WORLD FEATURE

> *Reverse osmosis has come along in leaps and bounds due to considerable advances made in the Australian CBM industry.*
> Tlou Energy chief executive Tony Gilby

$40 million **THE AMOUNT** spent so far by Tlou Energy and its predecessor Sabre Energy on CBM exploration in Botswana.

AFRICA

Remote location: far left, from left to right, Tlou geologist Remigoyo Mavata, Tlou regional manager Gabaake Gabaake and General Petroleum Oil Tools managing director Troy Wilson at Selemo-1A in Botswana. Above top, a 60-kilometre sandy track, frequented by cattle, leads to Tlou's exploration camp and, above, the Lesedi-1B horizontal well Photos: IAIN ESAU

Tlou wells could be game-changers for Botswana

Australian junior's **probes** on two **coalbed methane licences** have the **potential** to **unlock** up to **2.3 trillion cubic feet** of resource

IAIN ESAU
Karoo Central exploration camp, Botswana

IN SOUTH-EAST Botswana, about 60 kilometres along a sandy track from the nearest settlement, nestles a small exploration camp operated by Australian junior Tlou Energy.

The peace of the camp — a minor haven for birdlife, stray dogs and the odd giraffe all keen to find water in this arid landscape where cattle farming dominates — belies the potentially huge significance, to both Tlou and Botswana, of events under way at two well sites about 30 minutes away along more rutted and sandy tracks.

Resource The raison d'etre of this camp, which supports a crew of 25 to 30, is to find out if Tlou — which means elephant in the local Tswana language — has enough coalbed methane resource to declare a commercial project in its two wholly-owned Karoo Central licences and begin putting in place plans to exploit this gas.

Netherland, Sewell & Associates attribute 2.3 trillion cubic feet of contingent CBM resource to Perth-based Tlou's two licences, which form part of the company's wider portfolio of CBM acreage in Botswana and neighbouring Zimbabwe, plus acreage applications in Tanzania and Mozambique.

Gabaake Gabaake, Tlou's regional manager for southern Africa and previously permanent secretary at Botswana's Ministry of Minerals, Energy & Water Resources, describes the ongoing Karoo Central operations as "groundbreaking".

When Upstream visited the exploration site late last month, Tlou's geological team, including Remigoyo Mavata, were continuing to evaluate data from the first of two well test sites.

Also on site was Troy Wilson, general manager of Australian contractor General Petroleum Oil Tools, a highly regarded oilman with years of domestic and global CBM experience whose expertise will be important during this critical testing phase.

The first drill site — or pod — is called Selemo and consists of two horizontal wells, 1A and 1B, drilled into the targeted, six-metre-thick Lower Morupule coal seam for about 750 metres before each intersects the 1P vertical pumping well drilled into the same seam.

The Selemo testing operations began in early November and, based on data from the 1P and 1A-R wells, initial results are "very promising", Tlou says, despite a few technical hiccups.

The 1A well, Tlou reported in August, failed to intersect the 1P well "due to localised magnetic effects influencing the survey guidance ranging tools". As a result, it had to be re-drilled as 1A-R.

Mirror test In addition, a bottom hole assembly (BHA) got stuck in Selemo-1B, so that well cannot yet be used in the test campaign.

A mirror-test well set-up is being employed at the Lesedi site, with one vertical and one horizontal well having been drilled and a second horizontal well, 1B, due for completion imminently.

Before the Lesedi horizontals were drilled, specialist downhole drilling equipment was brought in from Australia to address the causes of the BHA issue in Selemo-1B.

Local contractor DeWet Drilling has been responsible for drilling at the Lesedi and Selemo sites. This is the first time this type of vertical-lateral well test set-up has been used in Botswana — it has been widely deployed in Queensland, a hotbed of Australian CBM activity — and is designed to allow for faster and more efficient de-watering and gas drainage than conventional vertical setups.

Mavata says the Selemo pod is in its drawdown phase and is producing gas via the casing and water via the tubing string to surface.

A pump installed in the vertical well is de-watering and therefore depressurising the coal seam, and as the pressure continues to fall more gas is released — or desorbed in CBM parlance.

Saturation level Mavata explains that evaluation of core data suggested the gas content of the Morupule coal seam is about 3.5 to 4 cubic metres per tonne, with a gas saturation level of about 70% or more.

Wilson suggests both these figures, are "comparable to some of the industry fields I have been associated with from different parts of the world".

Coring gives vital details about a coal seam's permeability and porosity, its cleats (fractures) and any infill material in the cleats, says Mavata.

"The more cores you have," explains Wilson, "then the better you know the (CBM resource) and what style of well needs to be drilled", along with well spacing needed during development and what bespoke equipment will be required "to deliver a safe, efficient, on-time and on-budget project".

All this coring data plus information from the Mopani pre-pilot wells allowed Tlou to pinpoint the coal seam's sweet spots at Lesedi and Selemo and design the surface-to-in-seam pilot wells.

Wilson explains each pod in the Morupule seam should be able to produce about 500,000 cubic feet per day, although this would depend on a variety of factors such as cleat size, permeability and correct drawdown of the well to maximise gas extraction from the coal seam.

Facilities: Tlou's exploration camp Photo: IAIN ESAU

Player moving ahead one step at a time

CBM EXPLORATION

Karoo Central permit key to programme

IAIN ESAU
Karoo Central exploration camp, Botswana

TLOU Energy first moved into Botswana in 2009 by farming into assets held by Saber Energy and, a year later, acquired the company.

To date, Tlou and its predecessor have ploughed about $40 million into exploring Karoo Central and other permits, including the six wells at Selemo and Lesedi, two pre-pilot production and monitoring wells at Mopani, plus multiple core holes.

Tlou has taken things one step at a time when evaluating its Botswana acreage, a strategy vouched for by General Petroleum Oil Tools managing director Troy Wilson.

"We will get there but it will take time," Wilson says. "Tlou is very professional in its approach to the environment and community and will do things the right way."

Wilson says the company is "big on risk assessment" in terms of business strategies, employee safety, community relations and the overall project.

One key challenge for Tlou has been to come up with a logistical plan to get all the required equipment transported from Durban to a remote location on the fringes of the Kalahari Desert.

"If you plan well and execute well you will inevitably succeed," Wilson says.

Nevertheless, not all risks can be foreseen when operating in such a remote area — as evidenced by the problematic Selemo horizontal well experiencing drilling delays due to a lack of support services and some rig equipment deficiencies.

Despite these teething issues, Tlou intends to continue to use horizontal drilling techniques — not hydraulic fracturing — to exploit its coalbed methane resource at Karoo Central.

Tlou chief executive Tony Gilby says: "Tlou has never used fracking techniques and never intends to do so. In any event, we do not need to as the gas flows freely using simple horizontal drilling techniques."

As for handling produced water, assuming a commercial development moves ahead, Gilby says the aim is to use reverse osmosis technology to remove naturally dissolved salts in the water.

"Reverse osmosis has come along in leaps and bounds of late due to considerable research and development advances made in the Australian CBM industry," Gilby says.

In Australia, he explains, there are "strict environmental guidelines that are associated with water treatment".

Gilby says Tlou's intent is to provide the clean water to residents, which could be used to grow appropriate crops.

"This... may also help create a whole new sustainable cropping industry in the otherwise relatively barren region."

He is also keen to point out that the water in the coal seams that Tlou aims to exploit is completely separate from the main aquifer that the locals draw water from.

"Our coals are hundreds of metres deeper than the aquifer and are entirely encased in impermeable shale rock."

Gilby says he is "genuinely excited" about the potential for Tlou's project to provide a new and clean source of energy for Botswana.

"To be in a position to also potentially provide a new source of clean water will be an incredible achievement."

Activity: Tlou Energy chief executive Tony Gilby

Photo: TLOU ENERGY

AFRICA

Testing: the Tlou Energy exploration camp on the margins of the Kalahari desert in Botswana

Photo: TLOU ENERGY

CBM offers hope for economy

Karoo Central gas asset may prove to be the **solution** for a **government** that has been **reliant** on **diamonds** and **diesel**

IAIN ESAU
Gaborone, Botswana

BOTSWANA'S economy has been heavily reliant on diamonds to underpin its economic future, but extraction could stop as soon as 2020, leaving a government starved of income.

President Ian Khama's government needs to find alternative sources of revenue quickly, and coalbed methane could be the solution.

CBM could wean the country's power generation plants at Morupule and Orapa off abundant but polluting domestic coal and imported diesel.

Speaking to Upstream in Tlou Energy's office in Gaborone, regional manager Gabaake Gabaake explains that brownouts and blackouts are regular occurrences in Botswana because energy demand outstrips supply. "Load-shedding in Botswana is an issue," Gabaake says. This is exacerbated by problems at the coal-fired Morupule power station, operated and owned by state utility Botswana Power Corporation (BPC).

BPC's 90-megawatt power plant at Orapa runs on expensive imported diesel.

Feedstock Gabaake suggests that if Tlou succeeds in certifying commercially viable gas reserves at its Karoo Central asset, coalbed methane instead of diesel could be used as feedstock for the Orapa plant.

"We hope we can provide them with a cheaper solution than imported diesel. It's currently costing the government an arm and a leg," Gabaake says.

According to Tlou, one near-term commercialisation option would be to send about 30 million cubic feet per day of gas to the 90-megawatt Orapa power station and a planned reverse osmosis plant also planned at Orapa.

In addition, the government has tentative plans to build a 180 MW power plant fired by CBM at Mmoshoro.

In total, diesel replacement opportunities may represent gas sales opportunities of 10 million Gigajoules per annum, says Tlou, while off-grid temporary power solutions that currently rely on diesel could add a further 1 million to 2 million GJ each year.

The company also identified South Africa as a potential market, with power demand there forecast to outstrip supply by 2000 MW annually up to 2016.

Tlou would appear to have a commercial edge on rival CBM acreage holders in Botswana. "We think we are the leading operator in that we have an independently certified (by Netherland, Sewell & Associates) contingent resource. Our focus currently is to firm up what our reserves are," Gabaake says.

Alternative Tlou has been "having discussions with a number of companies who have projects that are far from the (power) grid and some of them are planning to use diesel to provide power", says Gabaake.

"We want to provide an alternative that would be cheaper and more environmentally friendly. We have had fairly positive responses to date but they want to see gas reserves booked before they pursue serious discussions."

He explains that "Tlou did a lot of core drilling, drill stem testing and desorption tests" that were used by Netherland, Sewell & Associates to come up with their contingent resource estimate of 2.3 trillion cubic feet for Karoo Central and a further 8.5 Tcf of potential CBM resource in three other permits just to the south.

It will take a few months for maximum flow rates to be achieved on the Selemo and Lesedi drilling pods.

Once this data is available, it will give Tlou a clear idea about resources at Karoo Central, where the Morupule coal seam — dipping to the west — is found at a depth of about 400 to 500 metres.

Next year, the aim is to certify resources and also make a final investment decision.

A draft Gas Supply Act is currently being considered by the government, but Gabaake says Tlou could still sell gas to the market without this legislation being formalised.

"We don't see its absence as having an adverse effect on our ability to supply CBM to market," he says.

Tlou has a 100% stake in Karoo Central but, according to Tlou's regional manager, "there are no farm-out plans at the moment".

Government denies fracking took place on licences

BOTSWANA'S government has vehemently denied allegations that it has allowed hydraulic fracturing to take place in coalbed methane licences in the Central Kalahari Game Reserve (CKGR), *writes Iain Esau*.

Kitso Mokaila, Minister of Minerals, Energy & Water Resources, confirmed that CBM licences have been awarded in the CKGR but said most have been relinquished or cancelled. He stressed that no operators in the reserve have been given permission to carry out fracking.

"No fracturing has been done in the CKGR to date as alleged in the media," Mokaila says. "If such a process were to be carried out without authorisation, it would be a violation of the Mines & Minerals Act of 1999 and the Environmental Assessment Act of 2011." However, Mokaila told Botswana's parliament that specialist explosives were permitted for issue by one company in Lephephe and Mashoro in 2008, 2009 and 2010.

"These were one-off permits which are no longer valid. The explosives were used to fracture coals or carbonaceous materials in wells at depths of more than 450 metres."