How good are we in estimating CSG Reserves?

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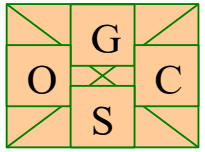

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Disclaimer

- Because of the “uncertainty principle” [Heinenberg]. It is impossible for the audience to know at the same time both precisely the Reserve and Deliverability of a CSG Field.

- There is a small but nonzero chance that through a process known as “tunnelling” [Cosmology] CSG Reserves may spontaneously disappear from its present location and reappear at any random place in the universe, for example your neighbour’s lease.

- Taking any investment advice from this presentation will increase the amount of disorder in the Universe. Although no liability is implied within, the audience is warned that this process will ultimately lead to the Heat Death of the Universe.

http://www.netfunny.com/rhf/jokes/91q1/prodwarn.html

- Overview of TECHBITs article April 2004 JPT
- PRMS: Investors viewpoint
- Confidence Index for2P Reserves: Trends in the past ten years of reserves reporting CSG QLD

Data Source

- Qld DME website: Last ten years of 2P reserves.
- QDEX: ASX announcements
- SEC K10 etc

Summary of the TECHBITS Article

This small survey gives insight into how the industry is managing unconventional resource estimation. How we react to these challenges will determine the long-term reputation and credibility of the SPE-PRMS.

Thanks Greg Horton, Dan Diluzio and Rawdon Seager for their guidance. I would also like to thank Barbara Pribyl [Santos] for her comments.

PRMS Reserve estimates presented by public companies are believable.

Sample	Agree	Neutral	Disagree
37	32%	57%	11%

PRMS Contingent Resource estimates presented by public companies are believable.

Sample	Agree	Neutral	Disagree
37	19%	57%	24%

PRMS Prospective Resource estimates presented by public companies are believable.

Sample	Agree	Neutral	Disagree
37	16%	46%	38%

Summary of the TECHBITS Article

This small survey gives insight into how the industry is managing unconventional resource estimation. How we react to these challenges will determine the long-term reputation and credibility of the SPE-PRMS.

This demonstrates that there is a concern that interpretation of the PRMS differs between Reserve Estimators.

Test of repeatability

It is expected that different reserve estimators estimating reserves for a conventional reservoir would have similar results (e.g., +/−10%).

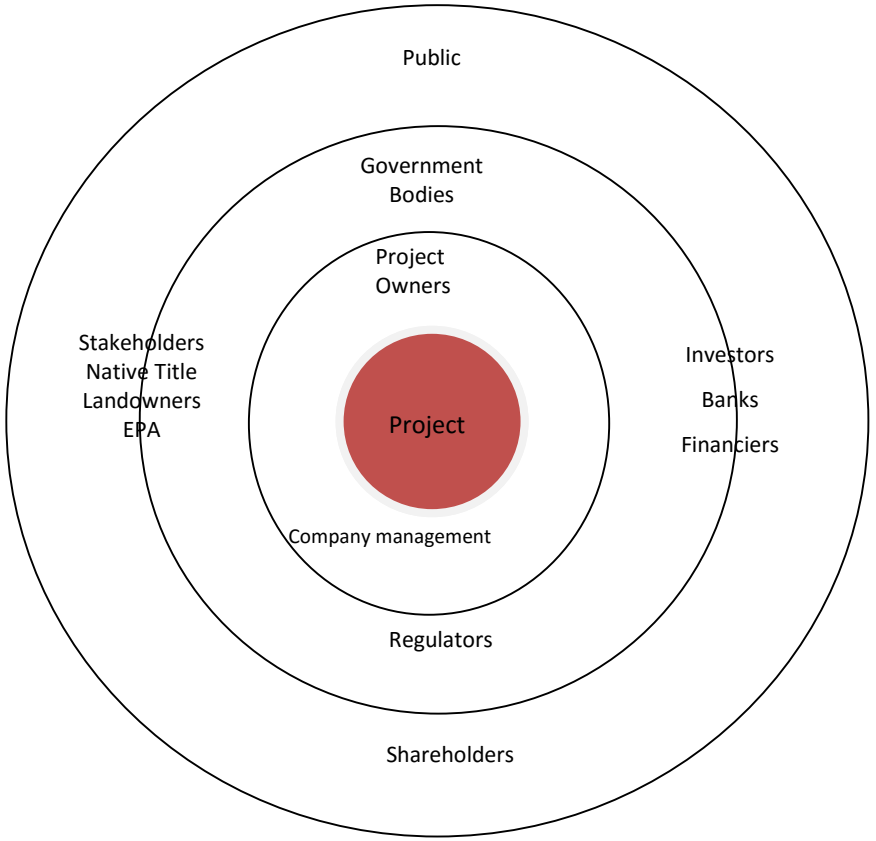
Sample	Agree	Neutral	Disagree
37	70%	19%	11%

It is expected that different reserve estimators estimating reserves for an unconventional reservoir would have similar results (e.g., +/−10%).

Sample	Agree	Neutral	Disagree
37	35%	32.5%	32.5%

Petroleum Resource Management System

- What is PRMS?
  - Standard or a guideline?
  - Regulatory Framework not included!!
    - Comparing reserves from one company to another would require a regulator framework.



- Who is the PRMS' audience?
  - Project management [Company level]
  - NOT the Investor

[SEC regulatory Framework is designed to overcome this issue]

What is 2P reserves?

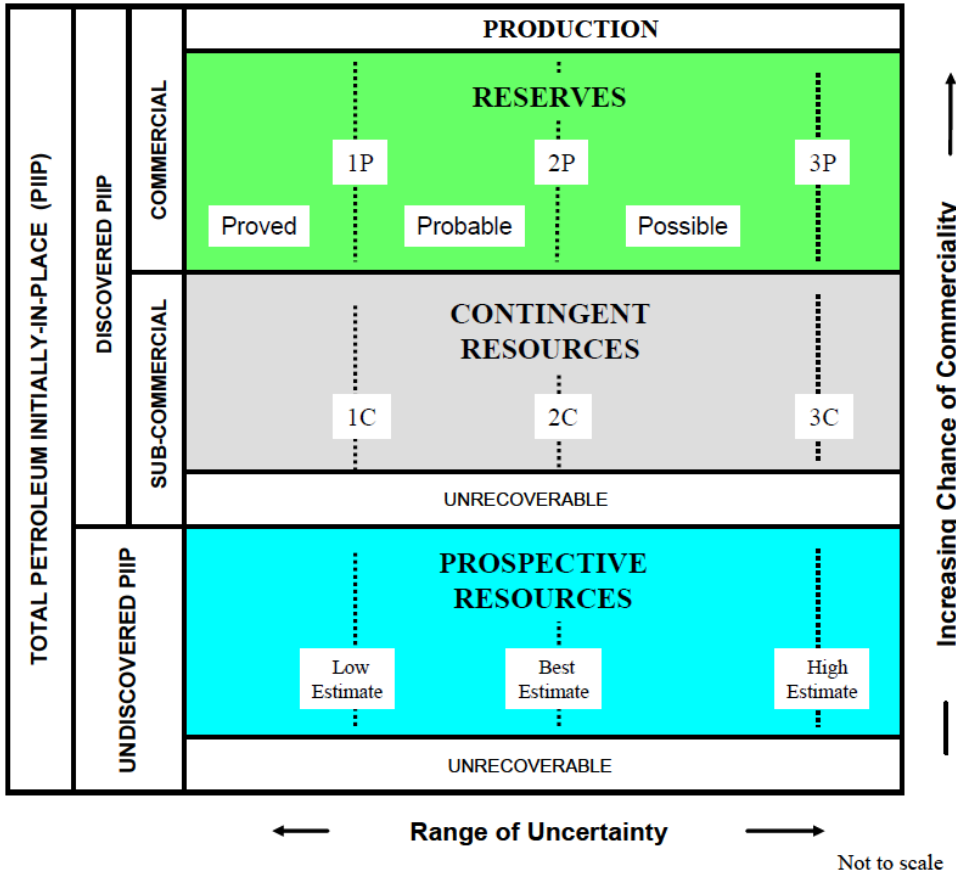


Figure 1-1: Resources Classification Framework.

Compliance issues

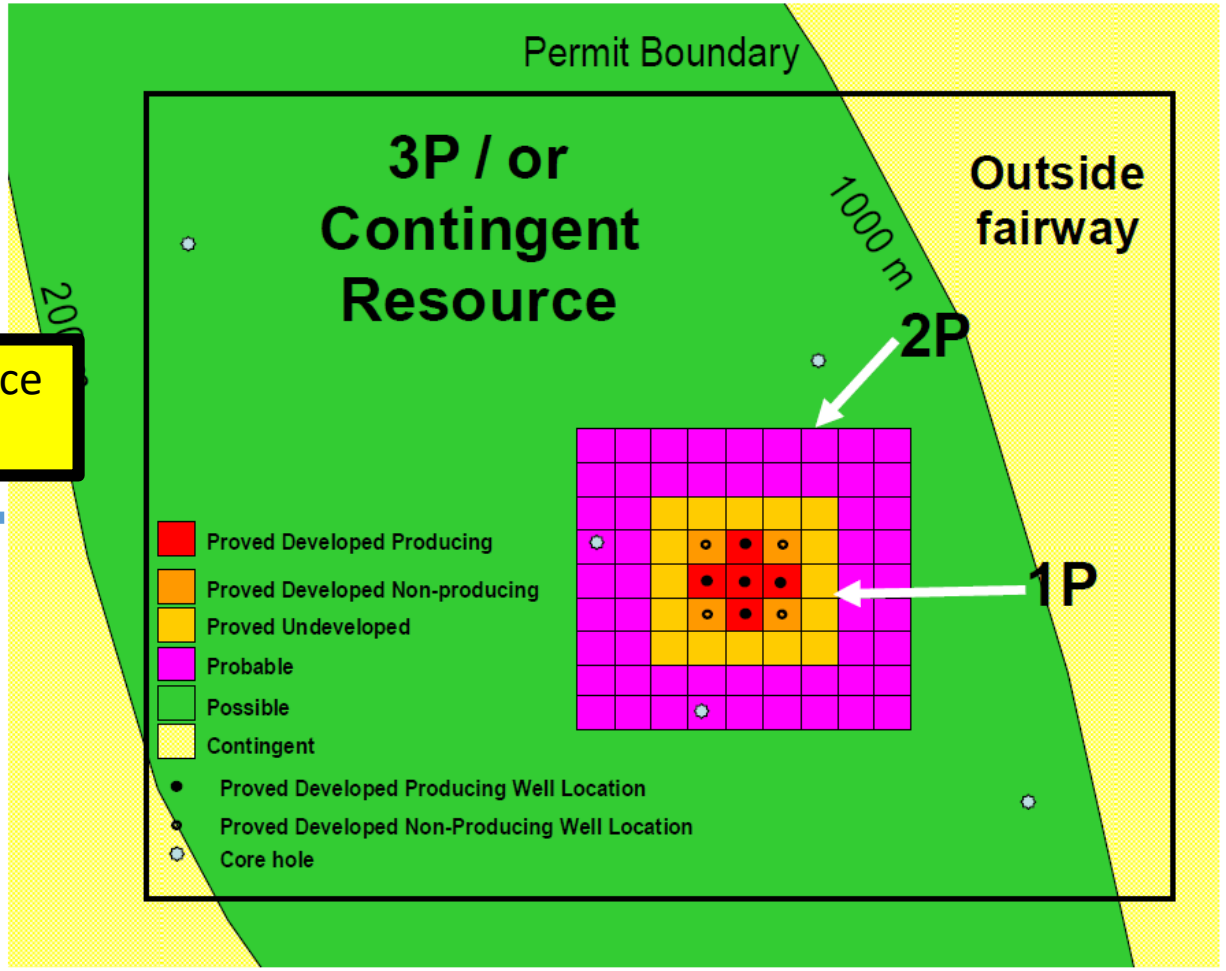


Fig. 8.3—Conceptual 1P 2P and 3P Areas used in the CBM Industry (Barker 2008).

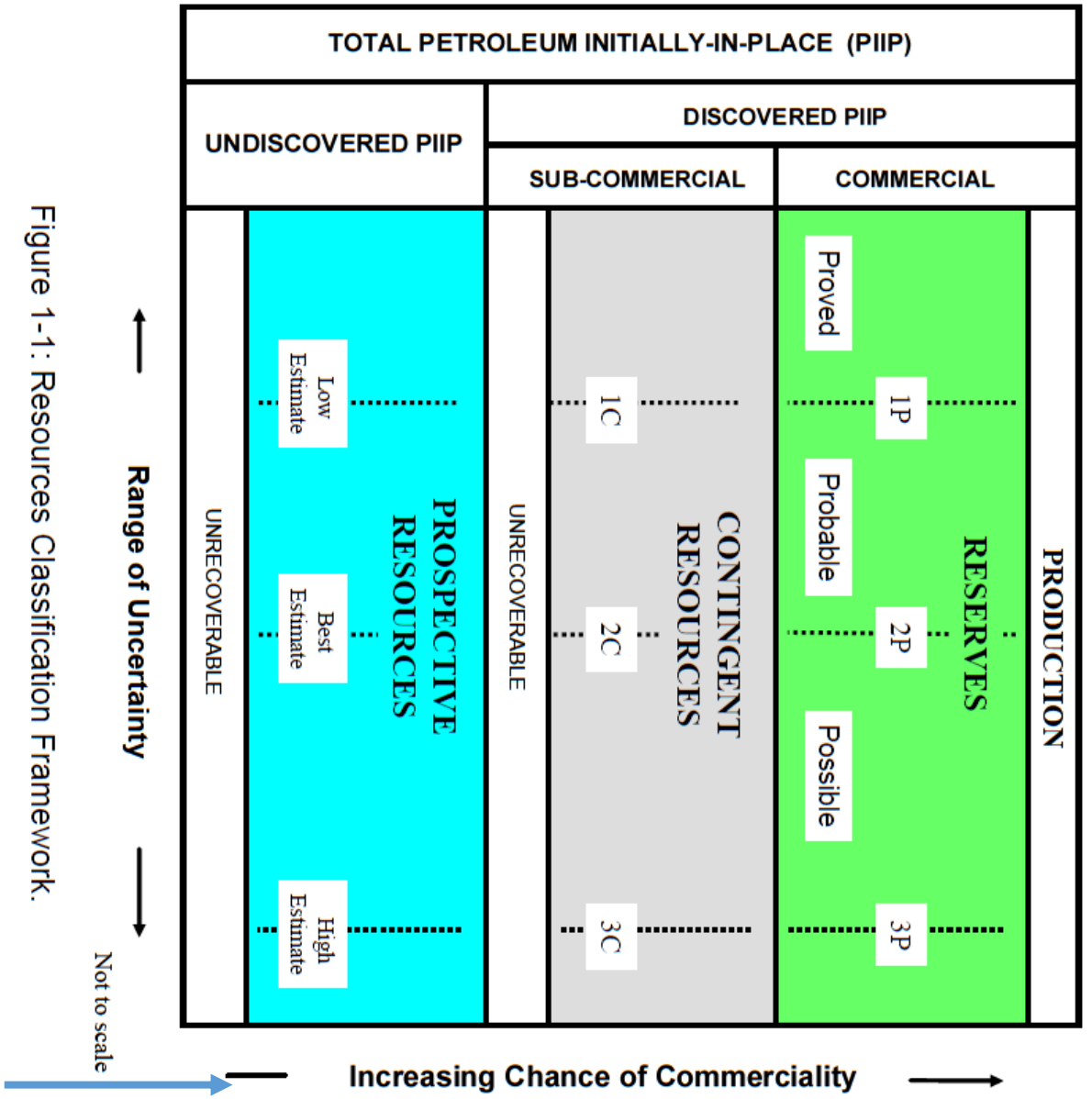
- Investors see
  - 1P as money in the bank.
  - 2P this is what they expect.
  - 3P reward

2P Best estimate corresponding to the Chance of Commerciality

2P is the only available reserve estimate for all PL's, that is, open data

What is 2P reserves?

- Chance of commerciality is the time line.
- At each point in time the reserve estimate [NOT MEASUREMENT] has a “Range of uncertainty.
- 2P = “Best Estimate” At any point in time we have a best estimate with a range of uncertainty.
- This is where the grid system has some compliance issues.



Time line on X-Axis

2P is the only available reserve estimate for all PL’s, that is, open data

What is 2P Reserves

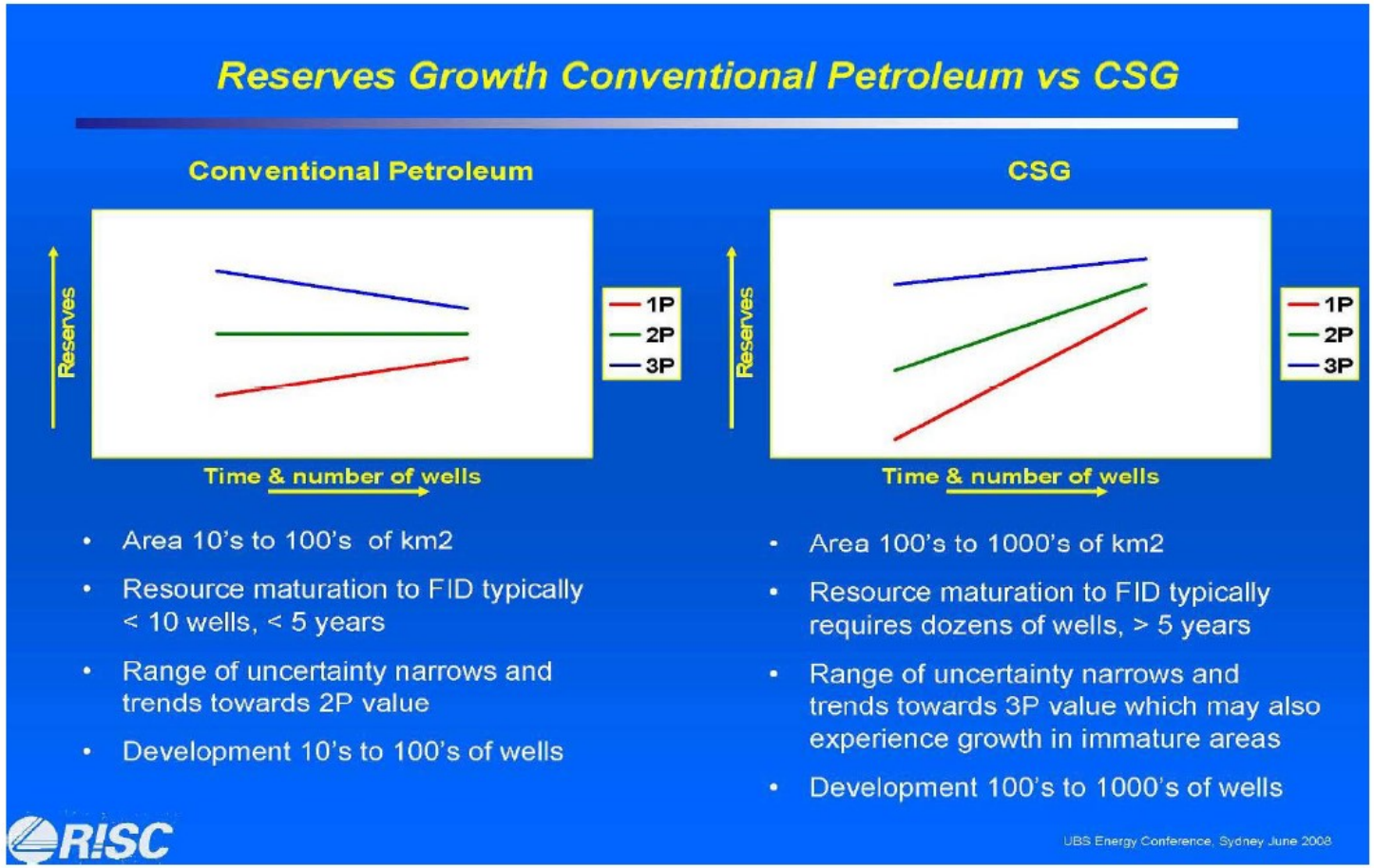
- 2P = Proved + Probable
  - 2 Methods [No requirement to equate]
    - Probabilistic
    - Deterministic
- The PRMS permits 2P = Proved + Probable for both methods.
- SEC does not permit reporting 2P if the Deterministic method is used.
- PRMS
  - Grid method amplifies the problem
  - Note the Grid method does fit well with the PRMS [Some areas of poor-compliance is accepted in the PRMS]

- 2P = Developed and undeveloped
- Undeveloped < 5 years
  - condition is not mandatory [PRMS]
- Undeveloped reserves require capital expenditure.
  - Again we add Developed & undeveloped reserves – if not disclosed 2P is not transparent to the investor.
- Difference between developed and undeveloped in economic terms
  - Rule of Thumb [Valuation]
    - Developed reserves = 20% of gas price
    - Undeveloped reserves = 10% of gas price

How does the PRMS Treat Unconventional Reserves?

Industry Experience: Maturation of 3P into 2P

- The CSG industry is characterised by rapid reserves growth at this stage in the development cycle



Source: RISC Presentation to UBS Conference 19 June 2008

Slide from APLNG 2010 APOGCE presentation showing RISC slide presented at the UBS Conference June 2008. [Note Reserves in this case I believe is EUR]

This pictorial presentation of EUR is a common within the industry.

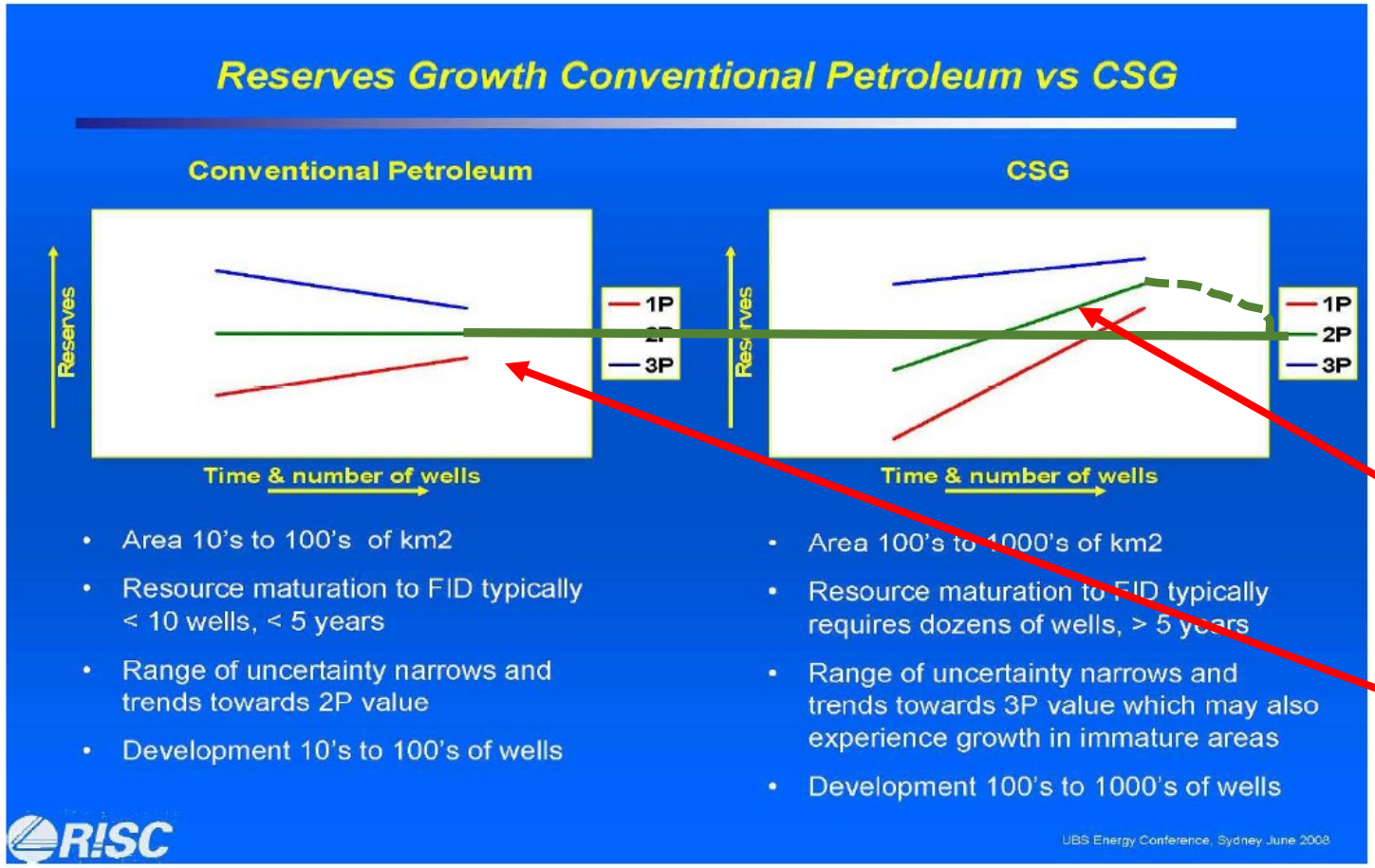
This implies:
2P conventional ≠ 2P Unconventional
This may be correct in reality but it is wrong regarding the PRMS concept.

Otherwise how can an investor understand a company's reserves base?

Opinion: This is what I suspect happens

Industry Experience: Maturation of 3P into 2P

- The CSG industry is characterised by rapid reserves growth at this stage in the development cycle



Source: RISC Presentation to UBS Conference 19 June 2008

So eventually
2P conventional = 2P Unconventional

The grid system lends itself to overshoot reserves relying on production for correction

The PRMS is still [struggling] how to manage unconventional reserves.

Unstable reserves system attracts speculators

Having a stable "reserves" system" attracts long-term investors

The rest is through the eyes of investors

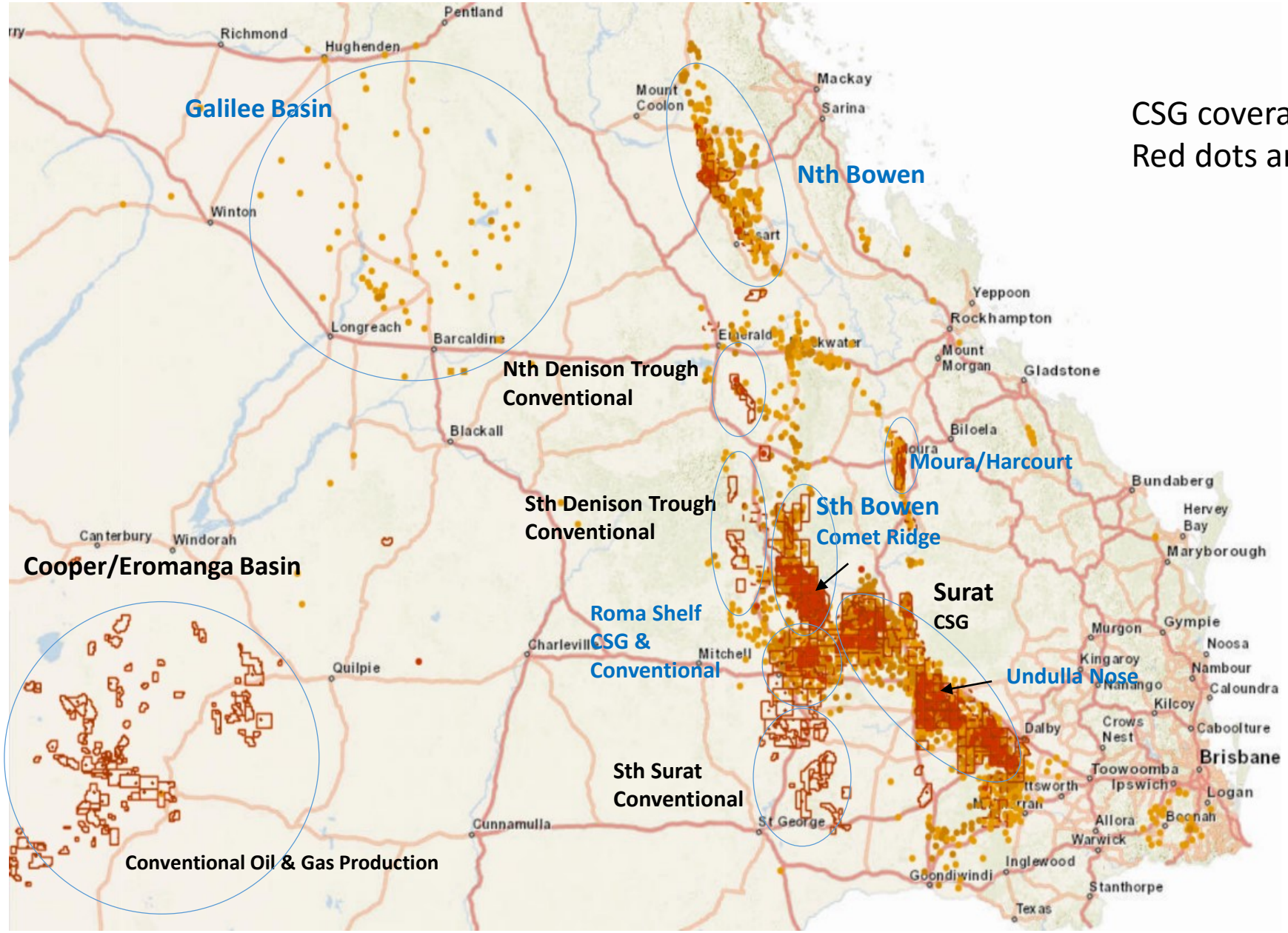
- Investors are confidence driven
  - Invest in a NSW CSG?????
  - NT?

Things I know

- 2P reserves ten years to Dec 15
- 6 monthly production to Dec 15
- No. of wells drilled
- No. of wells on-line

Things I don’t know

- Undeveloped Reserves
- Field not choked back
  - Do not find any obvious fields that has been choked backed.



CSG coverage
Red dots are CSG wells

Overview 96 CSG areas investigated

Production life	>0	=> 10years	=> 5years
No. of CSG areas	96	14	24

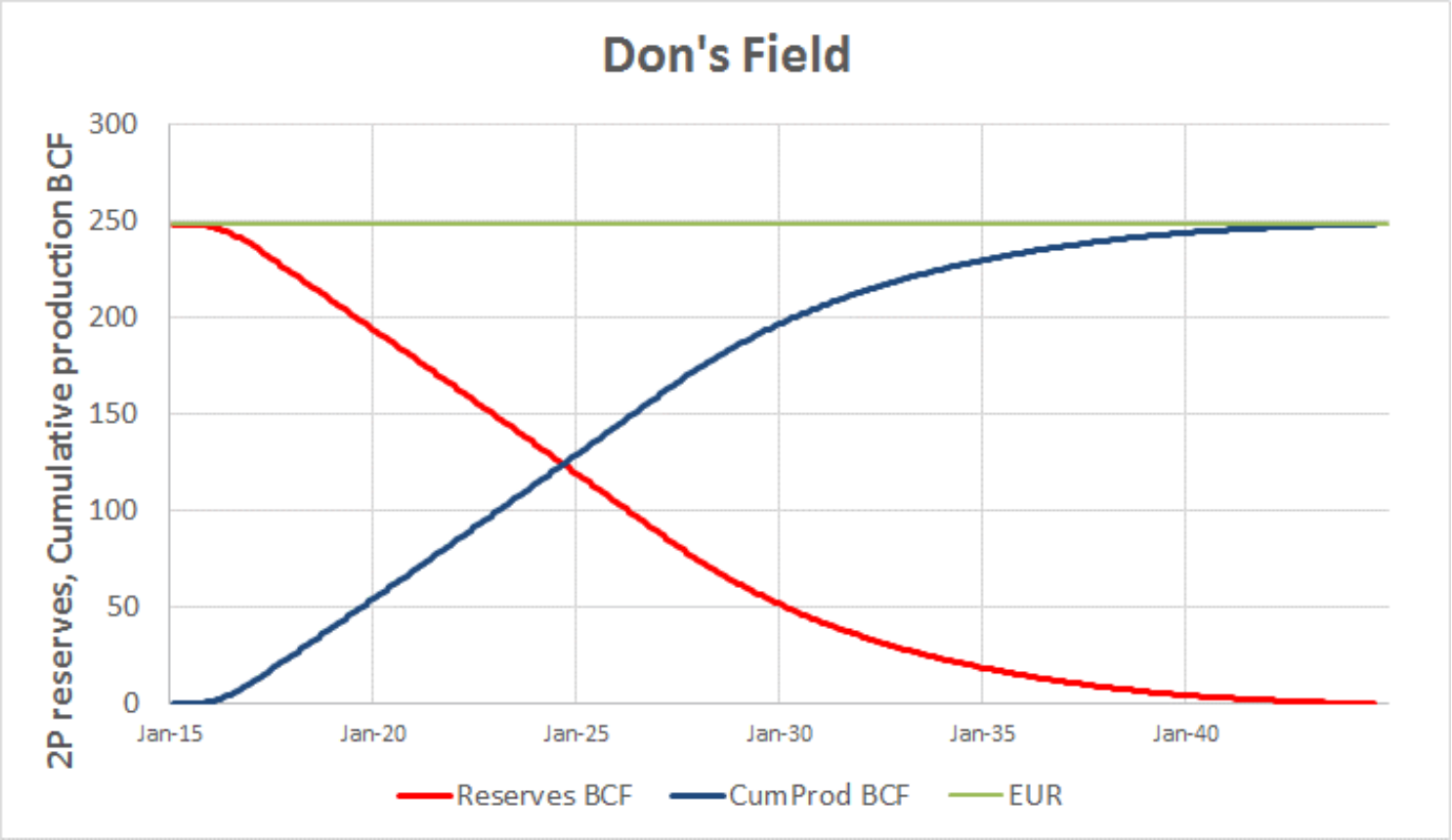
72 PLs have less than 5 years production and were not included in confidence calculations

Undeveloped Reserves [PLs without production]	
No. of leases with undeveloped reserves only	26
No. of leases with undeveloped reserves for over 5 years	5

Total EUR 2P	32.3	TCF	Estimate – some areas CumProd unavailable
Total 2P	29.7	TCF	As of 31 December 2015
Total Rate	2.1	BCF/day	Average of 6Mths to Dec15
~~3 LNG Plants~~	~~28.8~~	~~TCF~~	~~Reserves over 20 year period~~

The Ideal CSG Project and Reserve Estimate

- 100 well locations
- 2.5 BCF/well
  - Peak 1MMscfd
  - Harmonic decline
- Reserves of 250 BCF

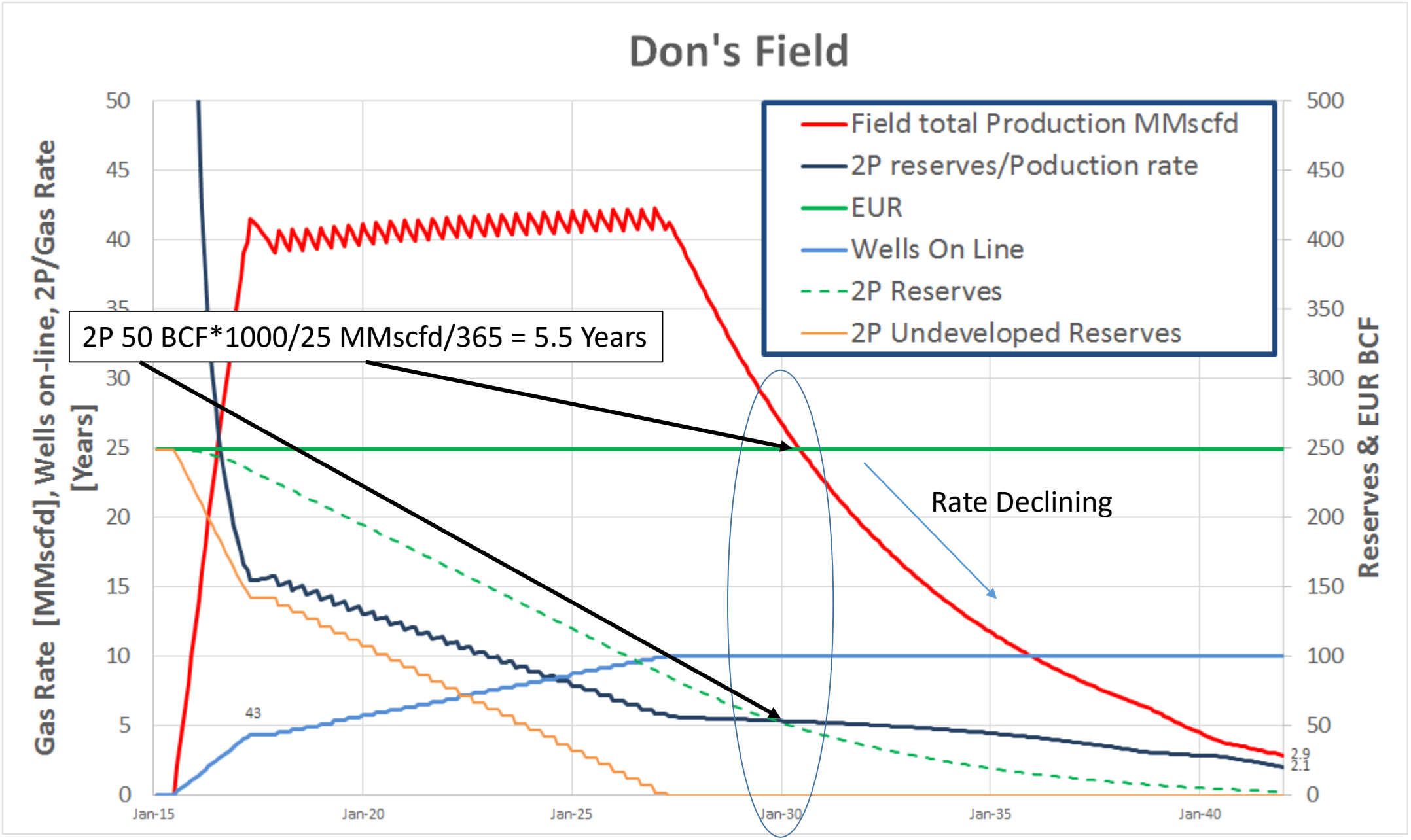


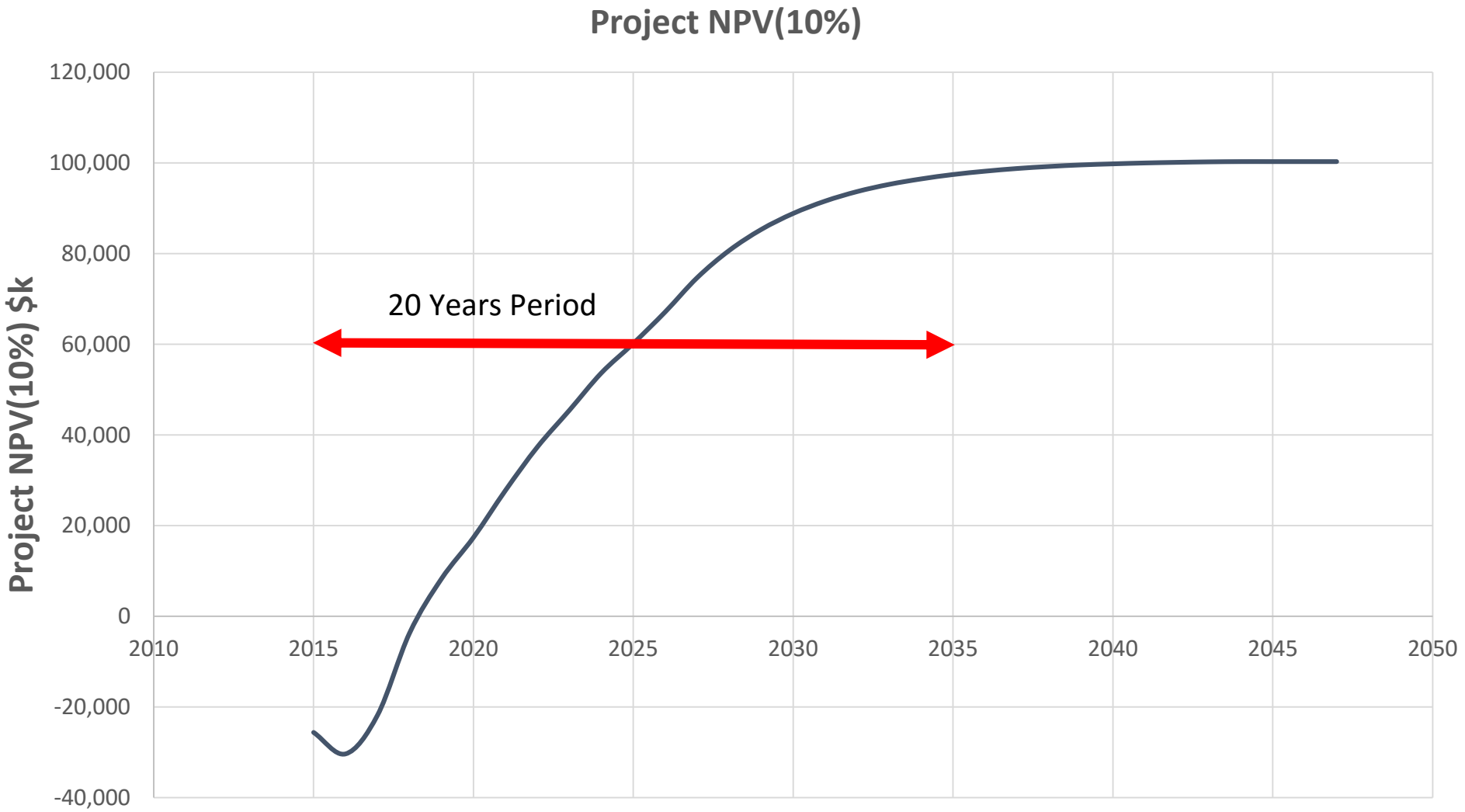
EUR

Estimated Ultimate Recovery = Reserves + Cumulative production

Confidence Metric

- As a “Metric” 5.5 years of 2P reserves at current rate has a high probability of completion.
- Greater than 20 years confidence in the 2P numbers start to decrease.
- Metric only valid for mature producers.



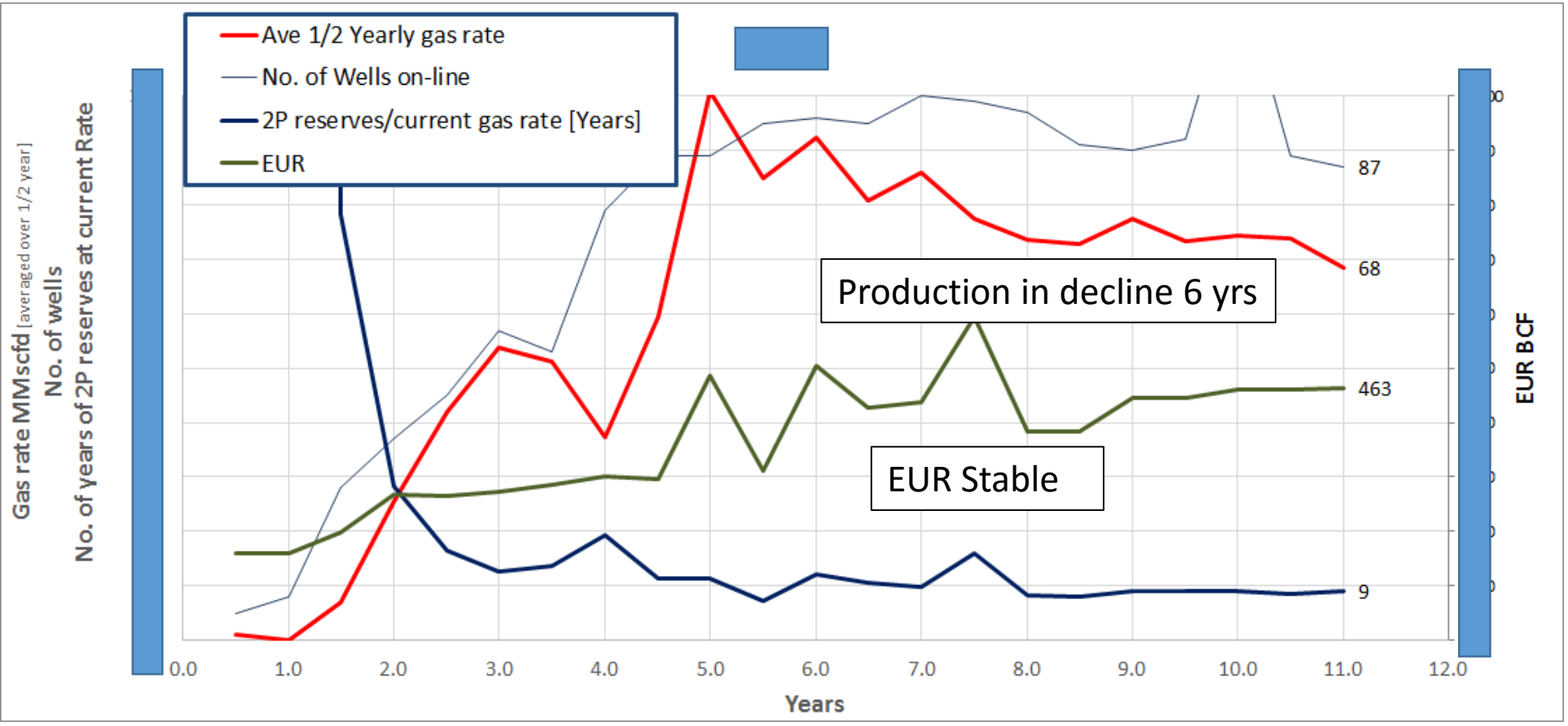


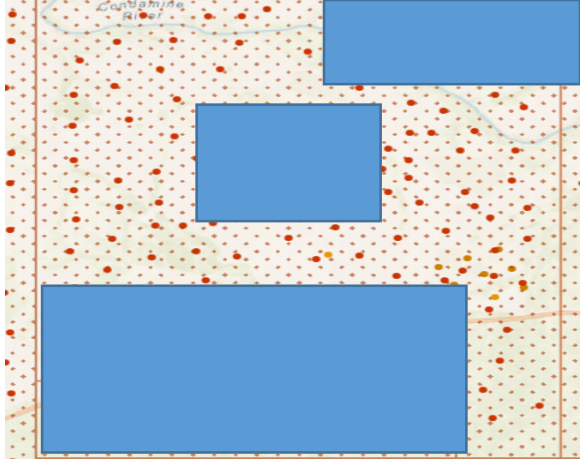
Investor outlook is 10 – 20 Years

20 Years correspond to 2P = Best Estimate

- Review of 96 CSG Production areas
  - By Lease
  - 2 combined leases -> EUR calculation
  - PL’s with separate formations are treated by formation.
- Analysis was performed on the following PL’s:
  - 5 Years Plus production

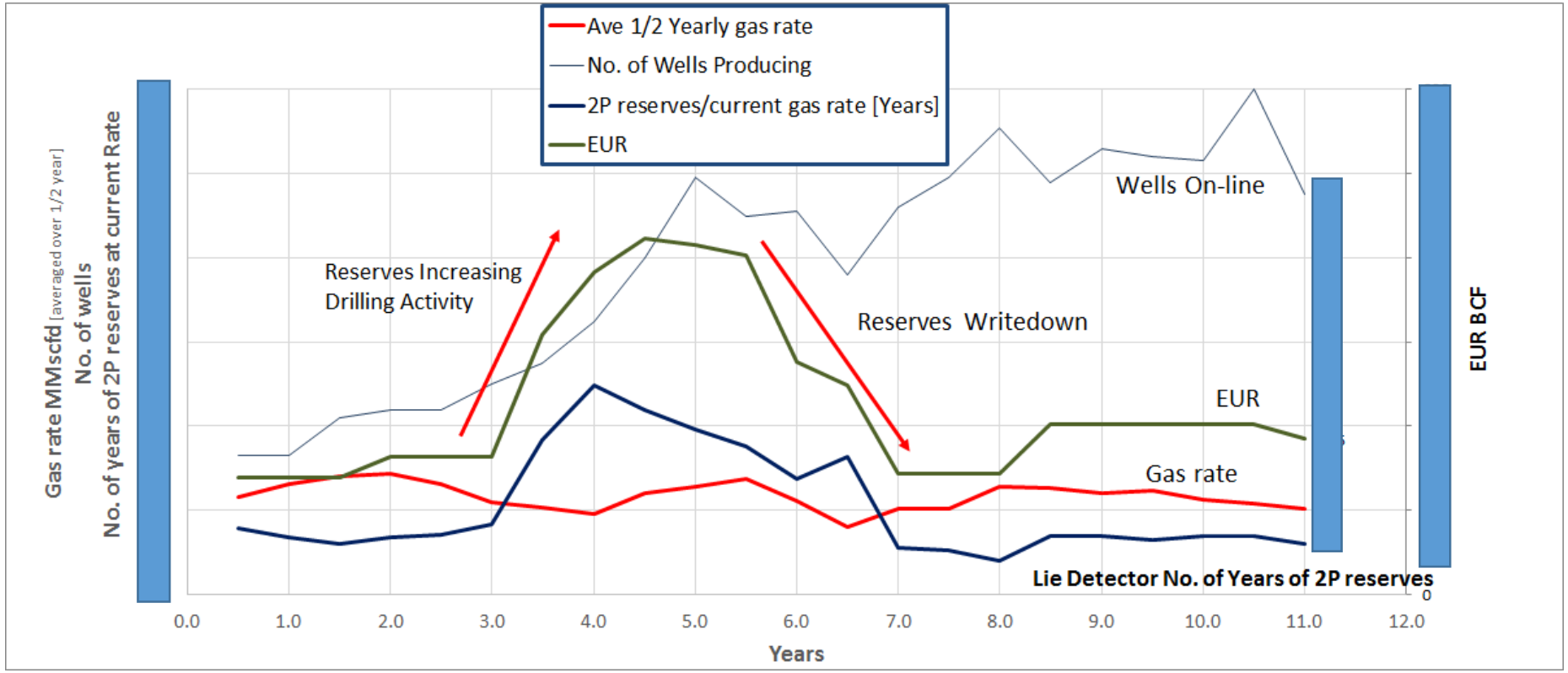
Example 1





- Assume Developed >> Undeveloped
- Production ~10 years
  - & In decline
  - No of online wells stable
  - EUR creeping up [Performance based]
  - Years of 2P <10 years
- Confidence in reserve estimate = High

Example 2

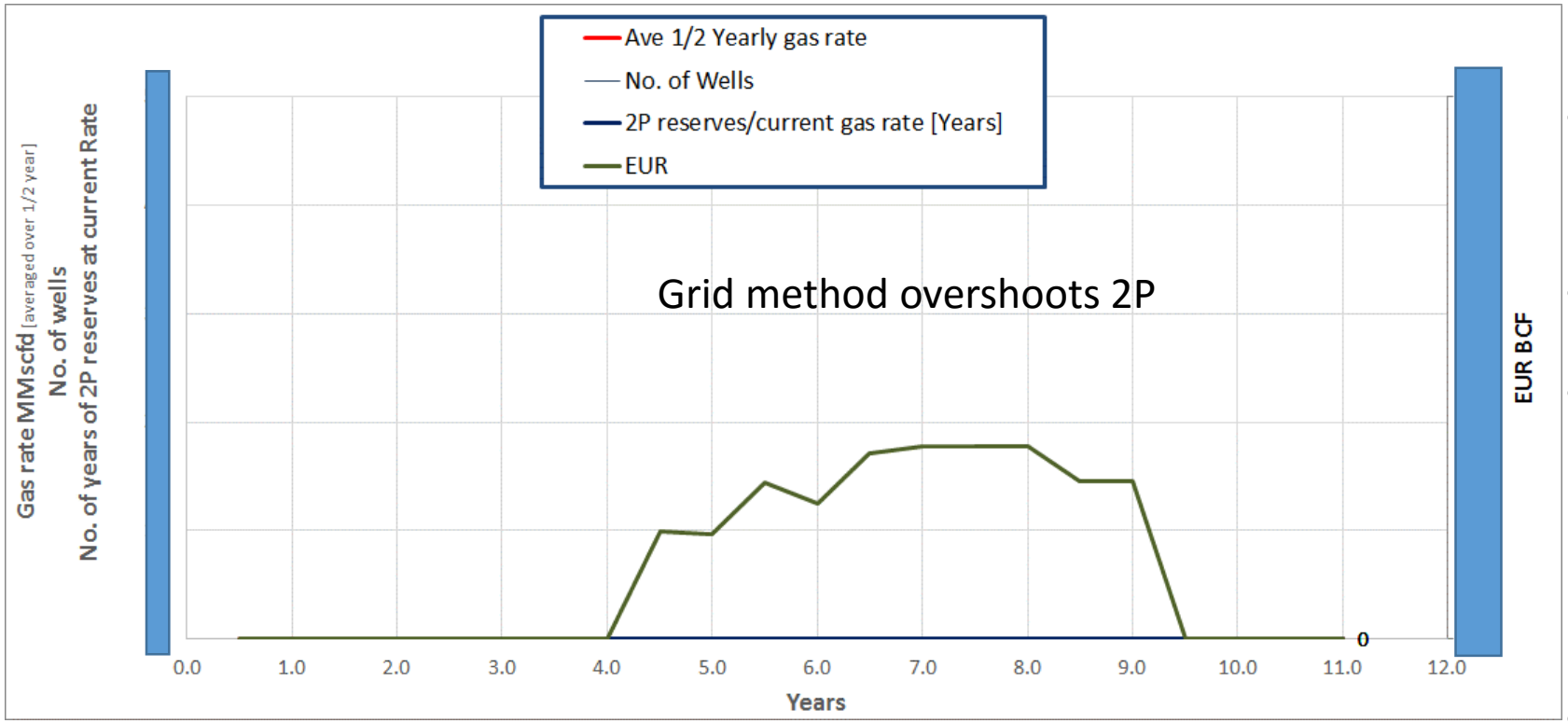


- Assume Developed >> Undeveloped
- Production ~10 years
  - Stable
  - No of online wells stable
  - EUR Stable
  - Years of 2P ~12 years
- Confidence in reserve estimate = High
- Operator prepared to reduce reserves when thing do not work out.
- Big Tick to operator.

EUR or 2P reserves increase – backed up by drilling. [Online wells grew from 2-Fold]
Production rate remains flat implying drilling programme may not have developed promised reserves.
Operator adjusted 2P reserves to reflect drilling outcome.

Confidence in operator = High

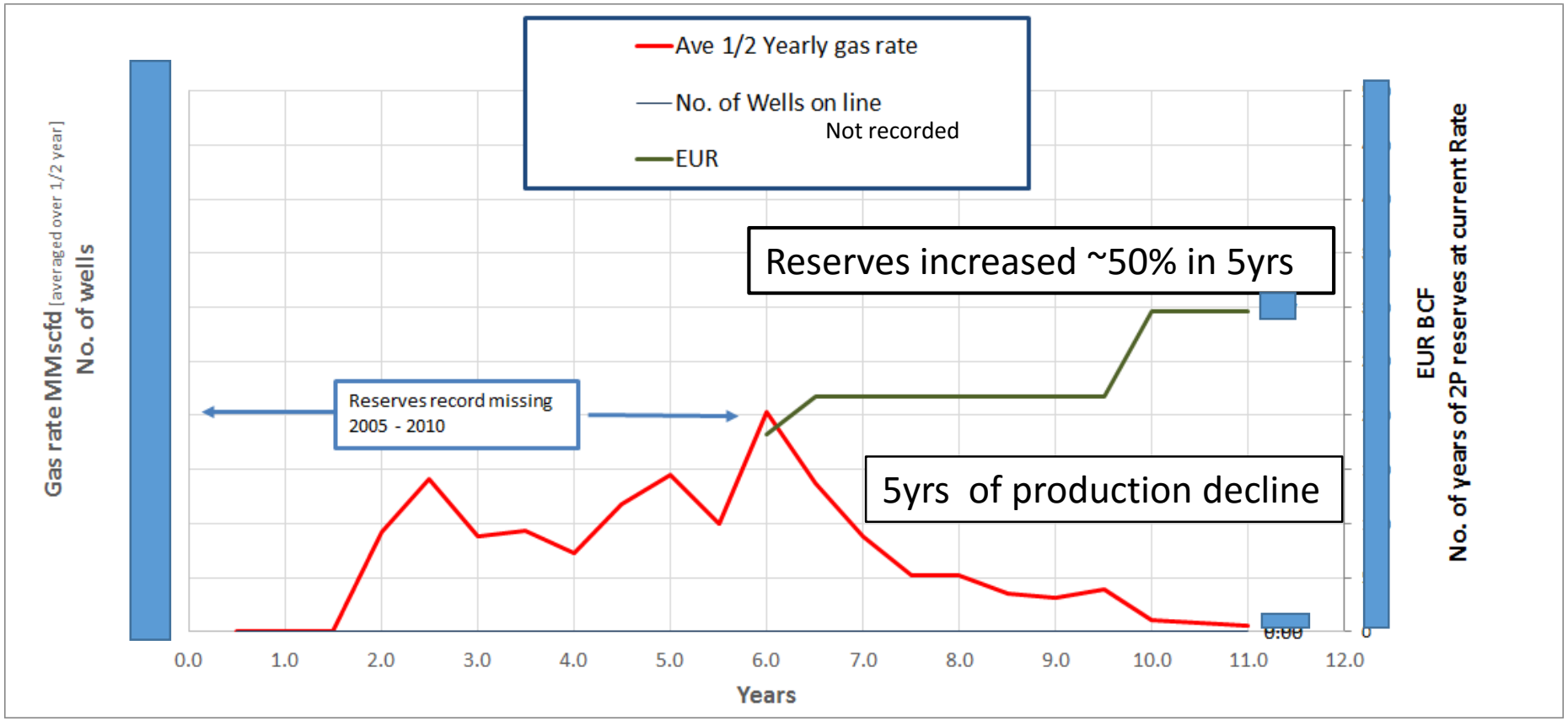
Example 3



- Undeveloped reserves
  - 5 year rule
- Drilled a number of wells obviously poor result
- 2P Reserves removed
- Can argue 2P reserves should not of been booked in the first place but……
- Prepared to correct.

Big Tick to the operator

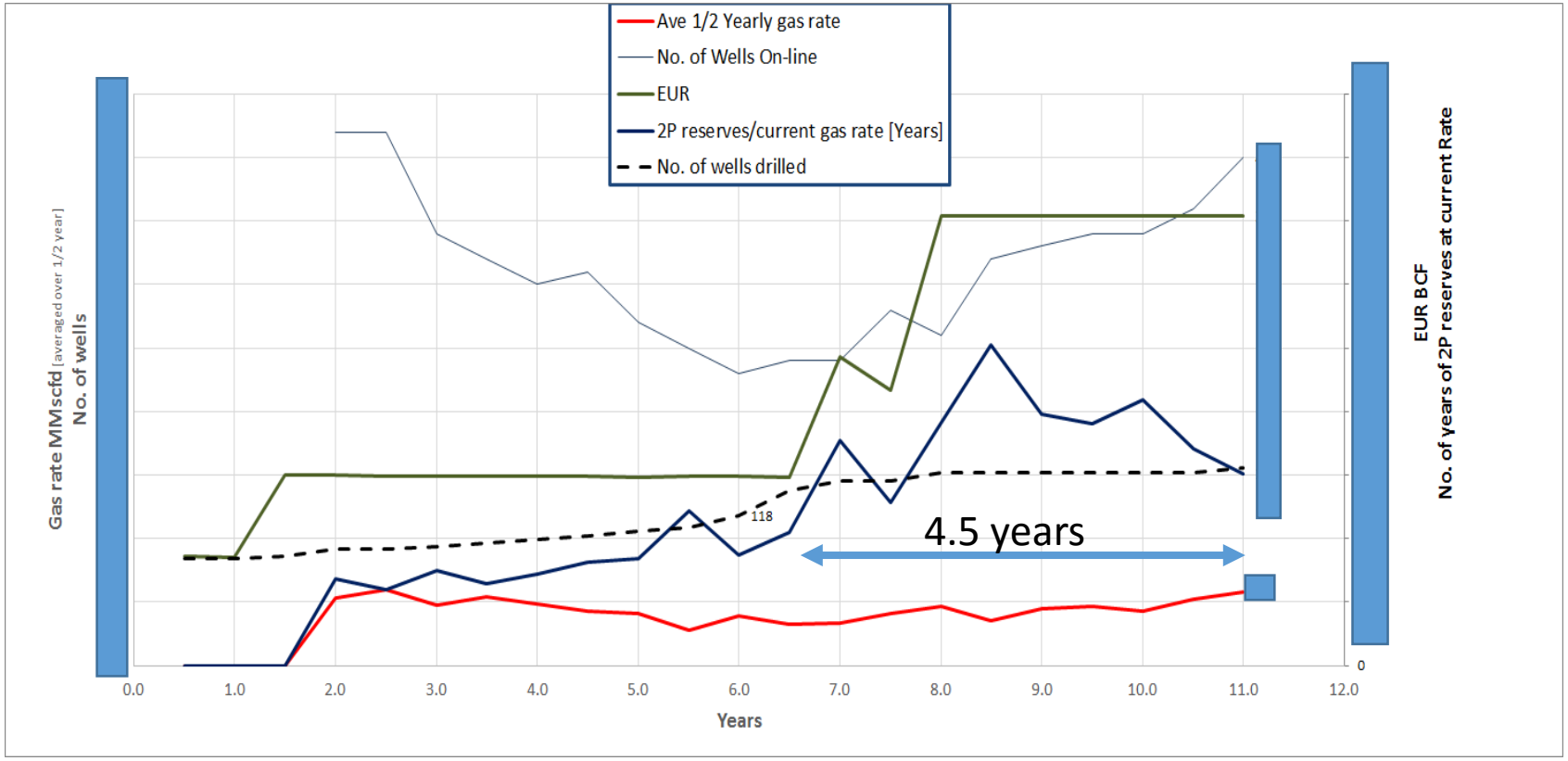
Example 4



- Reserves are increasing as Production is decreasing.
- No. of years of 2P reserves is off the scale

As an outsider looking in transparency is needed to understand what is happening.
Investor must assume the worse.
Reserve Estimation confidence is LOW

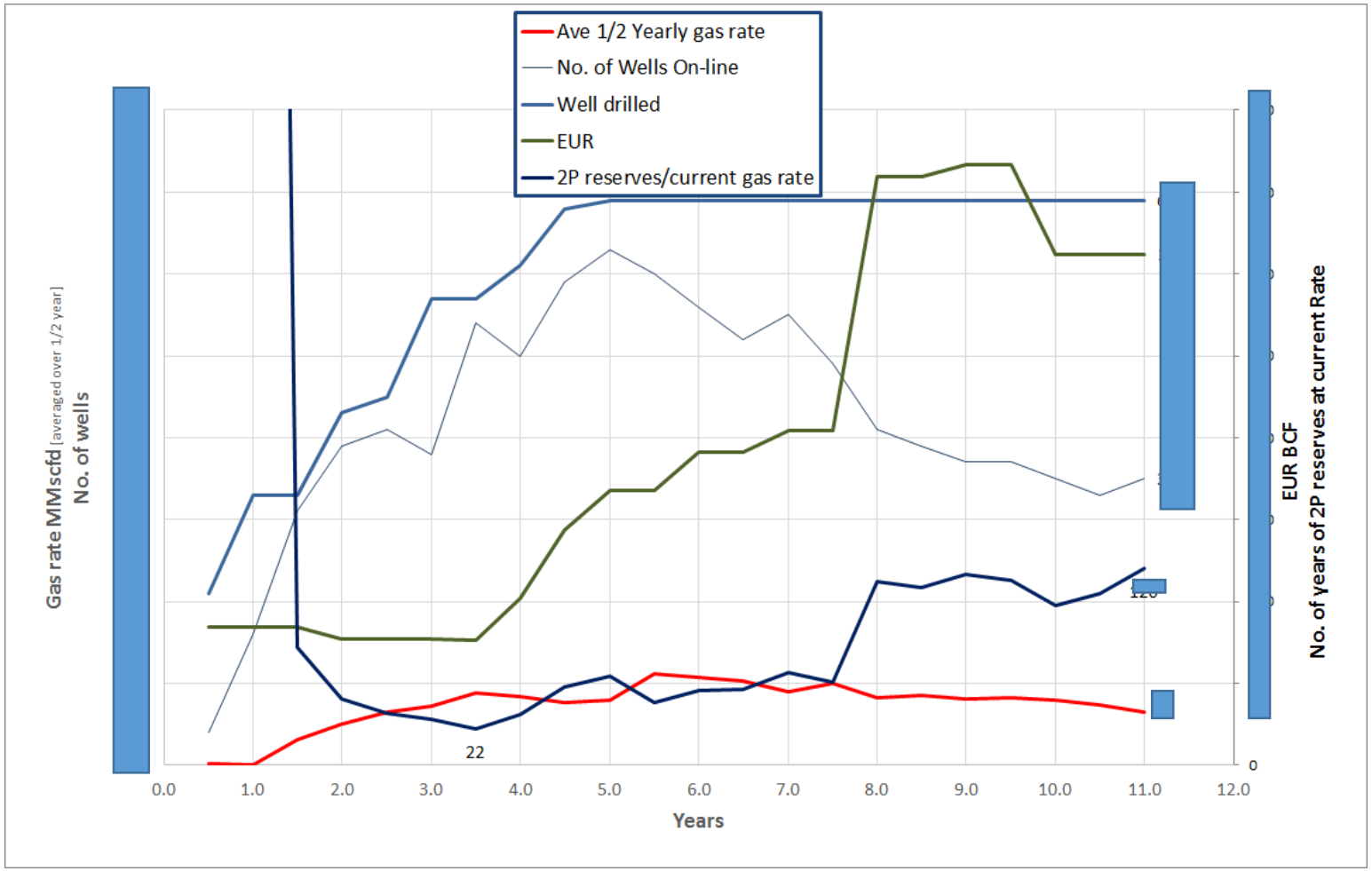
Example 5



- Last 4 years EUR reserves have doubled
- Online wells 40% increase corresponding to small increase in production rate
- Undeveloped Reserves -> 5 years
- 2P/Rate is always above 20 years increasing to 150 years

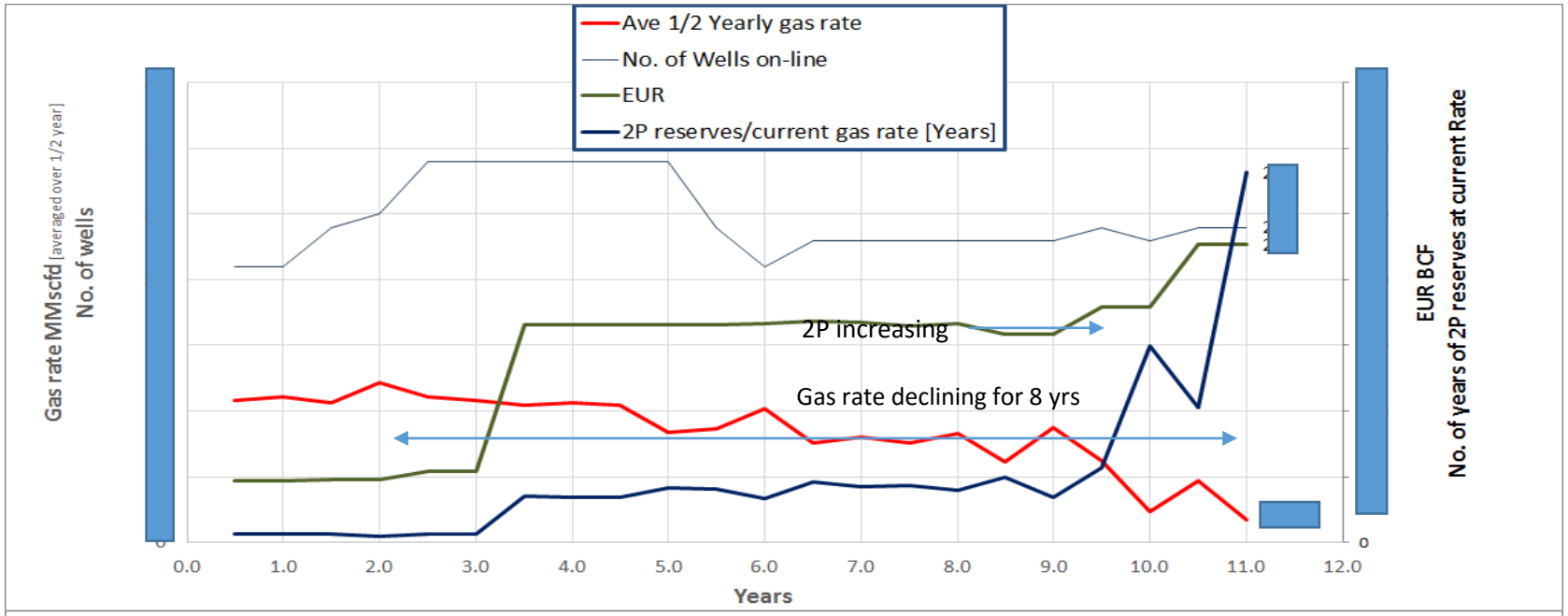
Field production rate is basically flat.
The drilling of new wells do not reflect rate of growth in reserves
Reserve Estimation = Low Confidence.

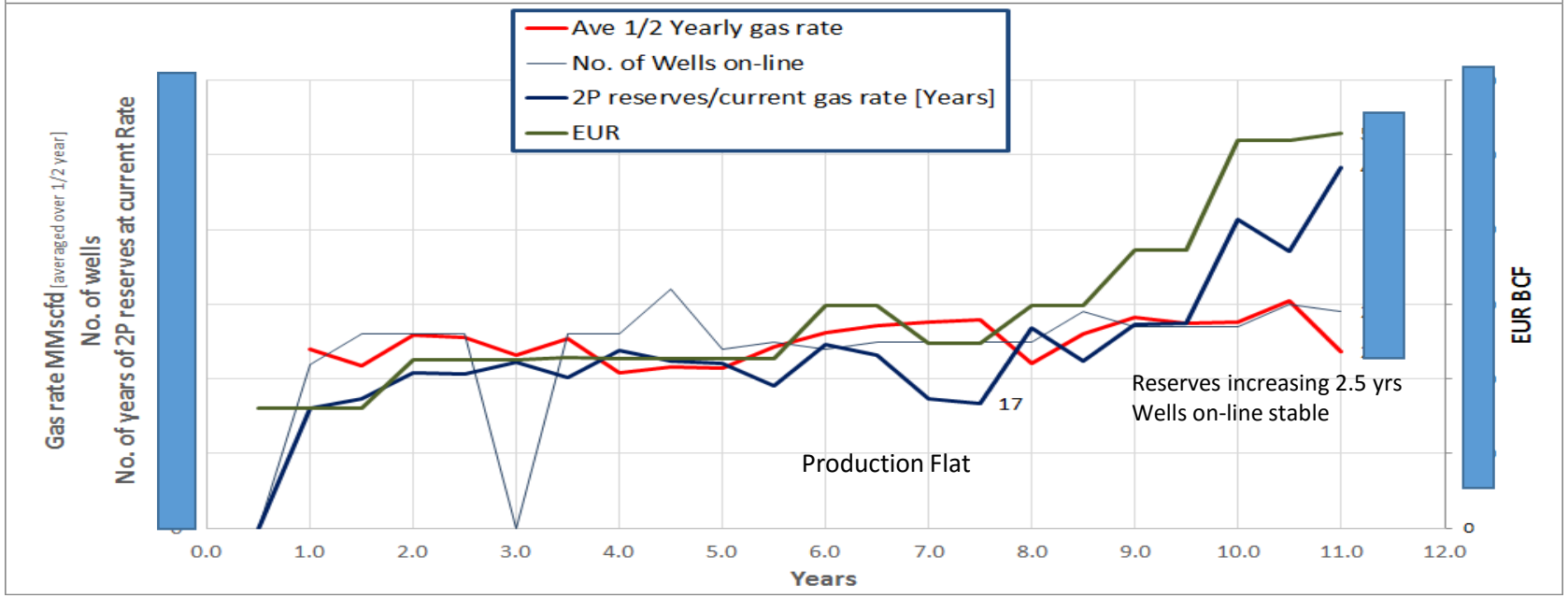
Example 6



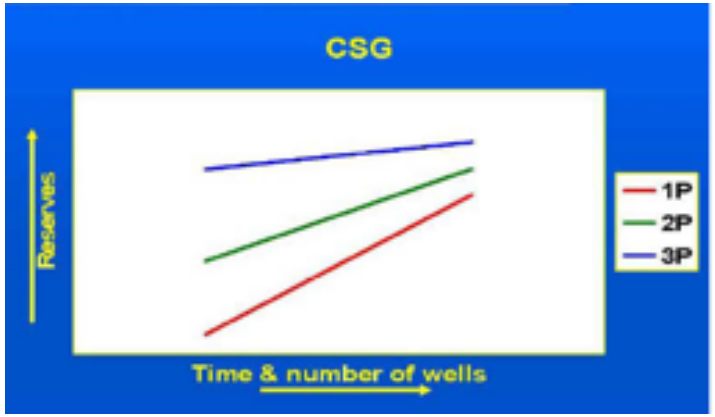
- Five years of production decline corresponds with 3-fold increase in reserves
- On-line wells declining
- No new wells drilled in the last 6 years
- Confidence low

Example 7 PL's side by side different operators

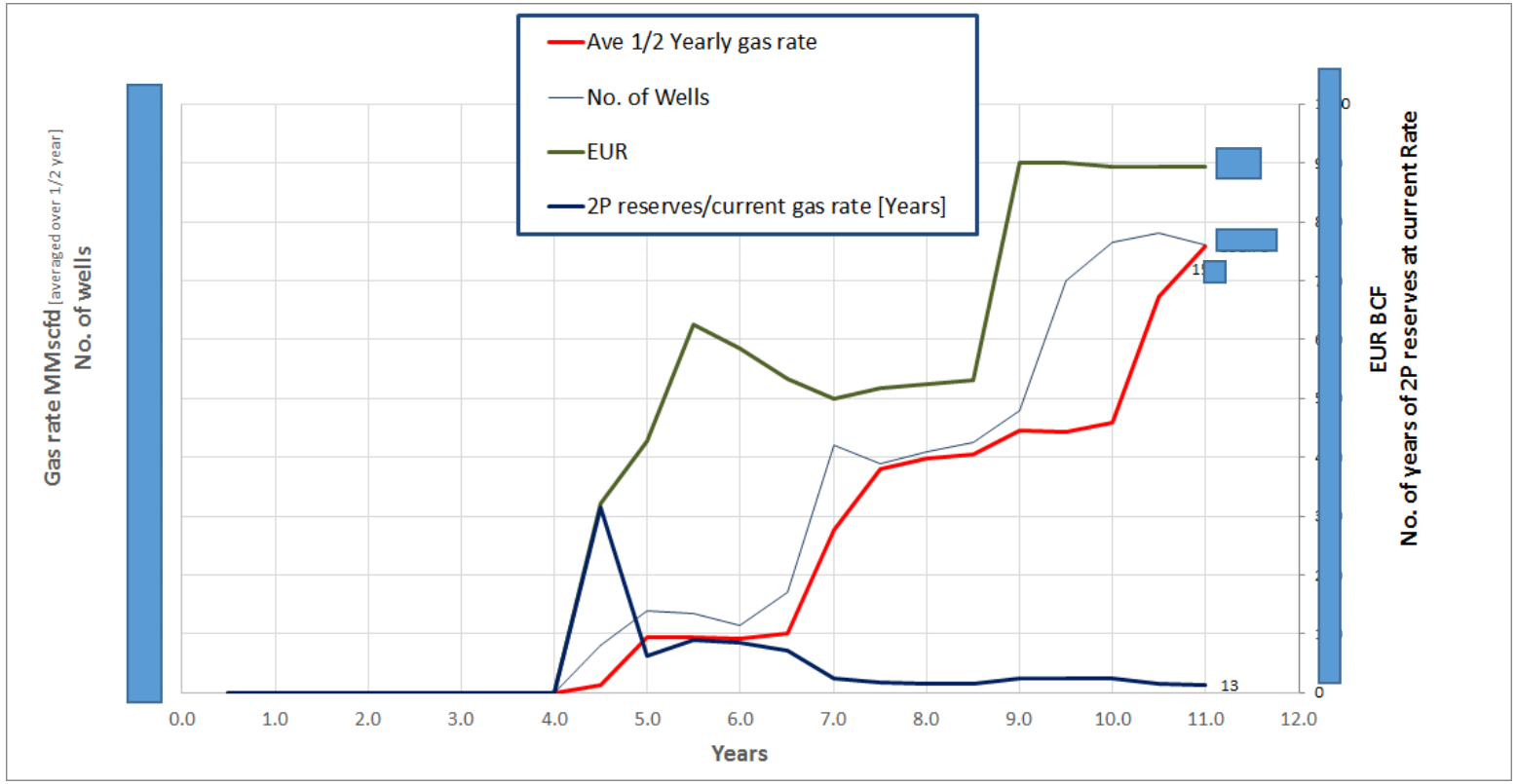




- Both been on production ~ 10 years
- In the last 2.5 years large growth in 2P reserves – Most likely undeveloped.
  - Why now the increase?
  - Transparency is required to understand what is happening.
- Confidence Mid to low



Example 8: +5years on production

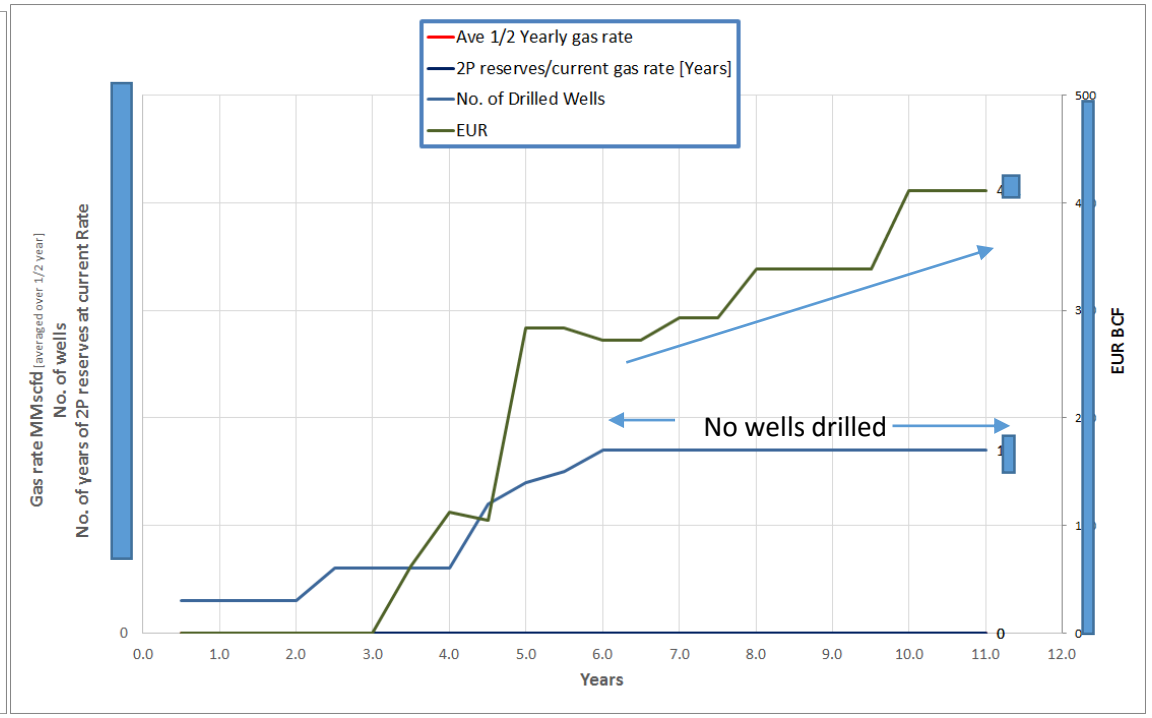


- Less than 5 years it can difficult to analyse.
- This case 6 years production & looks fully drilled.
  - Neg. Undev Res
- Gas increasing
- EUR & On-line wells stable.
- 2P/Rate is < 20 years
- High Confidence

Example 9 Undeveloped reserves

Not part of the confidence index

26 Areas of undeveloped reserves
5 have exceeded 5 years.



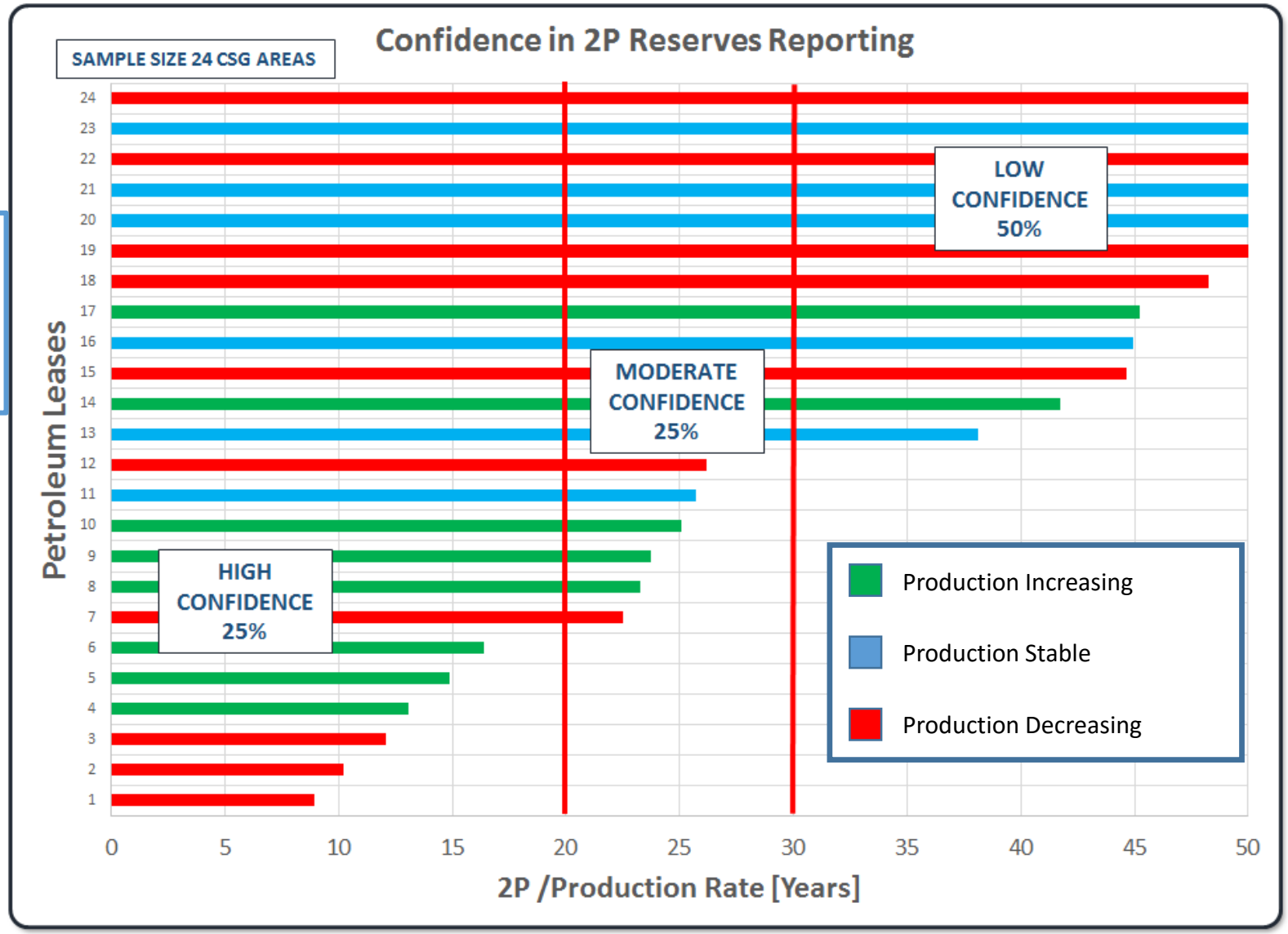
- 8 Years of 2P reserves
  - Plus 0.5 TCF
- One well drilled
- Check geology
- I am not convinced it is 2P
- Very low confidence

- 8 Years of 2P reserves
  - Plus 0.4 TCF
- 17 wells drilled [one 5-Pilot]
- Check geology
  - Next stage is to check core-holes & pilot
- Moderate confidence depends on pilot performance

Don's Confidence Index

- High - Mod Confidence 50%
- Low confidence 50%

In the absence of transparency 50% of 2P reserves are over-stated.



Low Confidence does not mean they are wrong just there is insufficient information to interpret their reserve booking.

Comparison with Conventional Gas Reserves in Queensland

CSG Reserves	Conventional
• High - Moderate Confidence 50%	• High to Moderate Confidence 90%
• Low confidence 50%	• Low confidence 10%
Sample size 24	Sample size 37

- This is an Unfair comparison but……
- Conventional fields are near End of Life.
- Conventional undeveloped reserves would be low as fields mature.
- Better comparison would be Comparing with Conventional reserves at the10 year mark.

Conclusion

- PRMS has a confidence problem which may take many years to be addressed.
- The only mechanism to ensure confidence in Reserve reporting is Transparency.
- Data Transparency collected by the respective authority:
  - 1P, 2P and 3P developed and Undeveloped reserves disclosed
  - Daily production from all wells [released after a specified time period]
- Advantages of Transparency
  - Improves Investor Confidence
  - Competition between Reserve Estimators
    - Healthy market has multiple service providers
  - No place for bad management to hide