Otway Basin
OT2012-A
South Australia Acreage Release

Bids close **APRIL 4 2013**
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THE OFFER
A new petroleum exploration licence (PEL) in the Otway Basin is being offered by the South Australian Government on the basis of work program bidding (Fig. 1). Block OT2012-A covers 5800 sq km comprising partial relinquishments from PELs 82, 154, 155, 186 and full relinquishment of PEL 187. Twenty two wells have been drilled and 4468 line kilometres of 2D seismic data have been acquired within the block (Figs 2, 3).

PRODUCTS AND DATA
A comprehensive summary of the Cooper and Eromanga basins is available in The Petroleum Geology of South Australia Volume 1: Otway Basin (2nd Edition). This volume include chapters on structural and tectonic history, litho- and biostratigraphy, source rocks and maturity, reservoirs, seals, trap development, discovered reserves, field reviews, undiscovered potential, and exploration history. The publication can also be downloaded via the DMITRE Petroleum website, and is also available for free on the Petroleum and Geothermal in South Australia DVD.

Previous exploration data and reports are readily available from DMITRE in digital format on portable hard drives, including:

- well completion reports (also downloadable from the DMITRE Petroleum website via SARIG)
- GIS datasets including wells, seismic, tenements, pipelines
- seismic survey shot point location data
- seismic survey reports and archive stack data (SEGY format)
- digital well logs (DLIS/LIS format)
- velocity survey check shot information
- structure maps and datasets

- PEPS database with production, well, seismic and engineering data (also downloadable from the DMITRE Petroleum website)
- company prospectivity reports (also downloadable from the DMITRE Petroleum website via SARIG)

SARIG (South Australia Resources Information Geoserver) can be accessed by selecting SARIG on the DMITRE Petroleum website <www.petroleum.dmitre.sa.gov.au>. SARIG provides an interactive map window to view, query and download data. More information on products and data can be accessed by selecting ‘Products and Data’ on the DMITRE Petroleum website home page.

INTRODUCTION
The Otway Basin is one of the best known and most actively explored of the series of Mesozoic rift basins that span the southern coastline of Australia, and which were formed as a result of rifting between the Antarctic and Australian plates (Fig. 4).

Seismic studies have shown that its structural evolution is analogous to basins such as the Tucano–Reconcauo Basin of Brazil and the Gabon and Cabinda basins of the west coast of Africa. Each of these basins contains at least one giant oil field.

The recent appraisal of the condensate rich Jacaranda Ridge Field has significantly upgraded the Early Cretaceous in the basin. The main risk factors are structural integrity and small targets; however, regional 3D seismic surveys are being used to address the first risk factor and sophisticated fault leakage analysis of prospects is being conducted by some operators prior to drilling.

The economic viability of small gas discoveries has been improved by the proximity to markets for such discoveries, their potential use for
Otway Basin, South Australia

PETROLEUM LICENCES

Otway Basin

Petroleum tenements
- Acreage release block
- Exploration licence (PEL)
- Exploration licence application (PELA)
- Production licence (PPL)
- Retention licence (PRL)
- Offshore acreage release block

Petroleum pipelines
- Pipeline licence (PL) – gas

Petroleum wells
- CO2 well
- CO2 well with oil shows
- Dry hole
- Dry hole with oil shows
- Gas shows
- Gas well
- Gas well with oil shows
- Oil and gas well
- Oil and gas shows
- Oil well
- Proposed or currently drilling

Figure 1 Petroleum licences and OT2012-A acreage release
Otway Basin, South Australia

PETROLEUM and GEOTHERMAL WELLS

Figure 2 Otway Basin petroleum and geothermal wells
Figure 3 Otway Basin seismic surveys coverage
peak electricity generation opportunities in the national electricity market (as demonstrated by the 80 MW Ladbroke Grove Power Station). In 2002–03, the SEA Gas pipeline was constructed to transport offshore Otway gas from the Iona gas facility in Victoria to Adelaide (Fig. 1). Origin Energy Retail Ltd constructed and commissioned the SESA Pipeline in 2005. This 45 km pipeline connects the SEA Gas Pipeline in Victoria to Epic Energy’s South East Pipeline System and the Ladbroke Grove Power Station.

PETROLEUM GEOLOGY

Structural setting

The northern limit is defined by outcropping early Palaeozoic metamorphic and igneous rocks (the Padthaway Ridge) and sediments may occur up to 160 km offshore. Approximately 70% of the basin is offshore. To the west, the basin passes into the Duntroon Sub-basin, and in the east it continues into Victoria. Offshore it is locally bound by a Palaeozoic outer-margin high or volcanics.

Separate grabens and half grabens filled with a Jurassic to Early Cretaceous rift sequence are interpreted to exist across most of the basin (Figs 4, 6, 7) but have only been penetrated onshore. The rate of riftin slowed during the Barremian to Albian but rapidly increased before the end of the Albian in the northern part of the basin. Over 4 km of late Albian to Late Cretaceous sediments occur within the Morum Sub-basin offshore, and the widespread Cenomanian unconformity is predicted not to occur towards the north.

Two major sedimentary sequences are targets for petroleum exploration in South Australia:

(i) The Berriasian to Hauterivian sequence (Crayfish Group, early rift) is known only from the northern area, where E–W and NW–SE trending half-grabens (Robe, Penola, St Clair and Tantanoola Troughs; Figs 5, 9, 10) contain fluvial to lacustrine sediments that are proven gas reservoirs.

(ii) The Late Cretaceous sequence (Sherbrook Group) occurs as a deltaic to deep-water wedge south of the Tartwaup Hinge (Figs 5, 8, 11).

Stratigraphy

The oldest unit is the Casterton Formation, a volcanic and lacustrine shale unit that occurs in
some wells on the northern flank of the Penola Trough and in Victoria, and may occur in the undiscovered deeper parts of the Robe and Penola Troughs (Figs 4, 5). The oldest sequence known in South Australia is the Crayfish Group, which fills half grabens that can be identified in Figure 7. The first unit is the Pretty Hill Formation, a braided fluvial sandstone that occurs in the deepest parts of the troughs. This is followed by fluvial-lacustrine shale and siltstone (Laira Formation), which in turn is overlain by the braided fluvial Katnook Sandstone. The Katnook Sandstone thickens to the NW, essentially as a sandy facies of the Laira Formation. On the extreme northern margin, both the Katnook Sandstone and Pretty Hill Formation are absent, and the Crayfish Group comprises only the shaly Laira Formation. The Crayfish Group is unconformably overlain by the Eumeralla Formation, which is a fluvial siltstone – shale sequence with some minor coal and meandering fluvial sandstone units. The Windermere Sandstone is a regionally extensive transgressive sand unit which overlays the Crayfish unconformity and thickens within the Early Cretaceous troughs. The Eumeralla Formation (Fig. 5) comprises extensive fluvial-lacustrine volcanogenic sediment deposited during the sag phase of the basin.

The Late Cretaceous Sherbrooke Group (Fig. 5) overlies the Otway Supergroup as a deltaic wedge that rapidly thickens to the south.
Otway Basin, South Australia

GRAVITY IMAGE MAP

Figure 6 Gravity map, Otway Basin, South Australia
Petroleum tenements
- Acreage release block
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- Retention licence (PRL)
- Offshore acreage release block

Petroleum pipelines
- Pipeline licence (PL) – gas

Petroleum wells
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Otway Basin, South Australia
CRAYFISH ISOPACH MAP

Figure 7 Crayfish Group isopach map, Otway Basin, South Australia
accounting for most of the sediment in the Morum Sub-basin. In the northern part of the basin, where the group is thin, it comprises a coarse sandstone that represents a condensed equivalent of the Copa, Waarre, Flaxman, Belfast, Paaratte and Timboon units found to the south. Offshore, beyond the present day shelf, thick packages of high-amplitude reflectors indicate the possible presence of paralic oil-prone coals or marine oil shale. From Belfast Mudstone to Timboon Sandstone the sequence represents a prograding delta, with early marine influence and deep-water submarine slope-fans along the outer margin. Thickening of Cainozoic sediments south of the Tartwaup Hinge provide adequate depth of burial of the Late Cretaceous sequence to generate hydrocarbons (Fig. 8). Regional sections across the Otway Basin are shown in Figures 9, 10 and 11.

Source rock distribution and maturity modelling

Source rocks are capable of producing both gas and oil and the present day temperature gradient is moderate, averaging \(-2.7–3.6^\circ\text{C}\) per 100 m depth.

There are numerous source rocks throughout the Late Jurassic to Tertiary section of the western Otway Basin (Fig. 4). For the northern portion of the acreage release area, only the Casterton Formation and Crayfish Group sediments are likely to have source potential (Figs 12, 13). These source rocks are non-marine, Type III to IV kerogen type derived from land plants with some non-marine Type II algal rich shales occurring, especially in the early rift succession. Sediments of the Casterton and near the base of Crayfish Group tend to be over mature for oil generation in the deeper portions of half graben and mature for gas. On the flanks of these troughs they tend to be early mature to mature for oil whilst on basement highs they are immature to marginally mature for oil generation (Figs 15, 16).

The Eumeralla Formation is not deep enough in the northern portion of the basin to be a source and shallow northern targets would rely on long-range migration, which may be impeded by the high density of E–W faults. However to the south of the Tartwaup Hinge, where thick Sherbrook sediments occur, coals and possible profundal shales within Eumeralla Formation (Fig. 14), Waarre and Belfast Mudstone contain potential Type II and III source rocks and are mature for oil making them a suitable source for Waarre and Flaxman targets.

For the southern portion of the acreage release area, coals and possible profundal shales within Eumeralla Formation, Waarre Sandstone and Belfast Mudstone contain potential Type II and III source rocks and are mature for oil to the south of the Tartwaup Hinge (Fig. 17).

The CO\(_2\) in Caroline Field has a volcanic source, assumed to be from the Holocene Mt Gambier volcanic chain, which trends NW through the Tantanoola Trough (Fig. 4). Carbon dioxide from a magmatic source has also been noted in Ladbroke Grove Field and Kalangadoo 1. The Caroline 1 well is the single most profitable well in South Australia.

Maturation profiles are strongly influenced by the thickness of the Late Cretaceous and Tertiary (Figs 8, 17). In addition for the Early Cretaceous play, each discrete half graben or structural province appears to have its own intrinsic sedimentological and thermal history. Accordingly, source rock distribution, richness, kerogen type and quality can be highly variable as a consequence of the basin architecture.

In South Australia oil is produced in negligible amounts from Caroline 1 and in 1992 heavy crude was recovered from Sawpit 1 over a 32 m interval below 2514 m. The oil is presumably sourced from Otway Supergroup sediments. In 1994 Wynn 1 recorded the first liquid hydrocarbon flow in the Otway Basin and Killanoola 1 (1998) produced 160 kL (1000 bbl) on test, however neither are currently deemed economic. Jacaranda Ridge 2 (2007) appraised 1.2 bcf of gas and 60 000 bbl of condensate. Hollick 1 and Patrick 1 wells, both drilled in 2010, have both flowed gas on extended production test and have produced modest amounts of gas and condensate. These wells are currently tied into the Katnook Gas Plant.

Reservoirs and seals

The Otway Basin contains a range of reservoirs that generally exhibit good porosity and permeability, and are predominantly in non-marine fluvial sandstones. Exploration risk associated with reservoir quality and distribution is generally low, but risk associated with seal is more variable. Almost all formations from
Otway Basin, South Australia

CAINOZOIC SEDIMENTS ISOPACH MAP

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**Petroleum tenements**
- Acreage release block
- Exploration licence (PEL)
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- Offshore acreage release block

**Petroleum wells**
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- CO₂ well with oil shows
- Dry hole
- Dry hole with oil shows
- Gas shows
- Gas well
- Gas well with oil shows
- Oil and gas well
- Oil and gas shows
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- Proposed or currently drilling

**Petroleum pipelines**
- Pipeline licence (PL) – gas

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**Otway Basin outline**
- Tartwaup Hinge
- North Shore Park or reserve – no petroleum exploration access

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Figure 8 Cainozoic sediments isopach map, Otway Basin, South Australia
Lithological zones
- Pretty Hill Formation sands
- Pretty Hill Formation shales
- Laira Formation
- Sherbrook Group
- Tertiary

Palynological zones
- Windermere / Katnook Sandstone
- Eumeralla Formation
- South Australian reference section

Figure 9: Wireline log correlation, Kalangadoo 1 to Bool Lagoon 1
Figure 10 Stratigraphic correlation, Lake George 1 to Camelback 1
Figure 11. Stratigraphic correlation, Kalangadoo 1 to Breaksea Reef 1.
Palaeozoic basement to early Tertiary sands are potential reservoirs.

The most important and oldest established reservoir in the South Australian sector of the Otway Basin is the Early Cretaceous Pretty Hill Formation, which hosts the commercial Katnook, Ladbroke Grove, Haselgrove, Haselgrove South and Redman gas fields, and flowed significant amounts of oil, condensate and gas from Wynn 1, Killanoola 1, Jacaranda Ridge 1 and 2.

In the Katnook Field, Pretty Hill sands have porosities in excess of 25%, permeabilities in excess of 1000 mD, and flowed over 451 000 m$^3$ (16.01 mmcf) gas per day on test. Reservoir permeability does not appear to decrease with increasing depth of burial, although only the upper part of the Pretty Hill Formation is generally of good quality. Reservoir quality in the Windermere Sandstone Member is excellent, although the low relief structures can make it difficult to avoid water production problems.

Some intra-Pretty Hill Formation shales and the Laira Formation form good top seals to the underlying Pretty Hill reservoirs, however where shallow faulting penetrates the Laira Formation, structural permeability controlled by the in situ stress field / fault reactivation is a significant risk.

The Windermere Sandstone Member–Katnook Sandstone reservoir has had commercial gas production from Katnook 1 and a 2 m column exists within Crankshaft 1. But Eumeralla Formation along the northern and western flank of the Otway Basin is a poor seal and the resulting thin hydrocarbon columns have had water production problems. The Windermere and Katnook Sandstones are usually thicker toward the centres of the Early Cretaceous troughs.

The Waarre Sandstone – Flaxman Formation/ Belfast Mudstone reservoir/seal couplet hosts the commercial Caroline CO$_2$ field. This proves the viability of this system as a potential hydrocarbon trap within the southern portions of OT2012-A, south of the Tartwaup Hinge.

**Petroleum entrapment**

In the northern part of the basin, where exploration is for Otway Supergroup targets, Pretty Hill Formation reservoirs of the fields in the Penola Trough comprise complex, steep sided, E–W tilted fault blocks, with the upper Sawpit shale member and Laira Formation acting as the seals. Common palaeohydrocarbon columns have been intersected and leakage is probably caused by the creation of structural permeability across the regional seal. The location of leakage depends on the interaction between the seal, associated faults, and the regional stress field.

Traps for Windermere reservoirs comprise much lower relief domes (close to the resolution limit of seismic mapping) that are generally un-faulted, and sealed by the Eumeralla Formation. The base Eumeralla seal is likely to improve towards the SW. Considerable potential exists for stratigraphic traps, either as meandering fluvial channels in the Eumeralla Formation (as in Katnook Field), or as pinch-outs of the Pretty Hill Formation to the north.

The Flaxman–Waarre units have proven to be excellent gas reservoirs in the Victorian portion of the basin, and in South Australia contain the Caroline CO$_2$ field. Traps are generally NE tilted fault blocks, bounded by closely spaced rift parallel faults. Offshore, potential exists for overpressured submarine slope-fan traps encased within the Belfast Mudstone (Fig. 11).

**Undiscovered conventional resources**

The Otway Basin in South Australia is an immature exploration province, with high potential for further discoveries (Fig. 12). Although gas discoveries to date are relatively modest in size (average recoverable reserves per field is ~23 PJ (21 bcf)), some discoveries in the offshore Victorian portion of the basin are an order of magnitude larger (up to 350 PJ (~321 bcf) in the Minerva Field and ~0.8 tcf in the Thylacine discovery). Oil discoveries have only recently been made, and there is considerable potential for significant oil discoveries in the future. Table 1 summarises the undiscovered potential for recoverable sales gas resources in the basin.

<table>
<thead>
<tr>
<th>PLAY</th>
<th>UNDISCOVERED POTENTIAL PJ (~bcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Probability that the ultimate potential will exceed the stated value:</td>
</tr>
<tr>
<td></td>
<td>90%</td>
</tr>
<tr>
<td>Waarre–Flaxman</td>
<td>30 (27)</td>
</tr>
<tr>
<td>Crayfish</td>
<td>120 (110)</td>
</tr>
<tr>
<td>Total</td>
<td>180 (165)</td>
</tr>
</tbody>
</table>

*Note: Totals do not add arithmetically as they are Monte Carlo simulations. Current 2000.*
Otway Basin OT2012-A

EXPLORATION POTENTIAL

The OT2012-A block is being offered at a time when the economics controlling commercialisation in the Otway Basin are good, with the entire SE Australian gas market accessible via the SEAGAS pipeline and the international oil price at high levels. Both conventional oil and wet gas targets and unconventional shale gas and shale oil targets and discussed below.

Five main plays exist within these areas:

- The proven gas play from within the Penola Trough, i.e. the Pretty Hill Sandstone, shale-rich Laira Formation reservoir-seal couplet,
- The Jacaranda Ridge Sandstone/Sawpit Sandstone reservoir members of the Pretty Hill Formation overlain by Sawpit shale seal,
- The Flaxman Formation/Waarre Sandstone reservoirs overlain by Belfast Mudstone seal which lies in the oil window in the Voluta Trough,
- The Casterton Formation shale oil play on the flanks of the northern Early Cretaceous troughs (Penola, Robe and St Clair Troughs), and
- The Casterton Formation/Sawpit shale gas play on the flanks of the northern Early Cretaceous troughs (Penola, Robe and St Clair Troughs).

The latter 2 play types are discussed in more detail below arising from increasing worldwide focus on unconventional shale gas and shale oil resource potential.

Shale gas plays

The principal targets for shale gas in the onshore Otway Basin are thick basal shale sequences within the Otway Supergroup, in particular the Casterton Formation and the Upper and Lower Sawpit shales (Fig. 5). These non-marine shales all have good shale gas potential in the deeper portions of the basin and are discussed below.

CASTERTON FORMATION

The Casterton Formation represents the richest source rock of the Otway Supergroup that is thought to be the source of commercial gas accumulations now in production in the Penola Trough region. It comprises pre-rift to early synrift interbedded lacustrine shales, siltstones and sandstones and volcanic lithologies that have only been sparsely intersected. The formation reaches a maximum known thickness of 230 m in Casterton 1 and 43 m in Sawpit 1 although it is thought to be up to 500m in the Robe Trough based on seismic interpretation. To date, the formation has been mostly intersected on the northern flanks where it is marginally mature for oil (as evidenced by oil shows in several wells) but not viable as a shale gas play.

TOC values range from 0.6 to 9 percent, averaging 1.9 percent (39 samples; 6 wells). The Tmax vs HI cross plot shows that these organic rich shales are Type II (algal rich oil prone kerogen) to Type III (Gas prone) at the threshold of the oil window (Fig.12). However, in the deeper portions of the Penola, Robe and Saint Clair troughs they are expected to be gas prone with liquids potential.

Maturity modelling indicates that the Casterton Formation lies within the gas window at depths in excess of 3800 m in the Penola Trough and Robe Trough (Fig. 15) but may be locally shallower in the Robe Trough where seismic coverage is poor.

Figure 12 HI vs Tmax plot, Casterton Formation
Somerton Energy is exploring the northern margin of the Otway Basin in Victoria and estimates the Casterton Formation, within PEP 171 Basin could contain more than 25 trillion cubic feet of gas and significant oil volumes.

**Upper and Lower Sawpit shales**
The Upper and Lower Sawpit shales represent lacustrine deposits at the base of the Crayfish Group and can reach thicknesses up 900 m and 250 m thick). The shales are better developed on the northern flank of the Penola Trough, away from the axial drainage in the central part of the trough which is dominated by stacked fluvial channel fill of Pretty Hill Sandstone or Sawpit Sandstone (Boul and Hibburt, 2002).

Rock Eval analyses of samples from the Upper and Lower Sawpit Shales indicate that the shale is dominated by Type III gas prone kerogen with some Type II algal rich kerogen present (Fig. 13). TOC values range 0.37 to 2.61 percent and average 1.12 percent (10 wells, 87 samples).

Maturity modelling in the Katnook area of the Penola Trough indicates that peak gas generation from the Casterton Formation and Upper and Lower Sawpit Shales occurred in the Maastrichtian at ~73 Ma and has remained in the gas window to present day at depths below ~3800 m (Fig. 15).

Access to infrastructure is a key factor in addressing the economic viability of both the Casterton and Sawpit Shale gas plays. Main exploration risks are:
- The complex faulting resulting from the rift through to passive margin tectonic history which could adsorb energy from hydraulic fracturing, and
- The prospective shale units have yet to be fully penetrated in the centre of the Penola Trough so an understanding of gas saturation and likelihood of water drive is yet to be established.

**Shale oil play**

**Casterton Formation**
As previously discussed, the Casterton Formation represents the richest source rock of the Otway Supergroup and the most likely to be prospective for shale oil. The Tmax vs HI cross plot shows that these organic rich shales are Type II (algal rich oil prone kerogen) to Type III (gas prone) at the threshold of the oil window (Fig. 12).

Maturity modelling suggest that the northern flank of the Otway Basin represents the most prospective area for shale oil play (Fig.15) where the Casterton Formation lies in the oil window at depths between 2300 m to ~3050 m (early
MATURITY at BASEMENT – CASTERTON - BASE PRETTY HILL FORMATION

Otway Basin outline

Not mapped due to poor mapping resolution

Petroleum tenements
- Acreage release block
- Exploration licence (PEL)
- Exploration licence application (PELA)
- Production licence (PPL)
- Retention licence (PRL)
- Offshore acreage release block

Petroleum pipelines
- Pipeline licence (PL) – gas

Vitrinite reflectance maturity
- Less than 0.5%  Immature
- 0.5% to 0.7%  Early mature (oil)
- 0.7% to 1.0%  Mid mature (oil)
- 1.0% to 1.3%  Late mature (oil)
- 1.3% to 2.6%  Gas generation
- Over mature

Petroleum wells
- CO2 well
- CO2 well with oil shows
- Dry hole
- Dry hole with oil shows
- Gas shows
- Gas well
- Gas well with oil shows
- Oil and gas well
- Oil and gas shows
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OT2012-A

Figure 15 Maturity at Casterton–Base Pretty Hill Formation
**Otway Basin, South Australia**

**MATURITY at TOP CRAYFISH GROUP**

Figure 16: Maturity at Top Crayfish Group

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- 1.0% to 1.3% Late mature (oil)

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**Petroleum pipelines**
- Pipeline licence (PL) – gas
Otway Basin, South Australia

MATURITY at TOP EUMERALLA FORMATION

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Petroleum pipelines
- Pipeline licence (PL) – gas

Vitrinite reflectance maturity
- Less than 0.5% Immature
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- 1.3% to 2.6% Gas generation
- Over mature

Petroleum wells
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- Gas well with oil shows
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Not mapped due to poor mapping resolution

Figure 17 Maturity at Top Eumeralla Formation
mature for oil; Ro 0.7 to 1.0 percent) and ~3050 m to 3800 (later mature for oil; Ro 1.0 to 1.3 percent) in the Robe, Penola, Rivoli and St. Clair troughs.

**Infrastructure and markets**

Eight commercial gas fields have been discovered in the Otway Basin in South Australia and total original gas-in-place is estimated at 128 PJ (121 x 1012 Btu) sales gas.

Cumulative production for the Katnook Complex for the period 1991 to end December 2011 is 78.74 PJ sales gas and 68 822 KL (432 875 bbl) condensate. Production rates are in decline with 387.7 TJ of sales gas and 919 KL condensate produced in 2011.

Carbon dioxide is also produced from Caroline 1 well with cumulative production of 766 704 tonnes of saleable CO₂ since production commenced in 1968. In 2011, 9000 tonnes of saleable CO₂ was produced.

Epic Energy owns and operates a 46 km long pipeline, 150 mm diameter, from the Katnook gas processing plant to the Apcel paper mill at Snuggery, 7 km SE of Millicent (Fig. 1). A second line, also 150 mm diameter and 19 km long, runs from this line to Mt Gambier. A third line, 50 mm diameter, runs from Katnook due east for 4.5 km to the Safries potato chip factory, 9 km south of Penola. The pipelines were constructed in 1990 and have a maximum operating pressure of 10 000 kPa (1450 psi). A fourth line, 12 km long and 89 mm diameter, was constructed in the second half of 2000, connecting Kalangadoo to Nangwarry timber mill. None of these pipelines have compression installed.

Gas from producing wells in the Katnook, Haselgrove, Haselgrove South and Redman gas fields is piped to a gas treatment plant located 300 m SE of Katnook 1 and built in 1991. The plant was operated by Origin Energy Resources, however in July 2008, Adelaide Energy Limited (operator of PEL 255 which includes the Jacaranda Ridge 2 discovery) announced that it had purchased Origin’s Otway Basin interests including the Katnook Plant. In February 2012 Beach Energy completed a 100% takeover of Adelaide Energy and has in turn taken ownership of the SE assets. Production was been suspended in October 2011 (due to re-commence shortly).

The gas from these fields requires a minimum of processing to yield sales gas, which is then sold at the pipeline outlet from the Katnook Plant. The main gas customers are the Kimberly Clark paper mill near Millicent, where gas replaced the use of LPG and brown coal briquettes; the Safries potato chip factory near Penola, which was attracted to the area by the natural gas supply; and domestic and industrial customers in Mt Gambier, which were previously supplied tempered LPG via a reticulation network. Condensate is stored onsite at the Katnook Plant before transportation by road tanker to the Shell Refinery, Geelong, Victoria.

Opportunities exist for small power stations in a more competitive electricity market. The strategic location of the Ladbroke Grove Field adjacent to the main electricity link between Adelaide and Victoria, led to Origin Energy seeing an opportunity to use the high-CO₂ gas to fire a 40 MW power station. Gas sourced from the Ladbroke Grove Field supplied power into the national electricity grid from early 2000 until late 2006.

In 2002–03, the SEA Gas pipeline was constructed to transport offshore Otway gas from the Iona gas facility in Victoria to Adelaide. Origin Energy Retail Ltd constructed and commissioned the SESA Pipeline in 2005. This 45 km pipeline connects the SEA Gas Pipeline in Victoria to Epic Energy’s South East Pipeline System and the Ladbroke Grove Power Station. As gas production from Ladbroke Grove Field ceased in late 2006, sales gas from the SESA pipeline now feeds both turbines of the Ladbroke Grove Power Station.

In addition, the South East of South Australia and western Victoria exhibit a high diversity of local industry — consequently, opportunities for gas marketing linked to industry development in the region are good given the industry base and service provision in the region. The region is strategically located between the major cities of Adelaide and Melbourne and the eastern Australian market.

**LAND ACCESS**

**National parks and reserves**

There are a number of national parks and other areas of remnant native vegetation in the area, in some of which exploration is permitted, and
in others their small size makes it possible to work around them (Fig. 18). The reserves have been created to conserve the best examples of vegetation and landforms in the region. There are three types of South Australian reserves including conservation parks, national parks and regional reserves. The conditions of access vary from park to park, based upon the type of reserve classification, the activity proposed and its likely impact on the environment.

Environmental regulation
Energy Resources Division acts as a one-stop shop for explorers in obtaining any necessary environmental approvals on the occasions when they are required from other government agencies. Approvals to conduct field operations etc. are first submitted to DMITRE, which arranges distribution to the other relevant government agencies for comment and then issues the necessary approvals. Energy Resources Division personnel are available to assist licensees prepare the necessary paperwork.

An objective based co-regulatory approach applies in SA for the regulation of the upstream petroleum industry to reduce compliance costs and deliver better environmental outcomes. As this is a move away from prescriptive regulation and the pre-existing ‘command and control’ regime a change in both culture and method are required. There will still be inspection of field operations, including audits by DMITRE authorised officers.

The following relevant documents have been produced by DMITRE Energy Resources Division and are available in hard copy or digital formats:


European heritage
A number of sites of European heritage significance such as historic buildings and structures and geological monuments occur in the region. These are indicated on environmental sensitivity maps held by DMITRE. The majority of the sites are small and easily avoided by exploration activities.

Aboriginal heritage and native title
In South Australia it is an offence to disturb or destroy Aboriginal sites, objects or remains. Standard procedures for determining the presence of Aboriginal heritage prior to the commencement of activities have been determined. These procedures involve consulting with the relevant Aboriginal organisation and maintaining a watch for sites, objects or remains during activities. Generally the sites are no larger than a few hundred square metres and are easily avoided. Since the inception of the *Aboriginal Heritage Act 1988*, there have been no conflicts between Aboriginal heritage sites and exploration or production activities in South Australia. Licence holders are encouraged to develop a dialogue with regard to Aboriginal heritage and related matters with Aboriginal people having associations with their licence area. Native title may be applicable on non freehold land. There are currently no native title applications over the areas on offer, and native title is not likely to be a significant issue in the SA Otway Basin area, as most land is freehold or permanent leasehold.

Geothermal Exploration Licences
A number of Geothermal Exploration Licences (GELs) coincide with petroleum exploration and production licences in the Otway Basin region (Fig. 19). The GEL licensee must be notified of activities in PELs, and may object to the activity and claim compensation if their activities or resources are affected. Likewise the GEL holder must notify the PEL holder of their activities, and the PEL holder may also object and claim compensation.

Associated Activities Licences
Associated Activities Licences (AALs) are now available under the *Petroleum and Geothermal Energy Act 2000*. These licences allow explorers to undertake activities (e.g. seismic surveys) or establish facilities in proximity to petroleum exploration, retention and production licences. AALs are typically used to enable the recording of full-fold seismic within a PEL by recording tails of seismic lines outside the licence area.
Figure 19 Geothermal licences
CLIMATE AND LAND USE

The climate in the South East is characterised by mild dry summers and cold wet winters, consequently exploration activities are generally conducted in the summer and autumn months of December through to April. However, with advanced preparation of sites it is possible to conduct activities year round. The main land use in the area is for mixed farming ranging from sheep and cattle grazing to crops and wine grapes. Most land is freehold, and as such native title is not an issue in the area (although Aboriginal heritage issues may need to be considered). The South East is characterised by a near-surface unconfined aquifer which is the main water supply for the landholders, and this requires consideration while conducting exploration activities.

BIDDING AND AWARD PROCESS

Winning bidders will be selected on the basis of the total five-year work program bid. The work program must be completed within the overall area of the PEL. It must include a statement of exploration operations the applicant proposes to carry out in the first five-year licence term. It is expected that at least one petroleum exploration well would be included in the program.

Bids will be assessed using the philosophies expressed in ‘Selecting the winning bid’. For a review of how this process has been applied see ‘Shaping the Cooper Basin 21st century renaissance’. The specific scoring scheme is detailed in ‘OT2012 Bid Assessment Policy’ included on this DVD.

In general, it is important to note that the timing of well drilling and seismic or other data acquisition will be taken into account. Key assessment criteria include:

- The number and timing of exploration wells to be drilled in the PEL.
- The number of years the applicant is prepared to guarantee the program.
- The extent to which proposed wells are supported by existing or new programmed seismic data.
- The amount and nature of seismic surveying (i.e. 2D versus 3D) to be carried out and its timing.
- Other data acquisition (e.g. gravity, aeromagnetic or geochemical surveys).

Seismic reprocessing to be carried out.

In addition to the above criteria, where bids are similar, the benefits of the introduction of new explorers into the area may be taken into account. In the case of cascading bids (i.e. multiple or hybrid bids by one applicant or joint venture), only the highest bid will be considered.

The closing date for OT2012-A applications is 4.00 pm, Thursday 4th April 2013.

The Minister is expected to announce the winning bidder, together with details of work programs, by late May 2013.

CONTACT INFORMATION

Comments, inquiries and applications for exploration licences may be addressed to:
Executive Director, Energy Resources Division
Department for Manufacturing, Innovation, Trade, Resources and Energy
Level 7, 101 Grenfell Street
Adelaide SA 5000 AUSTRALIA

Phone National (08) 8463 3204
Fax National (08) 8463 3229

Phone International +61 8 8463 3204
Fax International +61 8463 3229

Web www.petroleum.dmitre.sa.gov.au

The envelope containing your application must be marked ‘Confidential — contains PEL application’.

REFERENCES


