuart Weston		
Prepared by	Dogan Seyyar		
Prepared by			
Prepared by			
Peer Review by			
Editorial Review by	Simon Whitaker		10 June 2009
Authorised for Release by	Graham Jeffery		10 June 2009

Revision History

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1	5 June	Updated from Interim Report	SW	GJ

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1 INTRODUCTION

In July 2008 the Australian Federal Government announced the establishment of a Carbon Storage Taskforce to develop a National Carbon Mapping and Infrastructure Plan to prioritise the development of carbon capture, pipeline infrastructure and underground storage sites. The taskforce commenced work in October 2008 and has identified the Gippsland Basin as the pre-eminent carbon storage site, being both close to existing high sources of carbon emissions and having attractive geological attributes for carbon injection and storage. The potential storage sites in the Basin include fields currently in oil and gas production, with significant infrastructure operated by Esso Australia.

The Taskforce is scheduled to provide a final report to the Minister for Resources and Energy in May/June 2009, and intend to include an assessment of the range of potential ultimate carbon storage capacity and an estimation of the timing that capacity becomes available under current plans for extraction of oil and gas. To reflect the uncertainty in remaining oil and gas reserves, and in future oil and gas prices, a number of scenarios will be presented.

The Taskforce engaged RISC to construct a model to project the availability of carbon storage capacity in the Gippsland Basin using public domain information. This included an initial visit to Geoscience Victoria in Melbourne to gather available public data, and to meet with representatives of Esso Australia, the Operator of most of the Gippsland oil and gas production system. The purpose was to explain RISC's approach and to seek the Operator's assistance on defining the existing system and future plans, to enable RISC to compile a realistic model.

The Taskforce's brief was that the model should be capable of forecasting CO2 storage capacity and timing and approximate remaining value of production and taxes, and that projections could be made for various reserves and oil price scenarios. The model would be delivered to the taskforce, populated with realistic data, with brief user guidelines.

RISC's workscope, as proposed, is summarised below:

- Review work from Geoscience Victoria to identify storage cells
- Visit Melbourne (1 day) to meet key Taskforce staff to agree assumptions and approach
- Research reservoir initial in-place estimates, production, reserves and reservoir properties to derive decline curve production forecasts for each storage cell
- Investigate existing development plans and infrastructure production capacities and constraints, or estimate where information is unavailable
- Estimate operating costs for key infrastructure elements
- Develop an Excel model to forecast production, timing of cessation and availability of storage capacity with flexibility to vary reserves and costs to estimate early, mid- and late availability. This model will be provided to the Taskforce
- Use a cashflow model to value remaining production, and estimate PRRT and Tax cash flows. Compare value of production and value of storage using carbon capture and storage costs provided by the Taskforce. The cashflow model will not be provided to the Taskforce.

- Visit Melbourne (1 day) to meet key Taskforce staff to discuss/review results.
- Prepare a final (MS Word) report summarising findings.

This report serves to document RISC's approach, to provide user instruction, and to summarise the results generated by the model for credible scenarios.

2 APPROACH

RISC has developed an MS Excel nodal network model of the Gippsland Basin production systems. This includes the Esso operated infrastructure and fields, the Santos/Nexus operated Patricia/Baleen/Longtom system and the Anzon operated Basker/Manta/Gummy system. The onshore Longford plant and pipeline system are outside of the scope of the model. This onshore system is assumed to deliver gas to fulfil the gas demand and to maximise oil production within system constraints.

The general approach applied by RISC to develop a model was:

1. Establish the system configuration and constraints, designating fields and production facilities or ‘nodes’
2. Estimate reserves and production forecasts for each field using decline analysis based on production history to March 2008
3. Estimate oil, water and gas rate constraints and operating costs for each production node
4. Apply the projected system gas demand to determine offtake using a key field as the swing producer
5. Define a set of ‘production rules’ which apply production constraints and production priorities to wellstreams to translate potential production to forecast production for each field and node on an annual basis.
6. Apply an economic/rate cutoff at a field and node level to determine shut-in dates
7. Derive the carbon storage availability using public domain predictions of field storage potential
8. Use a cashflow model of the Petroleum Resource Rent Tax (PRRT) fiscal terms to generate forward looking value, resource rent and income tax paid.

The model is designed to be user friendly with a single ‘dashboard’ user interface, with primary inputs (user entered) being oil price, gas price, A$/US$ exchange rate, reserves scenario, field selection for valuation. Secondary (fixed) inputs are facilities oil water and gas constraints, field operating costs, field reserves.

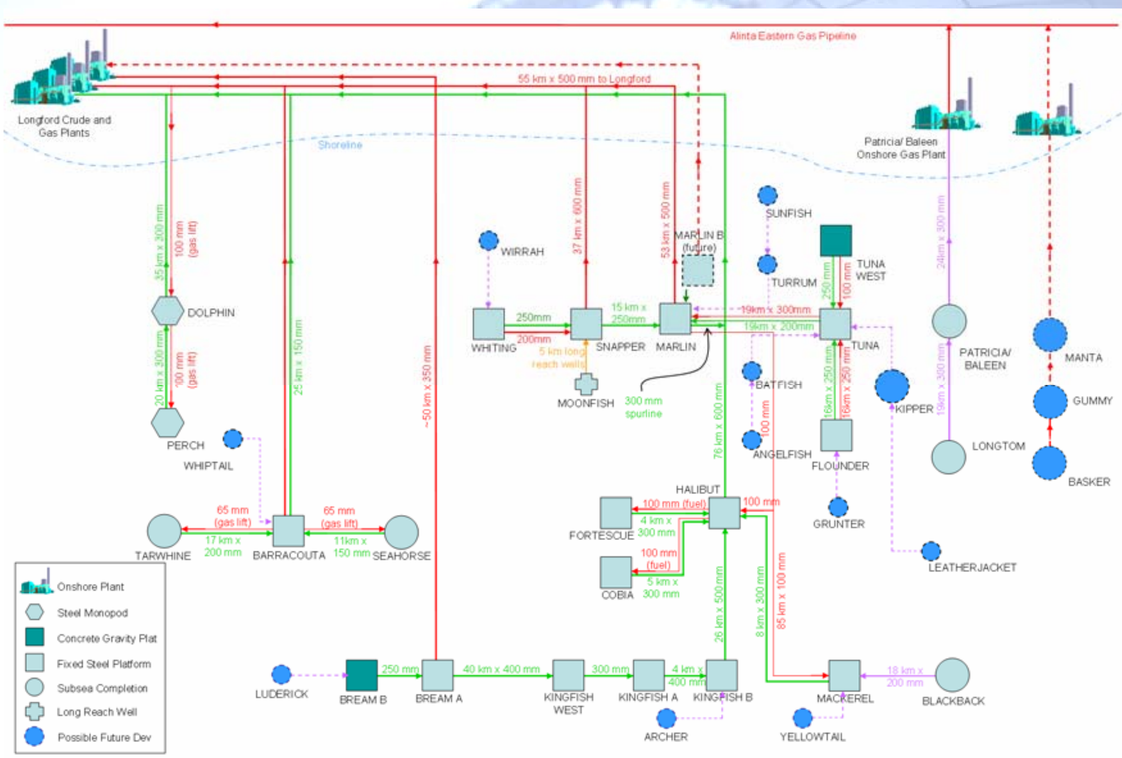
The main outputs are field life, annual oil and gas forecasts, prevailing constraints by year, annual carbon storage potential, totalised net present values, resource rent and corporation tax paid.

Model Security

User input is allowed for the primary inputs (dashboard interface), and on worksheets for the secondary inputs, but the many worksheets incorporating logic for production forecasts and developing projections are protected and restricted from user viewing and access to prevent corruption of the model.

3 PRODUCTION SYSTEM CONFIGURATION AND CONSTRAINTS

Public domain information was used to identify the existing and discovered fields with the existing and planned interconnecting infrastructure. The model is based on the infrastructure shown in the figure below, excluding the onshore plant and export pipelines from those plant.



Each infrastructure element or 'node' in the system has production capacity constraints. The constraints are aggregated at facilities levels and are applied to the field production potential to derive the resultant throughput and actual field production forecast. Oil, water, gas and total fluids constraints are listed in the model for each field and facility. For convenience, export pipeline constraints are included within facilities constraints. RISC has populated the model with representative values, which can be easily updated by the user if more explicit values become available.

The facilities' operating philosophy is represented by a constraint logic and production 'rules' which are tailored to the configuration of each node. Some simplifying assumptions have been applied to avoid complexity or an over-iterative and unstable solution.

For example, for the Tuna facilities (see figure) the production streams are:

•Tuna West Facility (oil/gas)

•Flounder Facility (oil/gas)

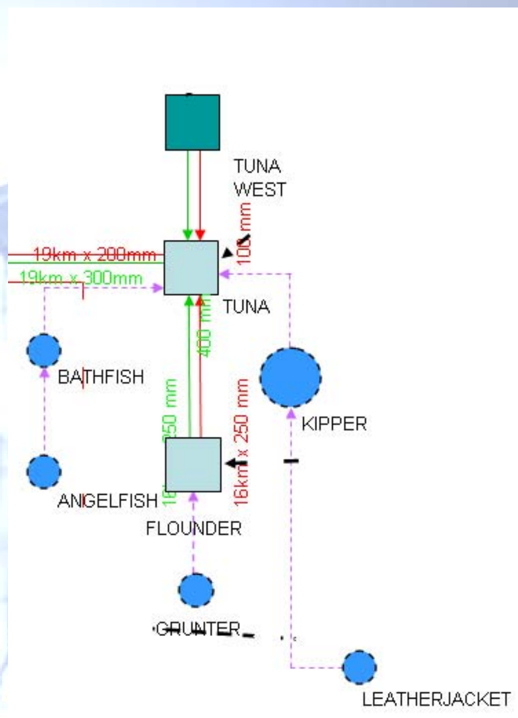
•Tuna Field (oil)

•Kipper Field (gas)

•Leatherjacket Field (oil)

•Angelfish Field (gas)

•Batfish Field (gas)



Production priorities are assigned as follows:

Oil Priorities

•Dry Oil and Condensate from Tuna West and Flounder Whiting Facilities.

•Oil fields produced in order of increasing water cut.

Gas Priorities

•Dry gas from Tuna West and Flounder Facilities.

•Associated gas from oil fields

•Gas fields.

Production rules have been designed to maintain continuous production from all fields until they fall below a field economic production threshold:

Facilities - Where the combined capacity of satellite facilities exceed the host capacity, the satellite capacities are each reduced by a common factor. This means that each field is allocated a proportion of the host capacity based on the ratio of that fields capacity to the total capacity of all satellites.

Water Handling - If water handling capacity is limiting, the lowest priority field is backed out first.

Oil Handling - If oil handling capacity is limiting, the lowest priority field is backed out first.

Gas Handling – If gas capacity is limiting all fields have a reduction factor applied to meet constraint.

It is recognised that these rules are a simplification of the actual operating philosophies, being based on limited (or no) available data. The simplifications serve to minimise computation logic but the resulting errors are not expected to be significant as the system is now generally operating well below historic production levels.

4 HYDROCARBON RESOURCES AND FIELD PRODUCTION FORECASTS

Three hydrocarbon remaining resources scenarios (low, mid, high) are provided for each field and can be varied by the user. RISC has used various public domain sources to define the mid-case resource and actual production data to March 2008 to produce a mid resources estimate as at 31 March 2009. A low and high estimate is arrived at using +/-25% of the mid value. RISC's estimate of basin resources and comparisons with other estimates are provided below:

RISC (end Q1/09)

- 'Mid' estimate of remaining economic resource: **Crude Oil 306 MMbbls**, **Gas 5.8 Tcf, Condensate 144 MMbbls**
- Includes identified future developments
- Excludes potential exploration success, in-field further developments/interventions
- Applied range of +25%/-25% on mid estimate of (technical) remaining resource
    - **Oil 290 - 480 MMbbls, Gas 4.5 – 7.6 Tcf, Condensate 108 – 180 MMbbls**

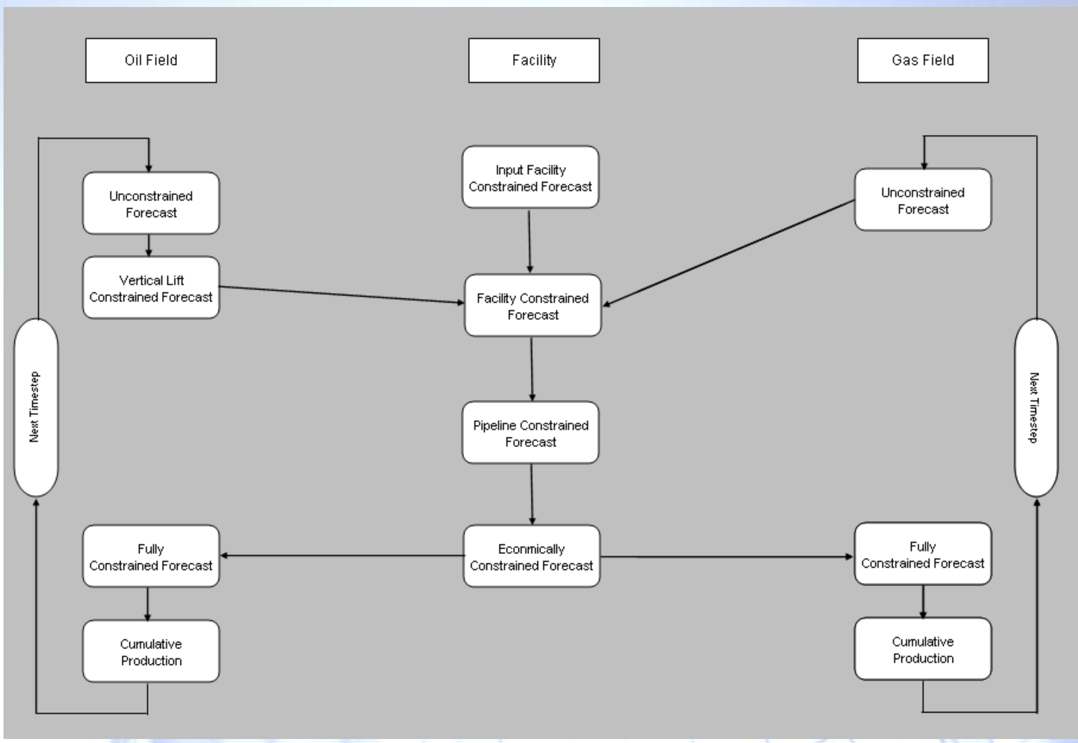
Geoscience Australia (Jan. 2006 less actuals to end Q1/09)

- **Oil/condensate 319 MMbbls, Gas 6.5 Tcf** (Cat 1 and 2, proven and probable for commercial fields, and proved awaiting appraisal)
- Includes ~130 MMbbls Condensate
- Excludes exploration potential

Esso Australia (May 2009)

- '**approximately 7 Tcf** of gas reserves remaining, including significant deep potential'

RISC's resources estimates, actual production performance and published reservoir properties are used to derive decline curve forecasts for each field to arrive at annual oil, water and gas production potential. In each annual iteration the production system constraints are applied to these unconstrained forecasts to generate the constrained (actual) annual production which is added to the cumulative production to provide the starting point for the next time step. The process is summarised in the figure below.



A simple economic test is applied at the field level to determine the end of field life, when operating costs exceed gross revenues.

Operating costs are derived from fixed and variable values input by the user. RISC has assigned reasonable starting values although guidance from the Operator is expected.

Gross revenues are derived from oil and gas prices applied to raw gas and oil volumes. No allowance is made for condensate volumes and price differentials arising from gas conditioning performed at Longford. These are not expected to introduce significant error.

5 FORECAST GAS DEMAND

Overall gas production is constrained by gas market demand. A demand profile and growth rate is a user input. RISC has used a third party demand projection[1] using a 2.4% annual growth estimate. This results in a 2009 gas demand of 260 PJ.

For simplicity the Barracouta field is used as the swing gas producer – the buffer between the supply for the system and gas demand. In reality the leanest (i.e. least condensate ratio) field, currently Snapper, is likely to be used.

[1] Reported by Deloittes in the Anzon Independent Experts Report, July 2008.

6 VALUATION ASSUMPTIONS

Simplifications used in the modelling are summarised below.

- The Esso operated infrastructure and fields, the Santos/Nexus operated Patricia/Baleen/Longtom system and the Anzon operated Basker/Manta/Gummy system are combined.
- Field independence i.e. depletion of field A is independent of field B.
- Remaining resources estimated from decline curves (producing fields), and reservoir properties/analogues (future production)
- Assumed production philosophy – e.g. satellites have priority over host capacity, oil produced in order of increasing watercut
- Generous water disposal capacity – (disposed offshore except Dolphin and Perch)
- Gas demand drives production with Barracouta as 'swing'. 2.4 % p.a. growth assumed
- Oil production limited only by field performance and facilities.
- Generally common unit costs. Abandonment costs neglected.
- Fields shut-in when operating costs exceed field gross revenue
- Longford/onshore costs excluded and LPG excluded from revenues
- Cashflows based on constant real terms oil/gas price, exchange rate, 2.5% inflation
- Basin pooled for PRRT/taxation: no outstanding deduction balances at Q1/2009, Bass Strait Royalty neglected (2.5%)
- CO2 capacity taken from Gibson-Poole[2] et al, starting when hydrocarbon production ceases

As the fields are located beyond the 3 nautical mile State territorial limit, the applicable fiscal regime is the Commonwealth's Petroleum Resource Rent Tax (PRRT). PRRT is a secondary tax based on a project's profitability. In addition, there is an Australian company tax of 30% on assessable income after petroleum taxes and depreciation.

The key aspects of PRRT are as follows included in the cashflow component of the model are:

- PRRT is assessed on a project basis where a project includes the project area and any facilities outside that area necessary for the production and initial storage of marketable petroleum commodities, including stabilised crude oil, condensate, natural

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[2] [2] Review of geological storage opportunities for carbon capture and storage (CCS) in Victoria, C.M. Gibson-Poole et al, PESA EABS III, Sept. 2008.

gas, liquefied petroleum gas and ethane. Manufacturing activities, such as liquefied natural gas production, are excluded.

- PRRT is levied at a rate of 40% of net project income. Net project income refers to net income once all exploration and project expenditures, including compounding at the appropriate allowable threshold returns, have been deducted from all assessable receipts.
- Compounding rates on expenditures are determined by the type of expenditure and the date of the receiving project's production licence. All expenditures, except those incurred more than five years before the production licence is granted, are eligible for annual compounding at the following rates:– 15 percentage points above the long-term bond rate (LTBR, assumed as 6% p.a.) for exploration expenditure, and 5 percentage points above LTBR for other expenditures. Expenditures, incurred more than 5 years before the production licence is granted, are eligible for annual compounding at a rate that compensates for inflation. Compounding for exploration expenditures, which are being transferred to another project, is set by reference to the date of the production licence of the receiving project.
- All project expenditures are deductible. Eligible expenditures include exploration and all project development and operating expenditures, and closing-down expenditures including offshore platform removal and environmental restoration. These closing down expenditures are deductible in the year in which they are incurred, with a refund from previous PRRT payments where receipts in that year are inadequate to cover the expenditure.
- Undeducted exploration expenditure incurred after 1 July 1990 is transferable to other projects with a notional taxable profit held by the same entity. In case of a company group, the expenditure is also transferable to other PRRT-liable projects held in the group.
- Expenditures specifically excluded from deductions include financing costs, private override royalty payments, income and fringe benefits tax, cash bidding payments and certain indirect administrative costs.
- PRRT payments, based on provisional assessments of an annual return are lodged quarterly, and are deductible for income tax purposes.

Australian Corporation tax rate is 30% and is applied to income after certain allowances, which include, but are not limited to:-

- Exploration costs
- Depreciation of capital development items
- Operating expenses
- Petroleum taxes

Interest and other eligible corporate expenses

The Weeks Royalty which is a 2.5% overriding royalty on the gross value of petroleum products in certain permit areas has been neglected, which does not introduce a material error for this exercise.

The valuation reference date is mid-2009, and the model permits specification of a future date from which to value cashflows to allow the user to value remaining production from a future point in time. Discounted Net Present Values are presented for real terms and nominal cashflows for discount rates of 8%, 10% and 12%, using a forecast annual 2.5% inflation rate to obtain nominal values.

The undiscounted amount of total future PRRT and Corporate taxes are stated in nominal (money of the day) terms.

7 CARBON STORAGE POTENTIAL

After each field reaches the end of economic life it is assumed to be available for CO2 injection. An assessment of how this would be performed is beyond the scope of this work and RISC have used values and approach provided by Gibson-Poole et al[3] as the CO2 storage capacity which is then available.

There is insufficient public domain data for those fields not reported in the Gibson-Poole paper to determine storage potential from first principles. Nearby fields have been taken as analogous to the new fields and storage capacity scaled based upon initial recoverable volume estimates. The Basker field has been considered analogous to the Flounder field. The gas fields of Patricia, Longtom, Manta and Gummy have been considered analogous to Kipper due to the close proximity of the fields.

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[3] Review of geological storage opportunities for carbon capture and storage (CCS) in Victoria, C.M. Gibson-Poole et al, PESA EABS III, Sept. 2008.

8 CONCLUSIONS

RISC has run the model assuming the mid resources case, being 5.8 Tcf gas recovery and 306 mmbbls oil recovery, with production from fields as listed below.

	Tech. MMstb	Econ. MMstb
Archer	2.8	1.3
Basker	19.0	13.2
Blackback	10.0	8.4
Bream	20.0	19.1
Cobia	8.0	6.3
Dolphin	1.6	1.3
Flounder	20.0	15.7
Fortescue	6.0	5.6
Halibut	13.0	10.5
Kingfish	13.0	10.1
Kingfish_West	7.0	5.9
Leatherjacket	0.7	0.7
Luderick	0.7	0.6
Mackerel	25.0	19.1
Moonfish	6.0	5.4
Perch	4.9	3.0
Seahorse	2.0	1.4
Sunfish	32.0	24.9
Tarwhine	0.7	0.5
Tuna	16.0	14.6
Tuna_West	16.0	15.0
Turrum	110.0	84.0
Whiptail	7.0	5.0
Whiting	1.5	1.2
Wirrah	10.0	9.4
Yellowtail	35.0	23.5
Total	388	306

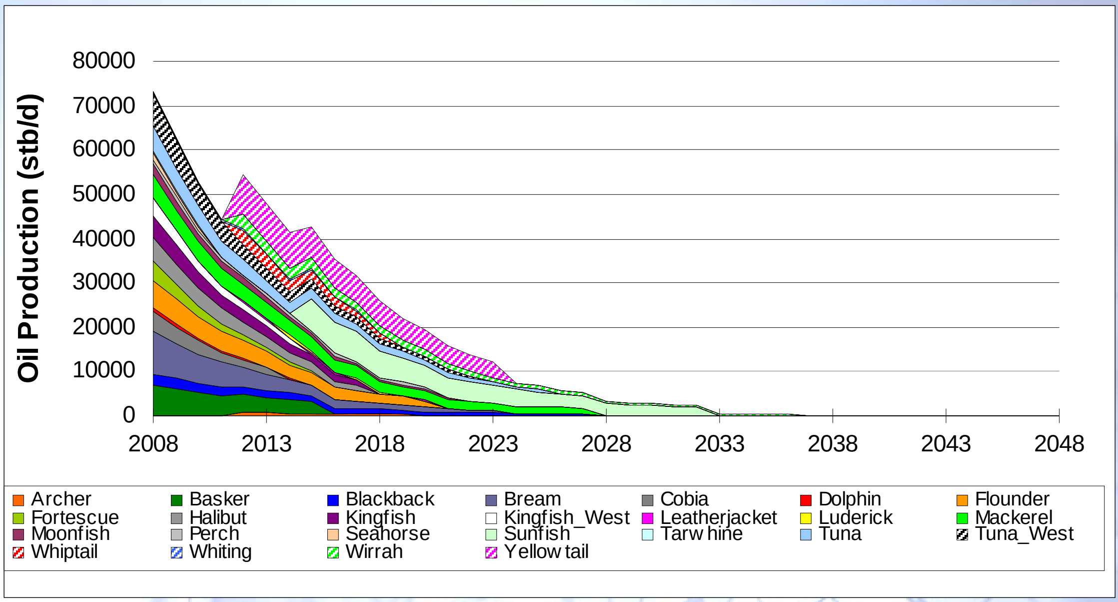
Oil Fields resources

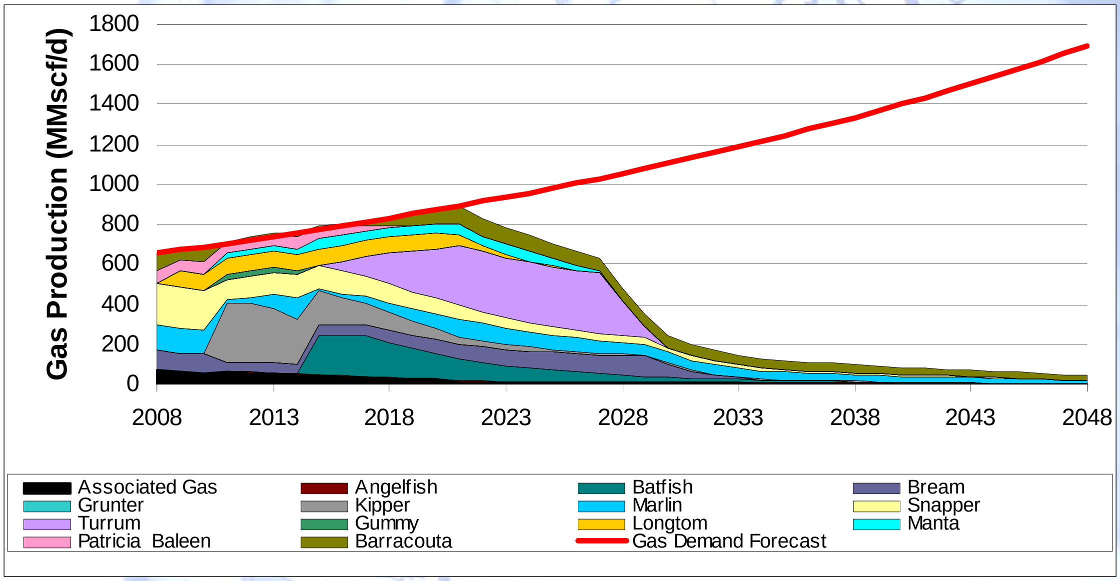
	Tech. Bcf	Econ. Bcf
Angelfish	36	31
Barracouta	800	631
Batfish	600	595
Bream	600	598
Grunter	2	2
Gummy	27	33
Kipper	620	620
Longtom	350	350
Manta	220	218
Marlin	800	702
Patricia_Baleen	200	202
Snapper	800	787
Turrum	1000	1009
Total	6054	5778

Gas fields resources

RISC has used an oil price of US$ 70/bbl real terms 2009 (and escalating at 2.5% p.a. to generate the nominal oil price), constant exchange rate of 0.65 US$/A$ and gas price of A$ 3.20/GJ real terms 2009, obtained from the Vencorp market report of March 2009.

The resultant oil and gas forecasts are shown below:





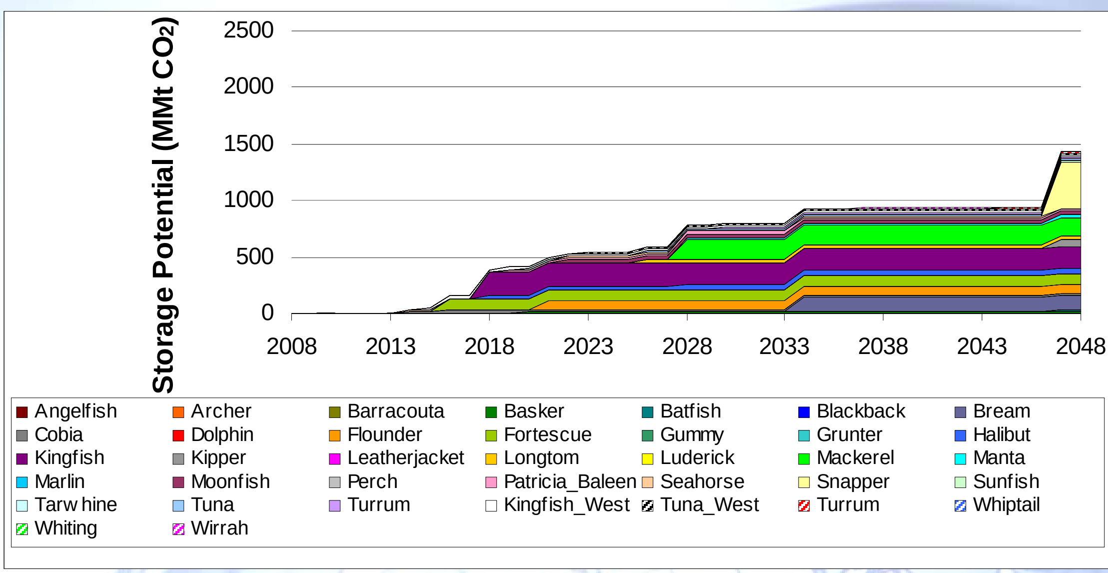
The timing of fields closing in is shown in the chart below (at the end of the red bar) with potential availability for CO_2 disposal shown in green:

Fields available for storage

Field	Remaining Resource Tech. Bcf	Remaining Resource Econ. Bcf
Angelfish	36	31
Barracouta	800	631
Batfish	600	595
Bream	600	598
Grunter	2	2
Gummy	27	33
Kipper	620	620
Longtom	350	350
Manta	220	218
Marlin	800	702
Patricia_Baleen	200	202
Snapper	800	787
Turrum	1000	1009
Total	6054	5778

Field	Tech. MMstb	Econ. MMstb
Archer	2.8	1.3
Basker	19.0	13.2
Blackback	10.0	8.4
Bream	20.0	19.1
Cobia	8.0	6.3
Dolphin	1.6	1.3
Flounder	20.0	15.7
Fortescue	6.0	5.6
Halibut	13.0	10.5
Kingfish	13.0	10.1
Kingfish_West	7.0	5.9
Leatherjacket	0.7	0.7
Luderick	0.7	0.6
Mackerel	25.0	19.1
Moonfish	6.0	5.4
Perch	4.9	3.0
Seahorse	2.0	1.4
Sunfish	32.0	24.9
Tarwhine	0.7	0.5
Tuna	16.0	14.6
Tuna_West	16.0	15.0
Turrum	110.0	84.0
Whiptail	7.0	5.0
Whiting	1.5	1.2
Wirrah	10.0	9.4
Yellowtail	35.0	23.5
Total	388	306

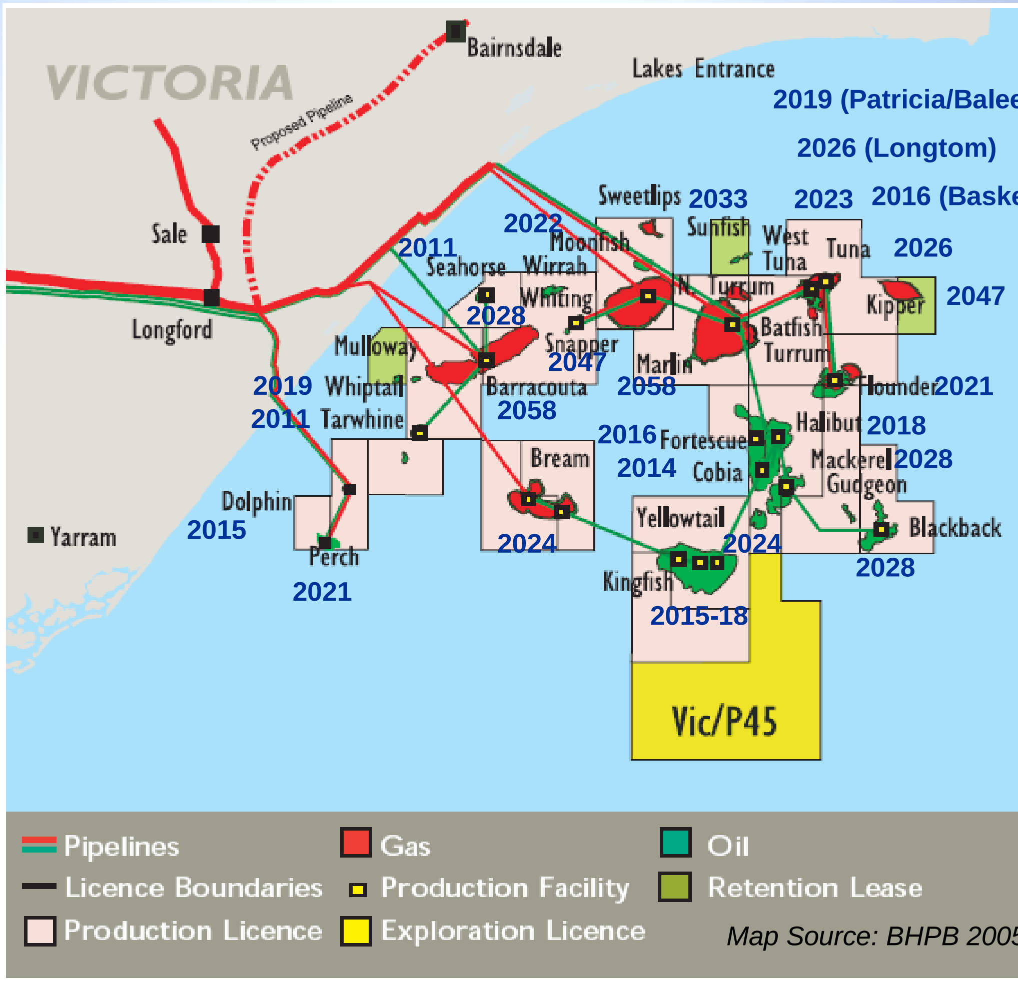
The projection of CO_2 storage capacity is provided in the chart overleaf. The Fortescue field becomes available for CO2 storage around 2016, with CO2 storage potential rising to as much as 400 MT CO2 by 2018 as Kingfish becomes available. This is delayed until 2021 for a high resources outcome.



Timings of field availability over the next decade is summarised in the table below:

Field	Availability	Capacity (MMtCO2)
Seahorse	2011	4
Tarwhine	2011	3
Cobia	2014	20
Dolphin	2015	1
Kingfish W	2015	19
Fortescue	2016	97
Basker	2016	7
Kingfish	2018	198
Patricia/Baleen	2019	18

Estimated end field timings are superimposed on a map of the fields overleaf:



As significant CO2 capacity could become available at Kingfish in 2018, the remaining value for the Kingfish node is illustrated as an example below. At prices of US$ 70/bbl oil, A$ 3.20/GJ gas – escalating at 2.5% p.a.:

- Net Present Value at 2009 is A$ 230 million (real terms 2009, at 10% discount rate)
- Future tax payable, A$ 161 million (nominal money)
- Future PRRT payable, A$ 359 million (nominal money)

Value could be reduced by future exploration, abandonment and corporate costs, Bass Strait Royalty, but increased by remaining deductions and LPG/ethane revenues.

By 2015 remaining value is reduced to A$ 24 million (real terms 2009, at 10% discount rate) using the assumptions stated.

The model can be easily used to test sensitivities to reserves, oil and gas prices, gas demand and if necessary technical and cost assumptions. Whilst intended to be user-friendly should assistance be required please contact RISC at the address overleaf.

AUSTRALIAN HERITAGE

INTERNATIONAL EXPERIENCE

GLOBAL VISION

RISC Pty Ltd
Resource Investment Strategy Consultants

HEAD OFFICE – AUSTRALIA

Level 3
1138 Hay Street
WEST PERTH WA 6005

Telephone:	+61 (0)8 9420 6660
Fax:	+61 (0)8 9420 6690
E-mail:	risc@riscpl.com
Website:	www.riscpl.com

UNITED KINGDOM

Golden Cross House
8 Duncannon Street
The Strand
LONDON WC2N 4JF

Telephone:	+44 (0)20 7484 8740
Fax:	+44 (0)20 7484 5100
E-mail:	riscuk@riscpl.com
Website:	www.riscpl.com