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The PRMS – An Australian Perspective

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decisions with confidence

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We'll focus on Gas, as it dominates the Australian hydrocarbons landscape and is the most visible with respect to challenges in resource estimation, disclosure and regulatory intervention

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Key Thought of Presentation

The consistency of reserves & resource estimations and disclosure is important in the Australian East Coast, given the apparently different historical understandings of what 2P, 3P and 2C…

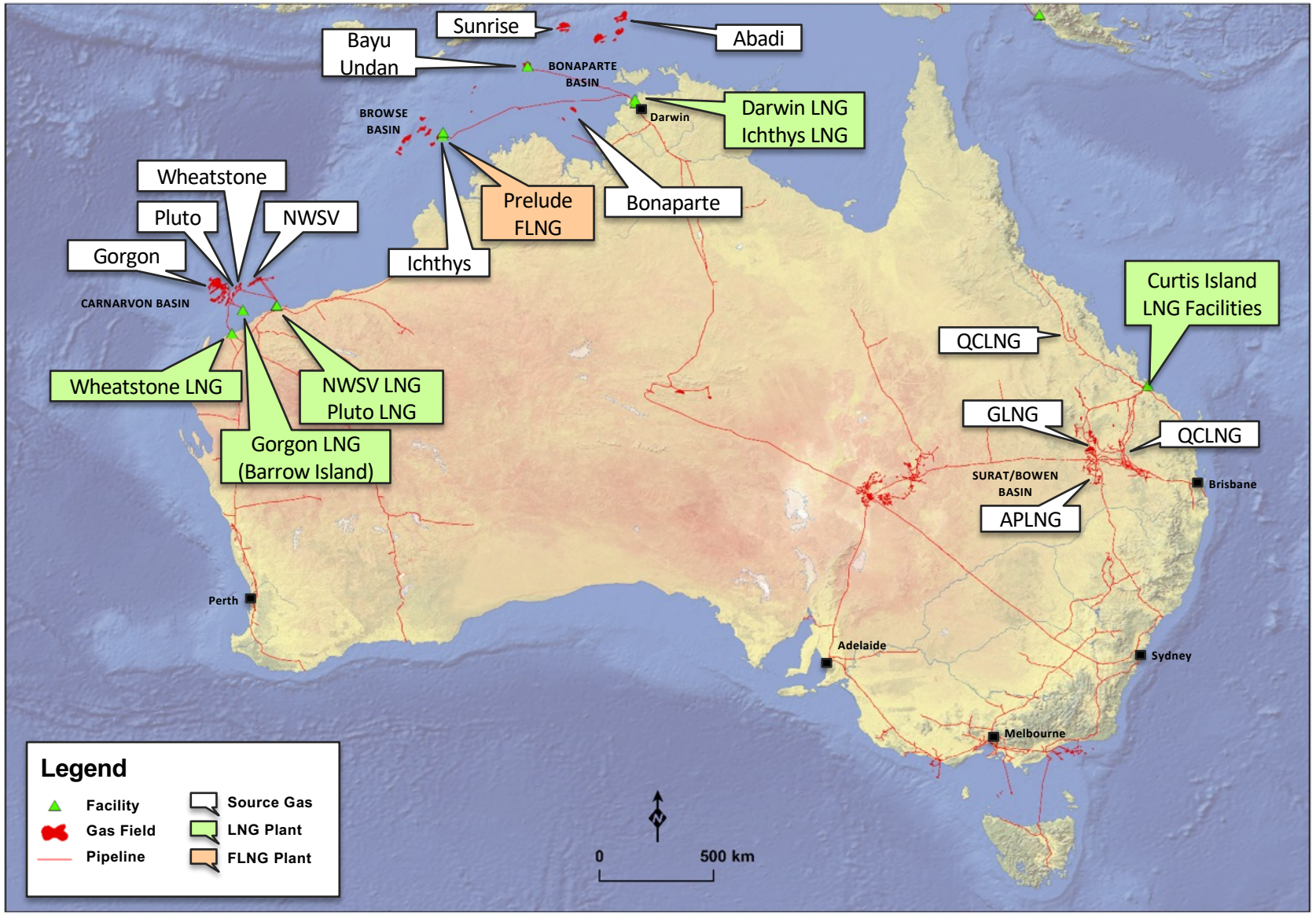
The accurate and timely disclosure of Reserves and Resources serves not only capital markets i.e. the ASX but Governments and industry for medium and long term infrastructure planning and ongoing viability of gas intensive industries

Where resource and/or reserves estimates suffer material downgrades and/or regulatory disclosure is obfuscated the market struggles to work efficiently potentially resulting in regulatory intervention

If we don't get it right the regulators may intervene.

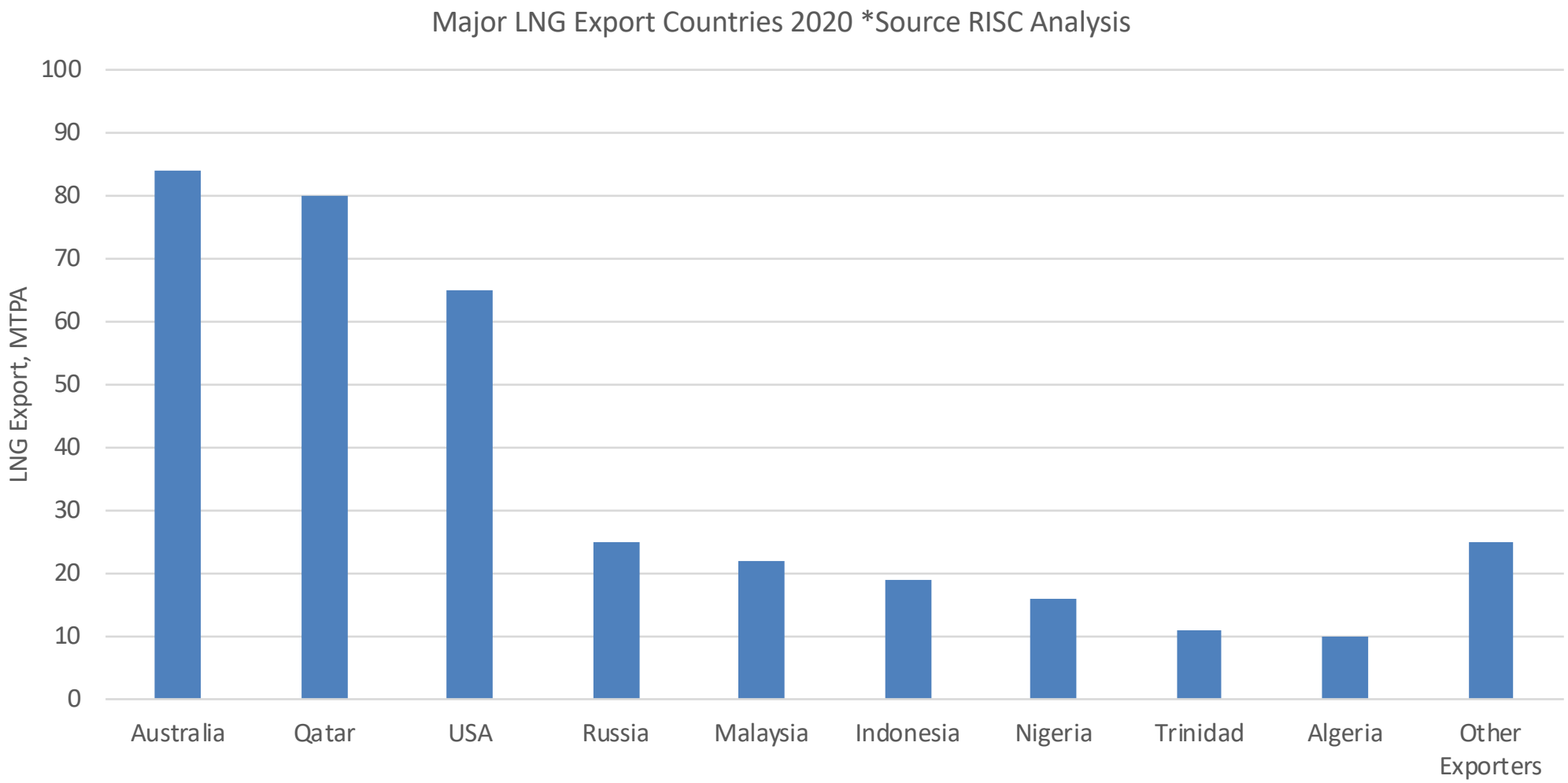
Scene 1 – Oil and Gas in Australia

A Tale of Two Countries with Respect to LNG



Australia, the Worlds Largest Island and Largest LNG Exporter

Approximately $^1/_3$ of Australian LNG Exports sourced from unconventional resources such as CSG
Will US unconventionals lead to the US overtaking Qatar and Australia?



Feast or Famine

However, it was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness – *Dickens, A Tale of Two Cities*

The Domestic Gas Market Reality:

- The West Coast is in a feast the East Coast is in a famine

Unconventional and Conventional Onshore Gas Bans:

- All states apart from Queensland and Northern Territory

The Reality in the East Coast:

- Domestic gas pricing surging above LNG import pricing
- Domestic gas shortages forecasted from 2020/22 onwards
- LNG import terminals are being proposed
- LNG import terminal pricing may commence at near export parity
- Federal Gas LNG Export trigger legislation for East Coast LNG exporters to protect domestic market

LNG Import Terminals on the East Coast

LNG imports are likely to be required into the east coast market from as early as 2020 to meet peak demand requirements potentially resulting in further upward pressure on gas pricing

Based on a Floating Storage Regassification Unit (FSRU).

There are currently five (5) proposals to build LNG import terminals on the East Coast*

Potentially exposes East Coast domestic market (industry) to LNG import Spot pricing rather than LNG export Netback pricing.

Not a long term solution from gas intensive industry perspective

*Source EnergyQuest 2019

Sovereign Risk & Gas Pricing

Export triggers for East Coast LNG exporters, potentially another Australian first but an awkward first
Spot Gas Market on the East Coast > $AUD12/Mscf during 2017, whilst ~ AUD$3.5/Mscf on the West Coast

Australia enacted a federal law to potentially control East Coast LNG exports in reaction to surging domestic natural gas prices on the East Coast

Rising natural gas prices became a highly visible political issues in East Coast Australia as households and manufacturers complained of the higher costs,.

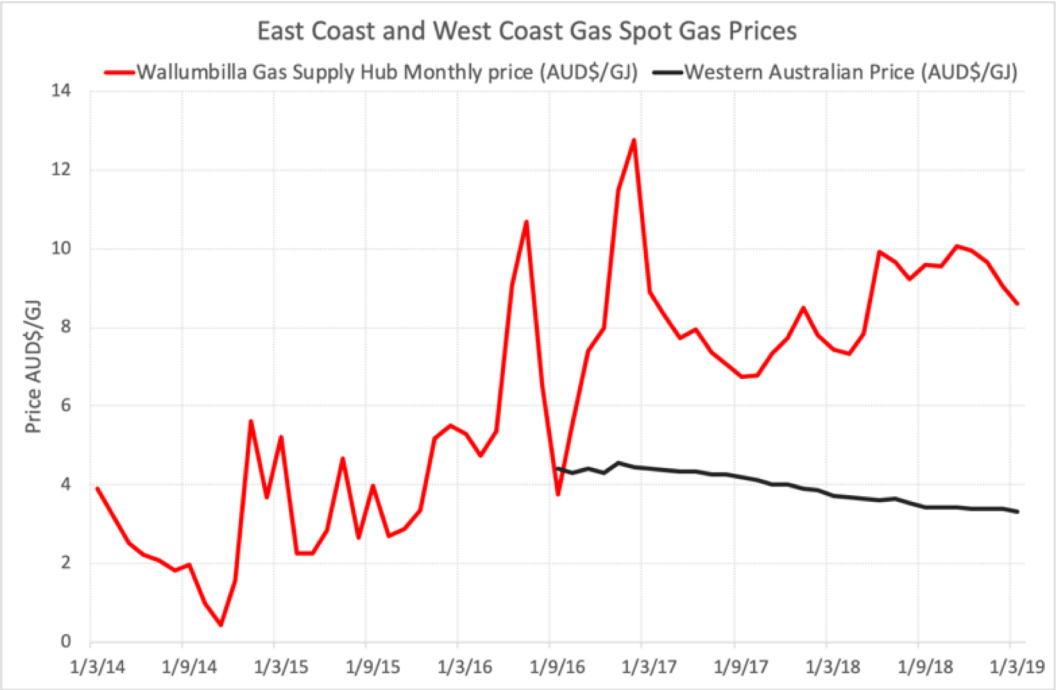
So far LNG export trigger have not been enforced, but they exist, or to paraphrase President Teddy Roosevelt, the Federal Government is *"speaking softly but carrying a big stick"*

*Source REUTERS COMMODITIES OCTOBER 24, 2018 / 4:57 PM / 7 MONTHS AGO

*1GJ ~ 0.95 MSCF

Ironic that without an LNG export market CSG would have remained a minor resource based on the East Coast, and is now being pursued for domestic shortfalls

Potentially sizeable CSG resources may just not be commercial to develop at "low prices" the domestic market wants



Australian Domestic Gas Security Mechanism

LNG Export controls buy time, the only long term solution is add supply to the market by developing unconventional gas proximal to existing gas infrastructure, but at what price?

Under the terms of this agreement, the LNG producers committed to offer sufficient gas on reasonable terms to the domestic market.

In the short term, following the government's intervention, domestic prices stabilised in the AUD$8–11/Mscf range and converged with East Coast LNG export parity prices.

The reality is that CSG is economic at higher gas price and other unconventionals are also likely to require high prices PLUS a successful technology under development process, that always has risk of failing

In the long term, investment to mature Contingent and Prospective resources into reserves is critical for the domestic market

*Source The Australian 2019

The Attitude towards Unconventionals

Blanket Moratoria in the Southern States prevents development of gas proximal to existing gas infrastructure

As we noted before unconventional gas is unlikely to return domestic gas pricing to historical lows

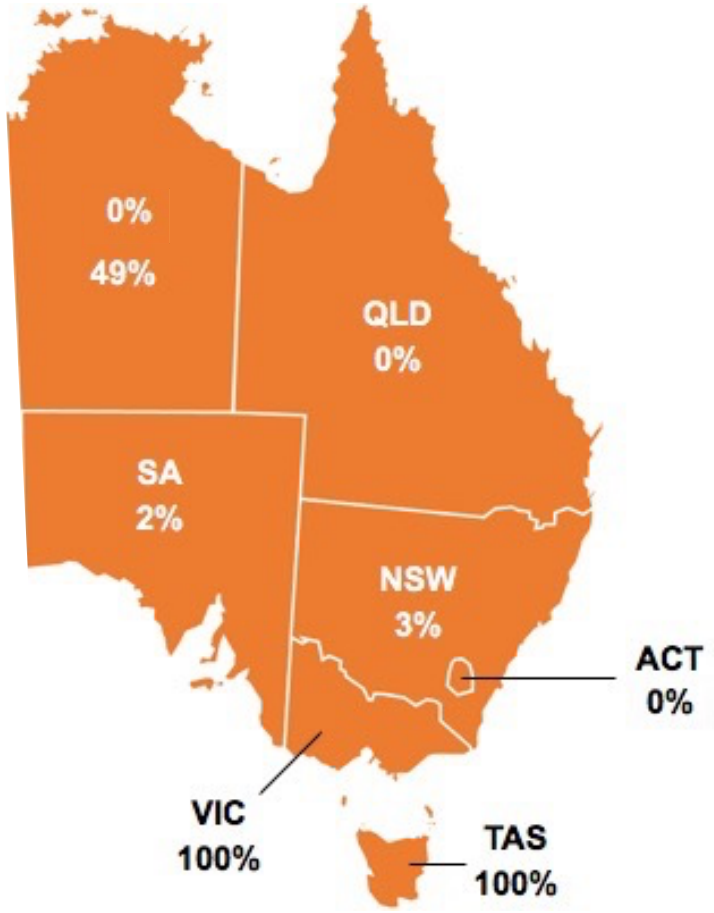
Four states have undertaken scientific inquires to fraccing:

- Risk to people and the environment is low and
- it can be be undertaken safely, and
- No evidence it has contaminated aquifers to date

But….

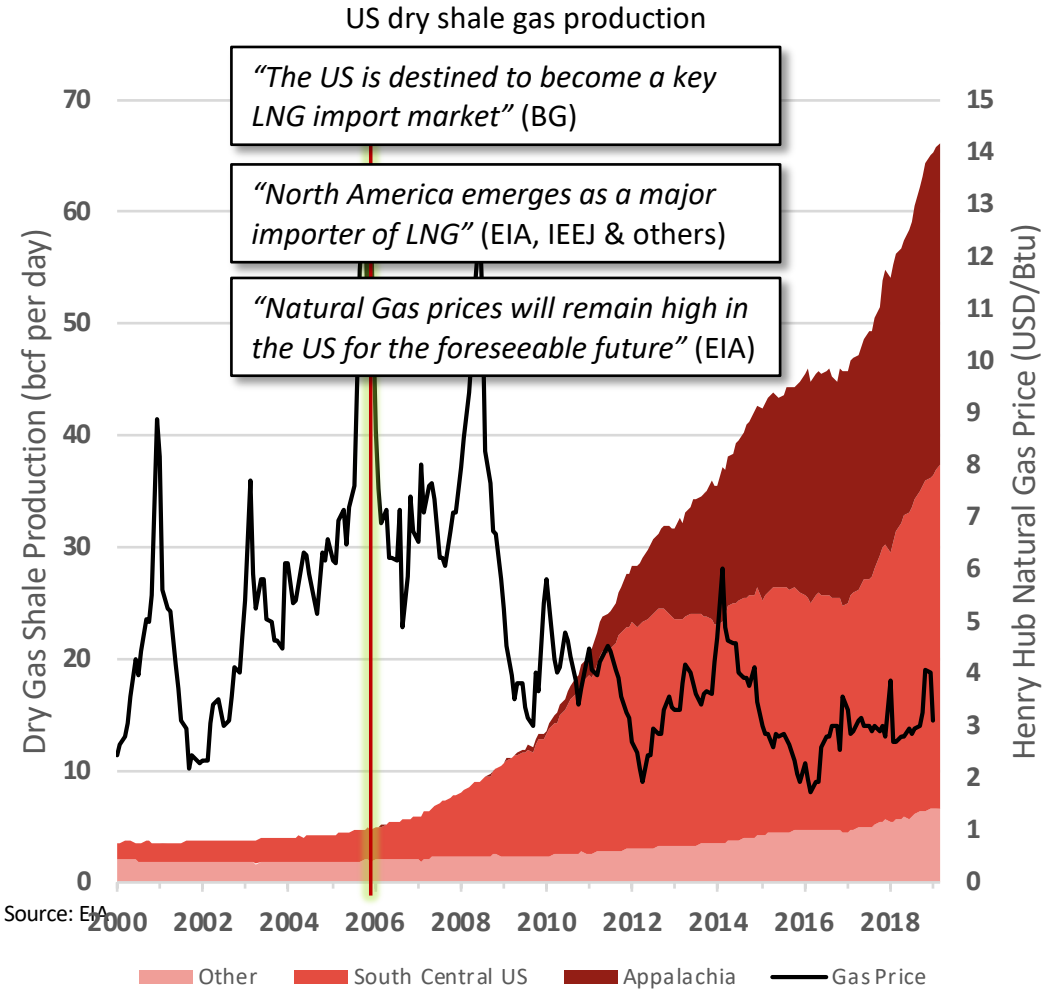
In March 2017 Victoria became the first state in Australia to permanently ban all onshore unconventional and conventional gas exploration and development

A single CSG development in NSW “Narrabri” would support NSW gas needs and mean less reliance on importing gas



History Repeating Itself on Australia's East Coast

Interestingly the East Coast of Australia finds itself in the same position the USA was in 10 years ago before the Shale Gale



Source: EIA

NATURAL GAS — 27 Feb 2019 | 07:44 UTC — Sydney

Australia's east coast needs to urgently start importing LNG: EnergyQuest

Sydney — Australia's gas-strapped east coast needs to urgently start importing LNG in order to mitigate a range of risk factors stretching from supply issues to regulatory uncertainties, energy consultancy EnergyQuest said Wednesday.

When insanity makes sense: Australia's best option is LNG imports

By Clyde Russell
March 7, 2019 – 12.06pm

Australia has painted itself into a corner with its natural gas industry and faces the stark reality that there are no easy choices to alleviate the dual problem of a looming supply crunch and the associated higher prices.

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LNG import terminal approval — an Australian first — a sign of hope for NSW manufacturing

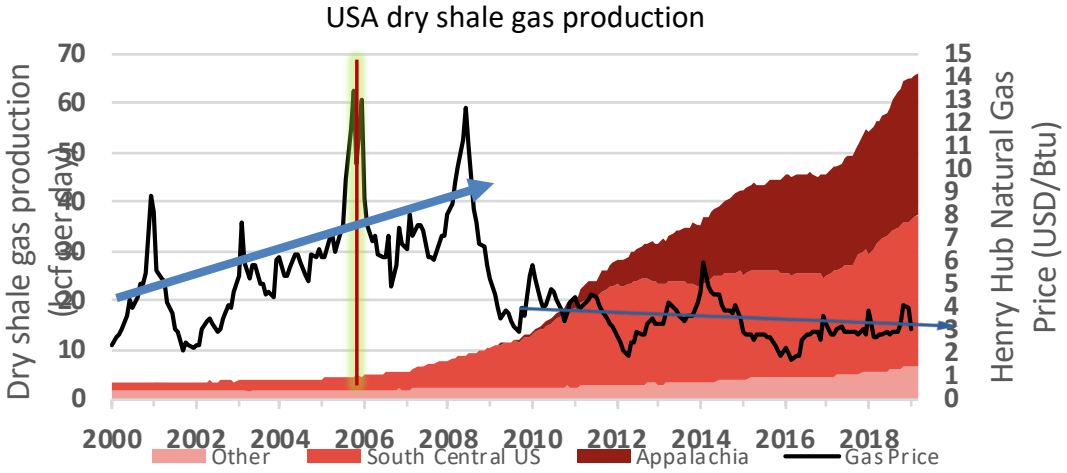
ABC Illawarra By Kelly Fuller and Gavin Coote

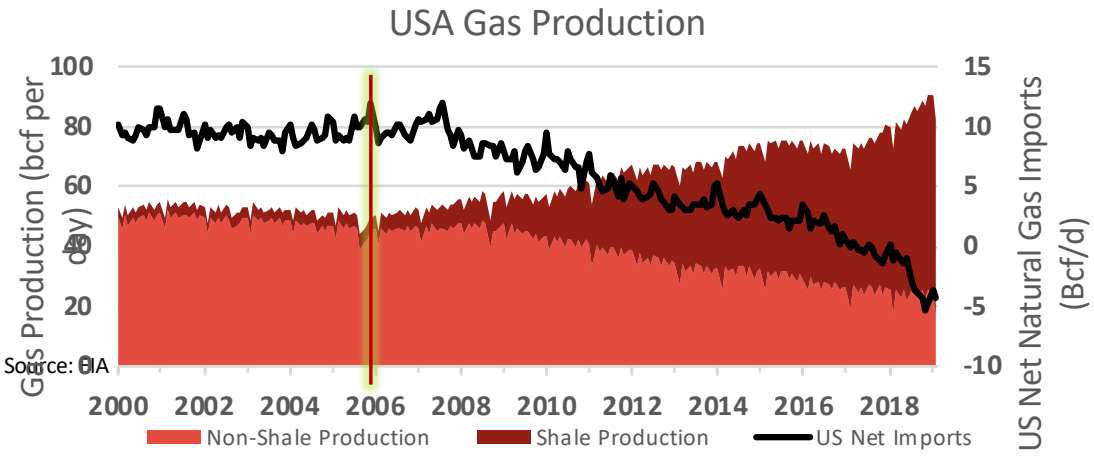
FROM ABC ILLAWARRA

- Why Tania Daykin is putting old chickens before the eggs
- Art and alcohol bringing out creative flair in expanding entertainment landscape
- Liberal candidate angry over 'go back to where you came from'

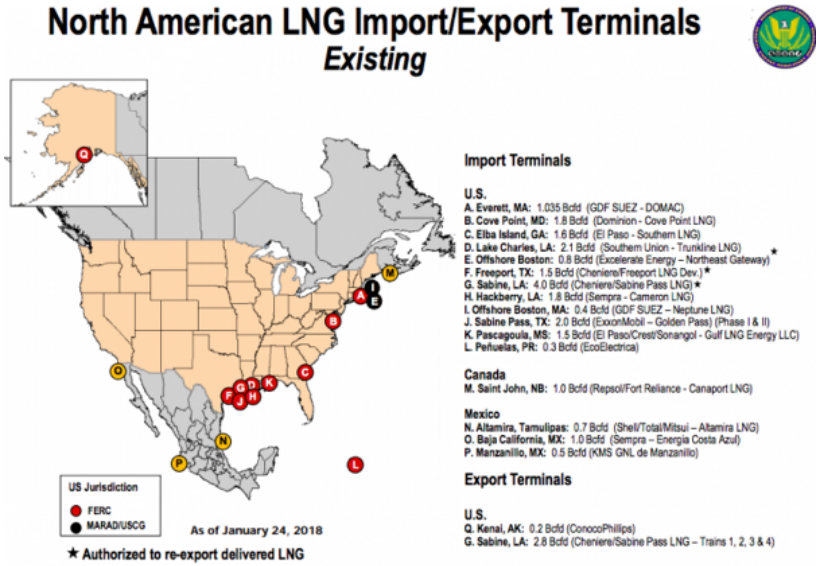
Have We Seen This Shale Gale Story Before?

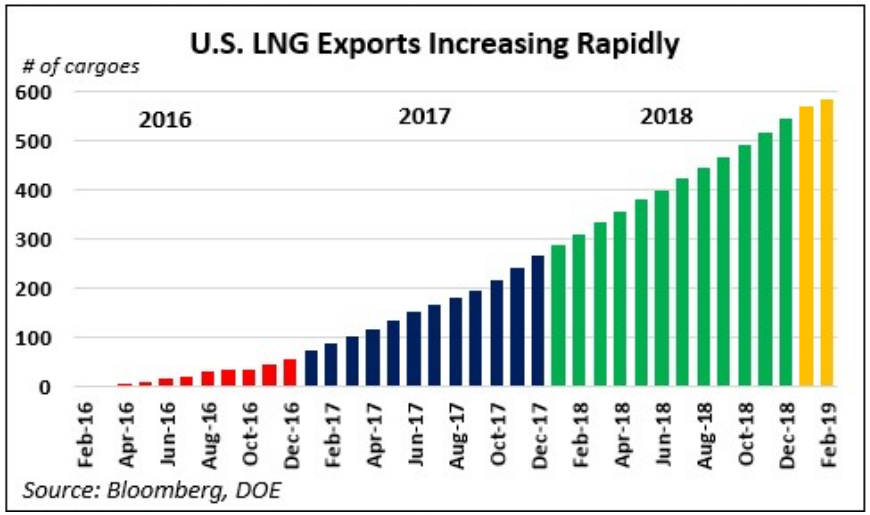
Rising gas prices in the Eastern Australian gas market are driving speculation about LNG import requirements
The same speculation occurred in the US in the mid 2000's. US managed to responded with unconventionals





Source: EIA





Key Takeaways from Scene-1

With the looming gas shortage, eyes are focused on whether booked Reserves and Contingent Resources are actually Reserves and Contingent Resources

There is severe gas supply shortfall looming in Eastern Australia

Potentially sizeable CSG resources may just not be commercial to develop at “low prices” the domestic market wants

Existing infrastructure proximal shale plays may provide additional supply, provided development strategies can quickly drive towards optimal cost effective drilling and completion strategies

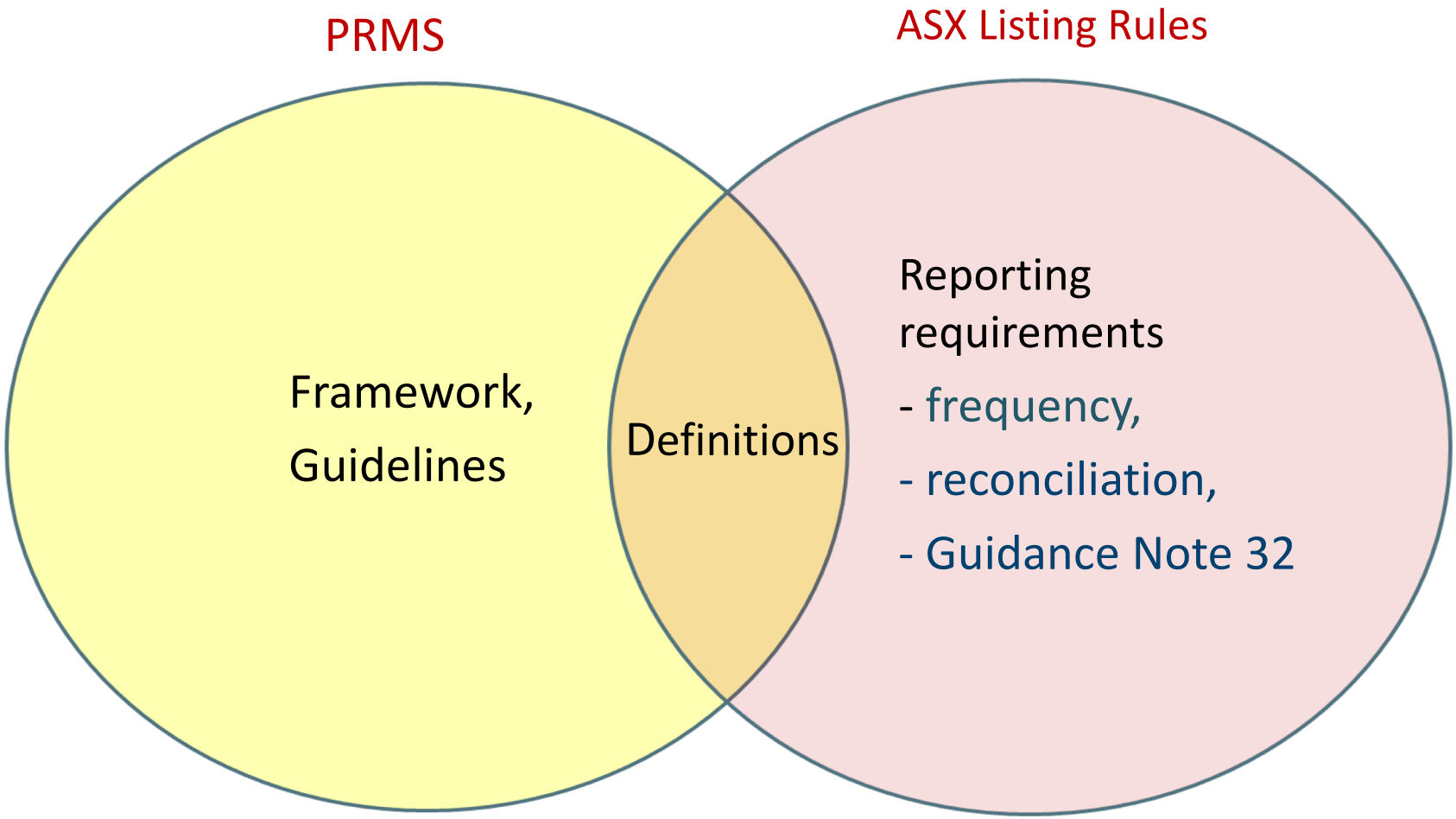
In the long term, investment to mature Contingent and Prospective resources into reserves is critical for the domestic market

Scene 2 – The Australian Regulatory Environment

The Australian Stock Exchange (ASX) and the PRMS

The Australian Stock Exchange (ASX) adopted the PRMS in 2012

ASC disclosure is dependent on materiality and maturity of resources under a continuous disclosure regime



The Australian Regulatory Framework Compared

Market disclosure in Australia is governed by ASX Chapter 5 listing rules and Guidance Note 32

State Governments and federal industry regulators such as NOPTA also have disclosure obligations

Australia perhaps lies somewhere between the US and the Canada with respect to market disclosure of Reserves and Resource estimates:

- Not as prescriptive as the SEC
- Does not have detailed prescriptive estimation guidelines/best practices such as the COGEH, instead refers to 2011 PRMS Application Guidelines
- Does not require Reserves and Resources estimates to be independently audited (although significant entities tend to have independent audits as part of their corporate governance structure), but requires sign off by a Qualified Professional Reserves and Resources Auditor/Evaluator (QPRRE/QPRRA)

ASX similar to the TSX in that Reserves, Contingent and Prospective Resources can be disclosed:

- In the absence of the COGEH in particular Vol 2 Chapter 2 ROTR or equivalent, the ASX Chapter 5 listing rules provide a degree of additional disclosure with respect to the Contingent and Prospective Resources
- The ASX like the TSX is mature enough to recognise the reality that Contingent and Prospective Resources do have value, they just happen to less mature and have inherent discovery and/or commercial risk.

ASX Reporting and Disclosure Observations

In 2019 the ASX noted issues with respect to reporting and disclosure of Contingent & Prospective Resources

A common theme, though not explicitly stated, is defining the project used in estimating Resources

In particular it noted entities failing to disclosure adequate information when reporting Contingent Resources, especially regarding:

- The basis for confirming the existence of potentially moveable hydrocarbons and the determination of discovery, and:
  - The analytical procedures use to estimate a Contingent Resource
  - The key contingencies that prevent the Contingent Resource from being classified as Reserves, and
  - The further work to be undertaken to assess the potential for commercial recovery

In the case of Prospective Resources, especially regarding:

- The basis on which the Prospective Resource is estimated and the further exploration activities to be undertaken, and
- The entity's assessment of the chance of discovery and the chance of development associated with the reported estimate of a prospective resource

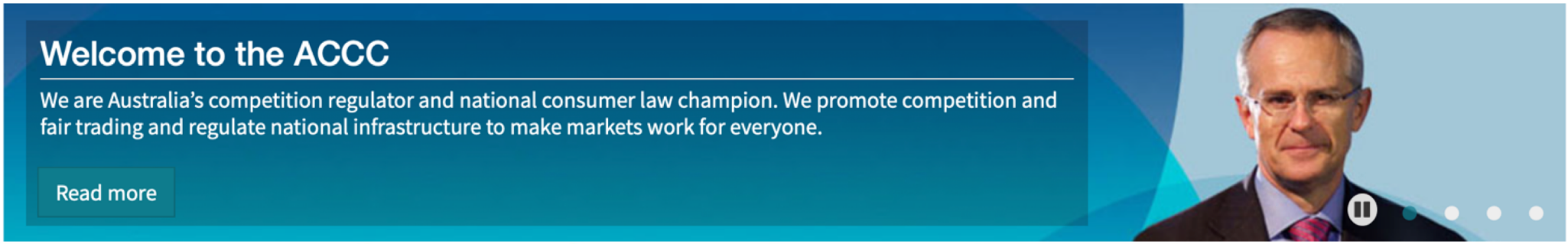
Australian Competition and Consumer Commission (ACCC) 2017 East Coast Gas Market Enquiry

In Feb 19, the ACCC alarmed at the potentially industry curbing East Coast Gas Prices, launched an industry consultation paper entitled *"Framework for the consistent reporting of natural gas Reserves and Resources"*

The ACCC was of the opinion there there is a need for more transparency to respond efficiently to the changing market conditions

One such transparency measure is the developing a consistent reporting framework for Reserves and Resources in addition to mandatory ASX reporting requirements

The Paper *strongly endorsed the PRMS* stating *"it is a widely-used principles-based reporting standard that provides for a consistent approach to the calculation of petroleum quantities"*



ACCC "Framework for the Consistent Reporting of Natural gas Reserves and Resources"

Consistent Reporting based on the PRMS sounds good however price assumptions are key since Reserves and Resources estimates are dependent on GSA and uncontracted Gas pricing assumptions

Specifically, the ACCC suggest producers be required to:

- Use the PRMS classification system
- Use the PRMS definitions when reporting:
  - The breakdown of 1P, 2P and 3P reserves into developed and undeveloped reserves
  - The *analytical method* used to estimate reserves and resources
  - Information on a field's stage of development including project maturity sub class
  - Producers states their own *gas price assumptions* and are required to disclose those assumptions
- Prepare estimates by or under the supervision of qualified *independent* evaluator

Table 2.1: Proposals on information to be reported and bases on which it is reported

Information to be reported			
Reserves	1P (proved reserves)	2P (proved plus probable reserves)	3P (proved plus probable plus possible)
	Broken down into developed and undeveloped reserves		
Resources	1C (low estimate)	2C (best estimate)	
Gas field information	Each of the fields in which the reserves and resources are located must be categorised according to: • The field's stage of development: the categories include on production, approved for development, or at another development stage • The type of gas contained in the field: the categories include a conventional gas field, a coal seam gas field, or another type of unconventional gas field • The nature of the gas field: the categories include a dry gas field (mostly methane), a gas condensate field (mainly condensates or liquid hydrocarbons), or an oil field (where gas is found associated with oil).		
Movements in 2P Reserves	Movements in 2P reserves in the last 12 months, broken down into: production, discoveries, acquisitions, divestments, extensions,[15] reserve reassessments and other revisions.		
Contracted 2P reserves	The total quantity of 2P reserves that have been contracted under existing GSAs reported at a basin level.		
Bases upon which information is to be reported			
Quantities to be reported and estimation methods	Reserves and resources estimates to be based on the producer's net revenue interest in the sales quantities of gas (measured in PJ) from all gas containing fields. Producers must also disclose whether they have used a deterministic, probabilistic or geostatistical method to estimate their reserves and resources.		
Reporting standard	The classification of reserves and resources and the definition of key terms used in the reporting framework, such as "1P", "2P", "3P", "1C", "2C", "developed reserves", "undeveloped reserves", "deterministic", "probabilistic", "sales quantities", "net revenue interest", "on production" and "approved for development" are to be based on the PRMS.		
Reporting level	• Reserves and resources and movement in 2P reserves: field level. • Contracted 2P reserves: basin level.[16]		
Reporting frequency	Producers to report information on an annual basis, but if any material changes in reserves and resources or contracted reserves are subsequently made, the updated information should be reported to AEMO for publication as soon as practicable.		
Evaluation requirements	Reserves and resources estimates should be prepared by, or under the supervision of, a qualified independent evaluator.		

Key Takeaways from Scene-2

The PRMS is adopted and well respected within Australia providing the framework for reporting

Perhaps a few areas to improve with respect to Contingent Resources

Analytical methods not defined by ACCC. PRMS defines established technology, reserves estimates *should* be made using established technology

Not all Contingent Resources are the same. In the absence of project maturity classes and Chance of Development (COD) what really is the commercial maturity of the resource and what are our 2P+2C estimates?

Should CR's be risked in reporting, when estimating CR should the PRMS *recommend* they be accompanied by COD for completeness of context and form?

Moving towards estimates from qualified *independent* evaluators, independent assurance and confidence in operators estimates

Section 3 - The Challenges in Application of the PRMS in Australia

The East Coast CSG Reserves Write-downs

Write downs in CSG reserves, was it simply just a matter of having insufficient appraisal?
Were Contingent Resources being booked as Reserves? Is so why?

2P and 2C CSG Reserves write-downs have occurred, but these need to be seen in context

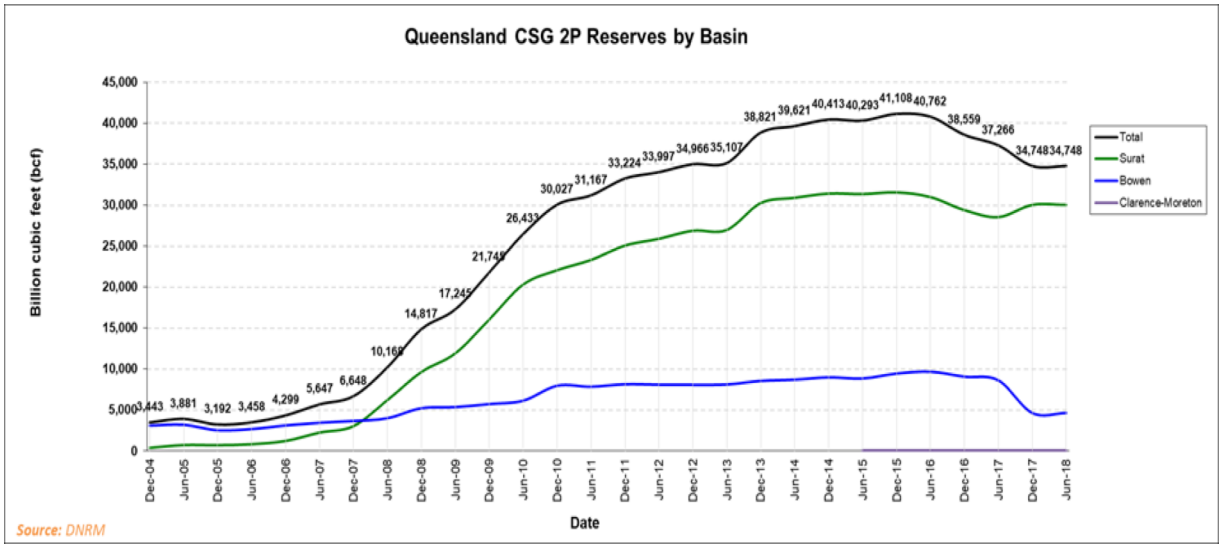
The major write downs were around Moranbah (Bowen Basin) and adjacent permits where due to operators deciding not to develop a mega project after assigning reserves:

- Reflects importance of appraising and certainty of development

In reality what has happened is that insufficient appraisal has led to a disconnect between volume and deliverability:

- More capital need to be expended to meet expectations (i.e. more wells)

Was application of the traditional Deterministic Incremental Method contributing to this?



Under Appraisal, a Common Theme?

One common theme seen worldwide is a correlation between reserve write-downs and insufficient project appraisal This is by no means limited to unconventional resources or the traditional Deterministic Incremental method.

Let’s take a step back here

Regardless of apparent incongruence of the traditional Deterministic Incremental Method with the uncertainty based philosophy of the PRMS, we must be careful as there are other factors at play in reserves write-down

We’ll paraphrase Lewis Carrol with respect to discussion of the traditional Deterministic Incremental Method in this presentation, "The time has not yet come", the Walrus said, "To talk of many things”

Since we work in the era of the PRMS 2018 Let’s lookback on what has transpired on the East Coast through the rose tinted lens of the PRMS 2018, would it have made a difference?

LONDON – Wintershall DEA’s Maria field in the Norwegian Sea has undergone a 71% downward revision to the 207 MMboe of reserves estimated at sanction following underperformance, according to consultant Westwood Energy.

The field came onstream a year ahead of schedule and close to $370 million under budget, but 50% of the $1.5 billion capital cost of the project has had to be written off so far, said Westwood analyst Joe Killen.

Benchmarking has revealed that Maria was under-appraised relative to its peers before the partners selected their development concept, and this is not an isolated case for projects offshore Norway, Killen added.

Discovery Criteria and Extrapolation Beyond a Data Point

Discovery is related to recoverable rather than just movable hydrocarbons

Ignoring this may result in a disconnect between volume and deliverability

Under the PRMS 2018: Requirements for unconventionals has been expanded. These emphasise the need for conclusive productivity data to recognise CRs in particular:

- Need for increased spatial sampling density due to uncertainty when compared to conventional resources
- Extrapolation of reservoir presence or productivity beyond a control point must not be assumed without technical evidence
- Extent of discovery is based on evaluator's reasonable confidence based on existing experience

CSG and Elsewhere:

- Some parts of the CSG development and elsewhere have assumed productivity and thus recognised CRs without sufficient direct technical evidence.
- For example parts of Queensland's 2P CSG Reserves have not yet established a consistent commercial gas flow history, potential reserves/EUR risk

Proper Definition of a Project

Write downs in CSG reserves, was it simply just a matter of having insufficient appraisal?
Did this potentially result in Contingent Resources being booked as Reserves and/or 3P as 2P

Under the PRMS 2018: Definition of a “project”

- A defined project should be subject to one investment decision and can be placed in one project maturity sub-class.
- Scopes for the low, best and high cases may be different for PRs and CRs, but not for Reserves. For Reserves there needs to be a “reasonable expectation” that all commerciality requirements per 2018 PRMS are met.
- How do we effectively handle these “mega CSG projects” under the 2018 PRMS if scope is the same for 1P, 2P and 3P?

CSG and Elsewhere:

- Some areas of development were subject to more that one investment decision, potentially the “mega project” could have been split into smaller “projects” reflecting a series of investment decisions commensurate with the commercial maturity of each project
- Arguably the smaller “projects "may have been classed as CRs until a critical mass of such projects were mature enough to commercialise in a single investment decision (with appropriate phasing)

Sufficient Appraisal and Technical Understanding Prior to Assigning Reserves

If parts of a sanctioned development possess inherent appraisal risk, then it is arguable the project has proceeded without due consideration and recognition of risk and uncertainty

PRMS 2018: Technical maturity is the "first" Commerciality requirement

- So if part of the development is, for example, of an area that is potentially contingent upon successful appraisal or well construction trials, then that part of development arguably should be CRs or potentially even PRs based on well control.

2.1.2 Determination of Commerciality

2.1.2.1 Discovered recoverable quantities (Contingent Resources) may be considered commercially mature, and thus attain Reserves classification, if the entity claiming commerciality has demonstrated a firm intention to proceed with development. This means the entity has satisfied the internal decision criteria (typically rate of return at or above the weighted average cost-of-capital or the hurdle rate). Commerciality is achieved with the entity's commitment to the project and all of the following criteria:

A. Evidence of a technically mature, feasible development plan.

CSG and Elsewhere

- Some parts of the CSG development and elsewhere have been implicitly been contingent on successful appraisal and/or well construction trials, so arguably could have been classed as CRs Development Pending (or lower CR sub-class) until that part of development was "technically mature"
- This may have avoided the situation of booking Contingent Resources as Reserves

Use of Analogues

Analogues in the full context, reservoir and the recovery process

PRMS 2018: Requirements for “analogy” have been expanded:

- Notably elements of the “Development Plan” in addition to the geological and reservoir characteristics must be considered.

> F. Development plan (e.g., well spacing, well type and number, completion methods, artificial lift, development and operating costs, facility type and constraints, and processing).

CSG and elsewhere:

- Some parts of the CSG development and elsewhere had developments that may not have been analogous to North American experience in particular for reserves
- Perhaps there was insufficient allowance for the differences; development and operating costs, experience, plus geological and reservoir characteristics.

Key Takeaways from Scene-3

2018 PRMS update does addresses the bulk of the historical challenges we have seen in CSG

Still a work in progress in potentially applying the 2018 PRMS Deterministic Incremental Method to CSG

Updated section on unconventionals recognises well control extrapolation and sampling density issues

PRMS provides for assigning of Contingent Resources where appraisal risk is judged material

Mega CSG project challenging in terms of PRMS project definition

Is PRMS 2018 Deterministic Incremental Method applicable to CSG or is the Deterministic Scenario Method better suited?

- In the upcoming SPE ATW on Reserves and Resources Estimation in July 2019 in Perth, we will talk more on this in depth…..

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