Gas Lift to ConocoPhillips – Value of Gas Lift on Conventional and Unconventional Reservoirs and the Influence of New Technologies

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ALRDC Gas Lift Workshop

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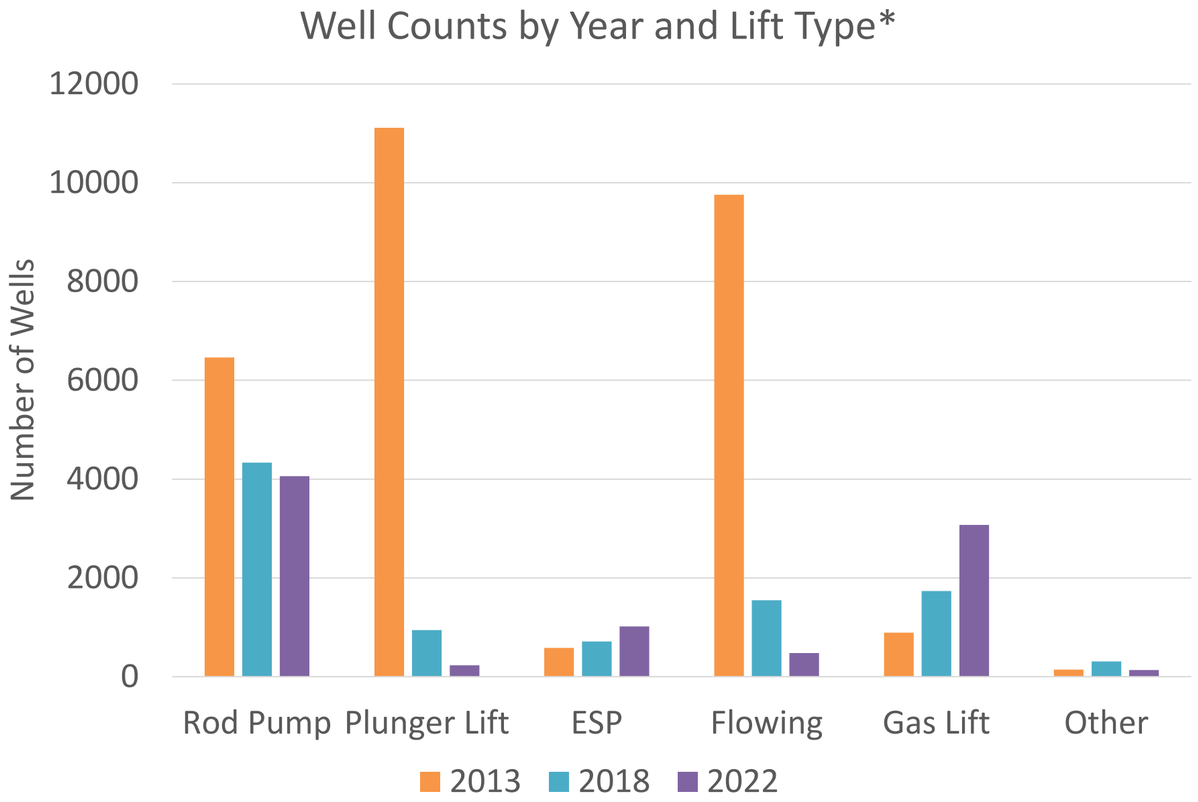
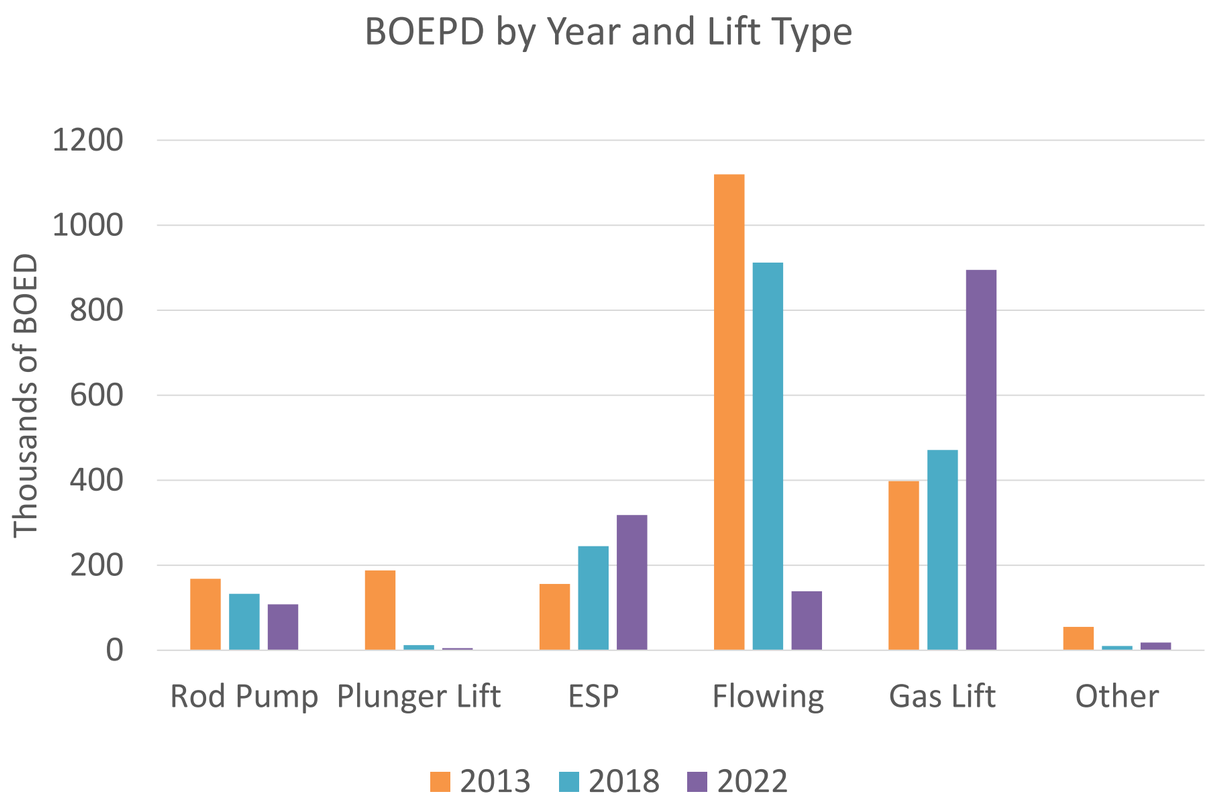
Presentation Agenda

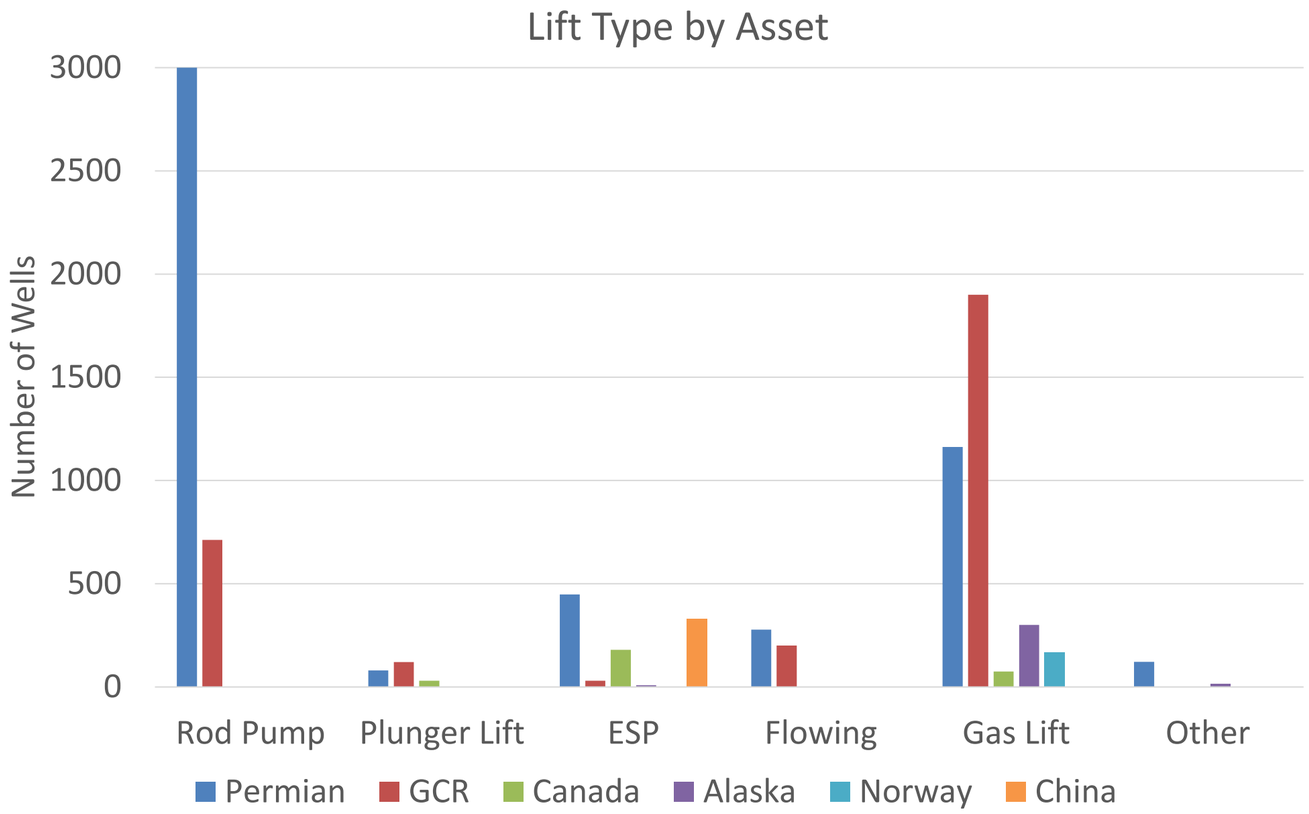
- Acknowledgements
- Overview of Gas Lift usage
  - Strategy
  - Results
  - Challenges
- Current technology deployments
  - Software/Modelling
  - Hardware

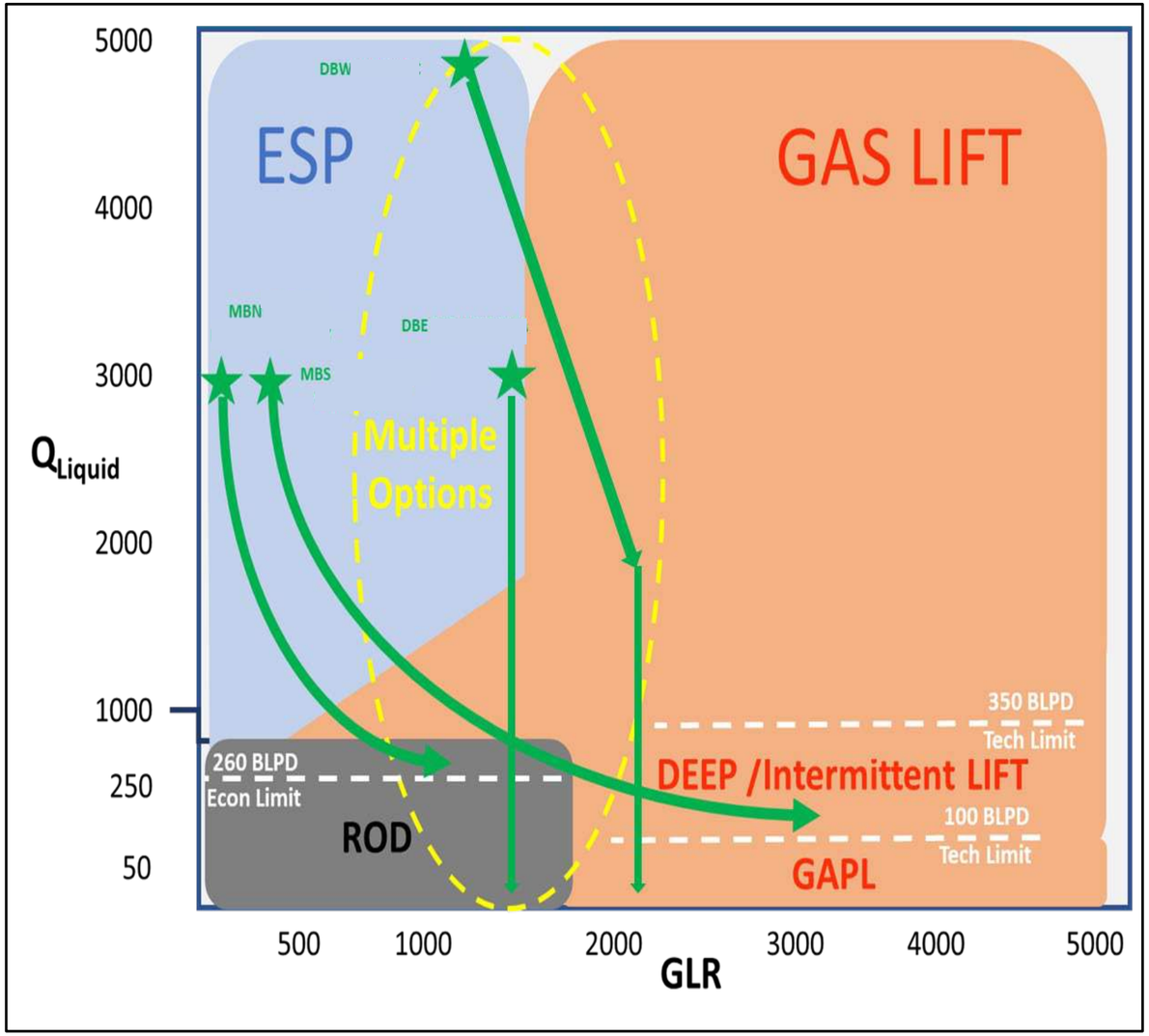
Gas lift usage historically and at ConocoPhillips today.





Artificial Lift Strategy – Permian



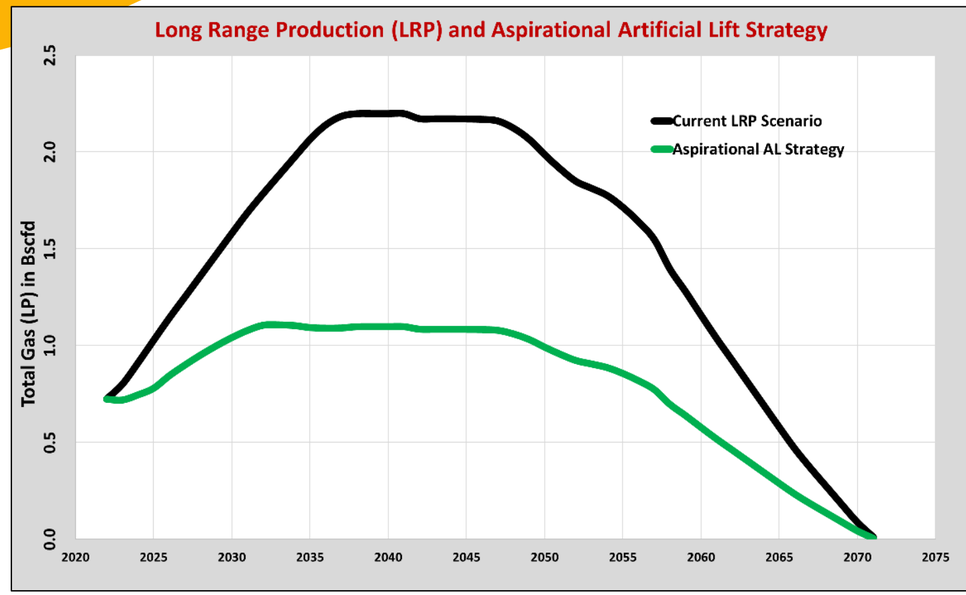


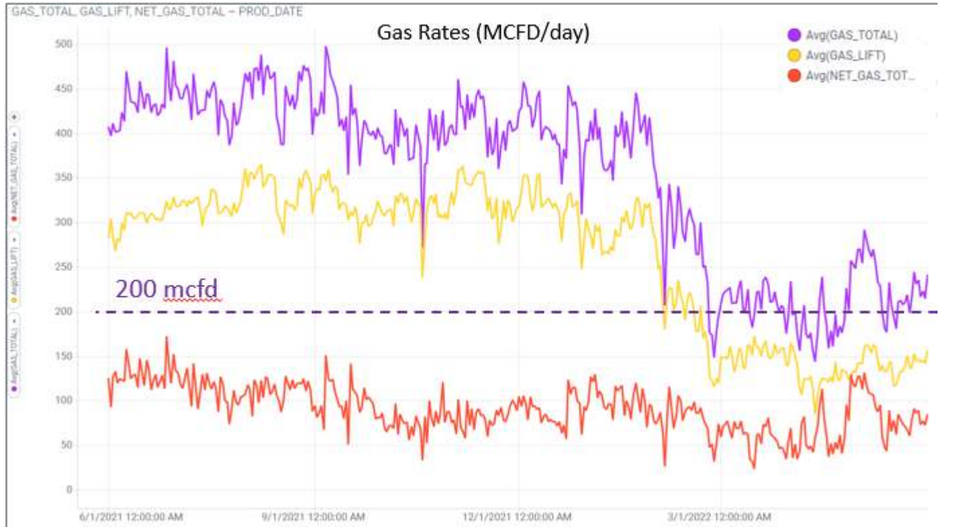
Gas Lift Strategy Progress and Challenges Summary

- Typically first lift in for high GLR Unconventional wells (EF, Delaware Basin, Bakken, Montney)
  - Increase MTBF from 12-16 Months (ESP), and 24 Months for Rod Pump up to >48 Months for gas lift
  - In high rate applications has required the use of annular and tubing flow gas lift.
  - In some cases high pressure gas lift (HPGL) as helped in delivering early production rates (upcoming slides)
  - Longevity of gas lift valves (reliability) and check valves (Norway) remain priorities but have been more dependable when partnered effectively with our vendors.
  - Temperature changes over time (upcoming slides)
  - Current major focus on GL usage optimization impacting compression($).
- Applied in challenging downhole conditions (high GLR, severe deviation, solids, etc) in Midland Basin but default is still ESP to Rod Pump
- Gas lift vendor partnerships are critical!

Gas Lift Usage optimization

- Introduction of pilot valves, plunger lift, and intermittent gas lift widespread to EF.
- Reduction of gas lift usage typically by 50%
  - Plunger Lift related to total GLR requirements (5 Mcf/bbl)
  - Intermittent Lift (Pilot and Manual surface control) around 10 Mcf/bbl
  - Rodless rod pumps also being deployed to reduce this requirement further (<1 Mcf/bbl)



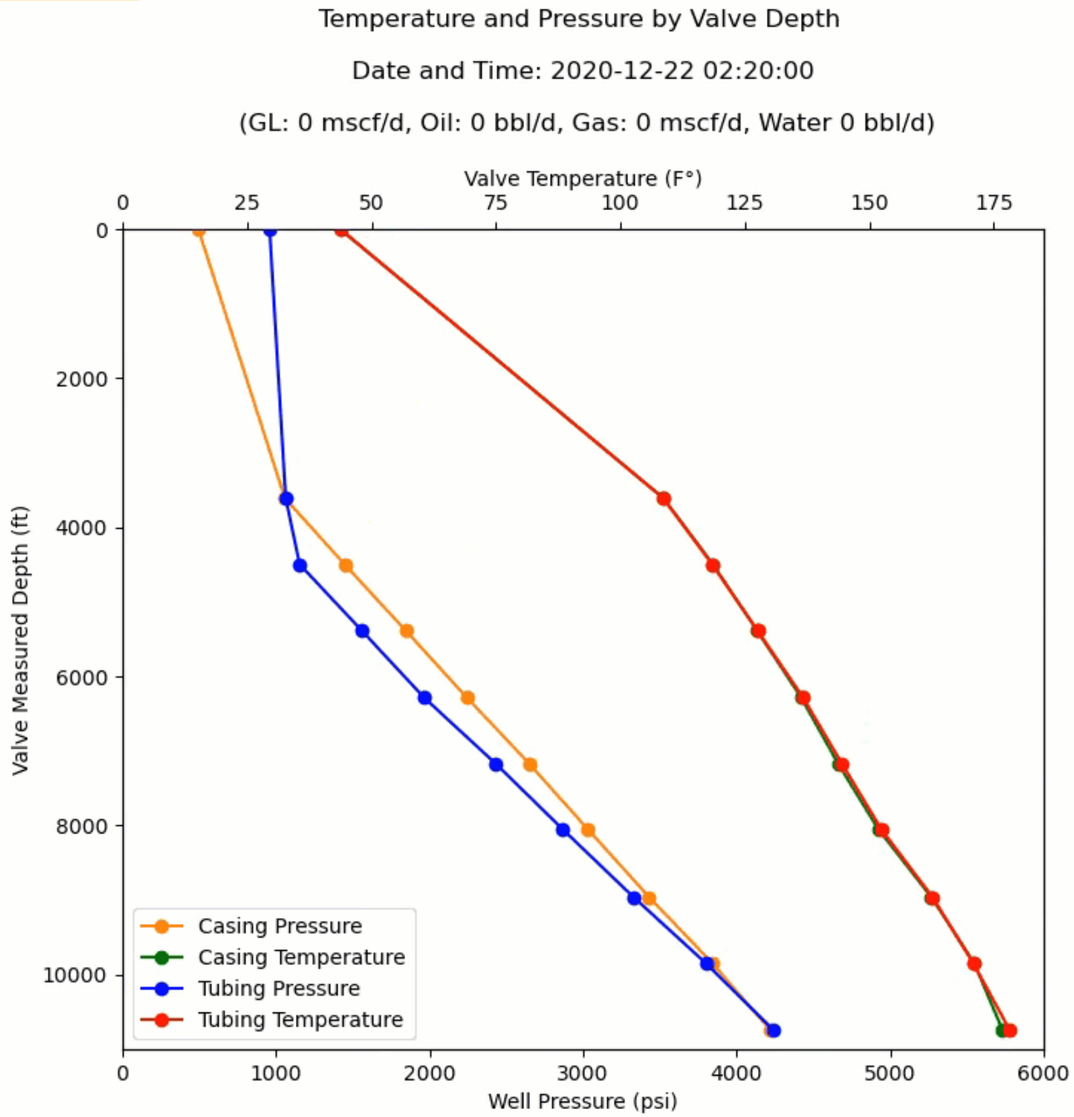


Summary of technologies ConocoPhillips is piloting or has piloted in the Gas Lift Space

- Surface controlled gas lift
- Deep gas lift (lifting at the toe of long horizontal wells)
- Surfactant assisted gas lift.
- Annular flow and High Pressure Gas Lift
- Gas Lift Optimization and Analytics Tools (GLOAT) – (Automated surveillance)
- Automated Gas Lift Optimization (AGLO) – (Automated step rate testing)
- Variety of full integrated production modelling tools
- Electric drive compression (CO_{2e}) reduction
- Rodless Rod Pump (Gas driven)
- Improved gas lift valve designs

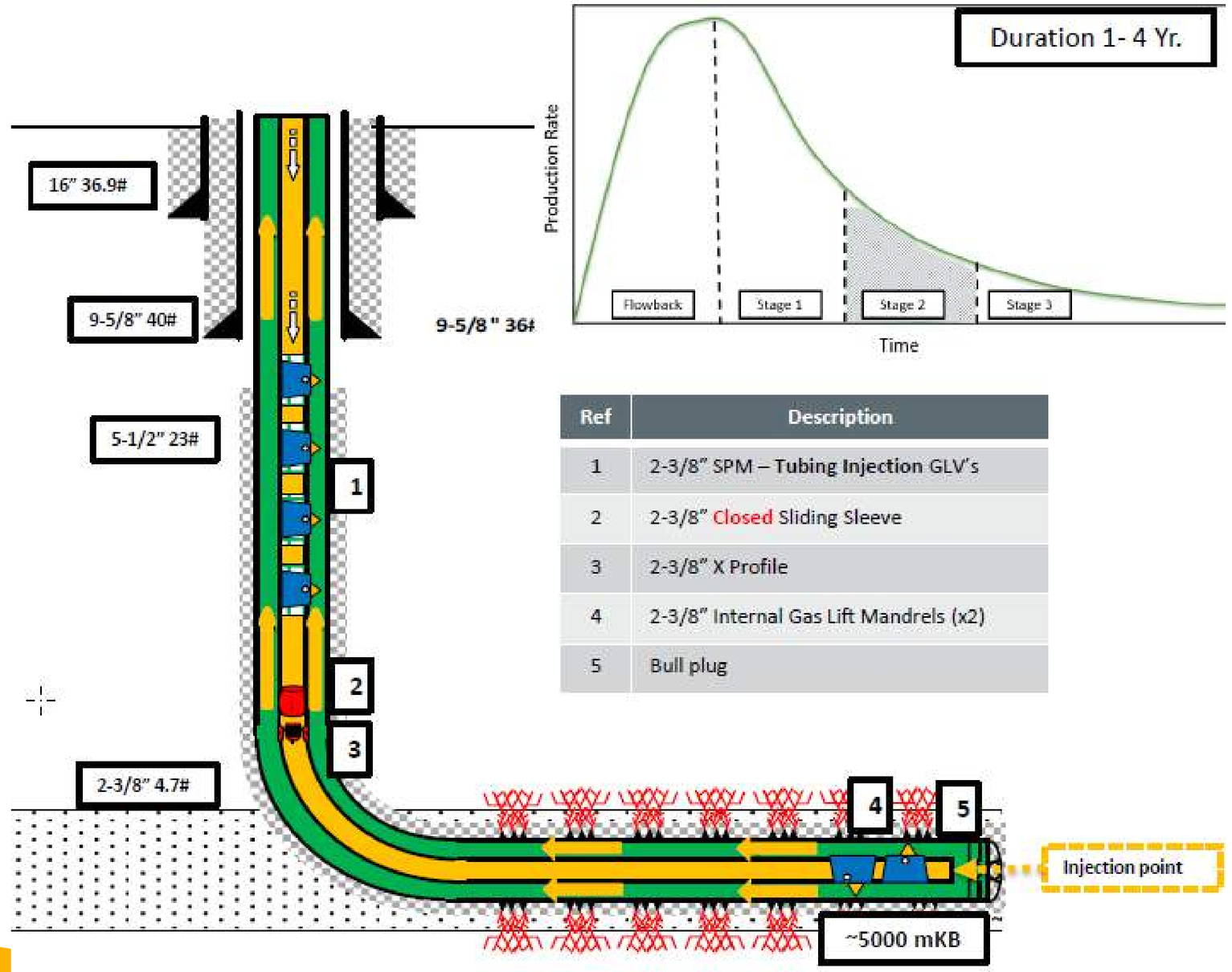
Surface controlled gas lift

- Continue to deploy each of the technologies as they reach TRL's indicating ready for field testing
  - We have partnered on some with other operators to share costs.
- Testing typically done on L48 (Low cost) environments with a big piece of the value associated with higher cost environments (Alaska, Norway)
  - Learnings have been very useful in understanding temperature profiles over time.



Deep Gas Lift

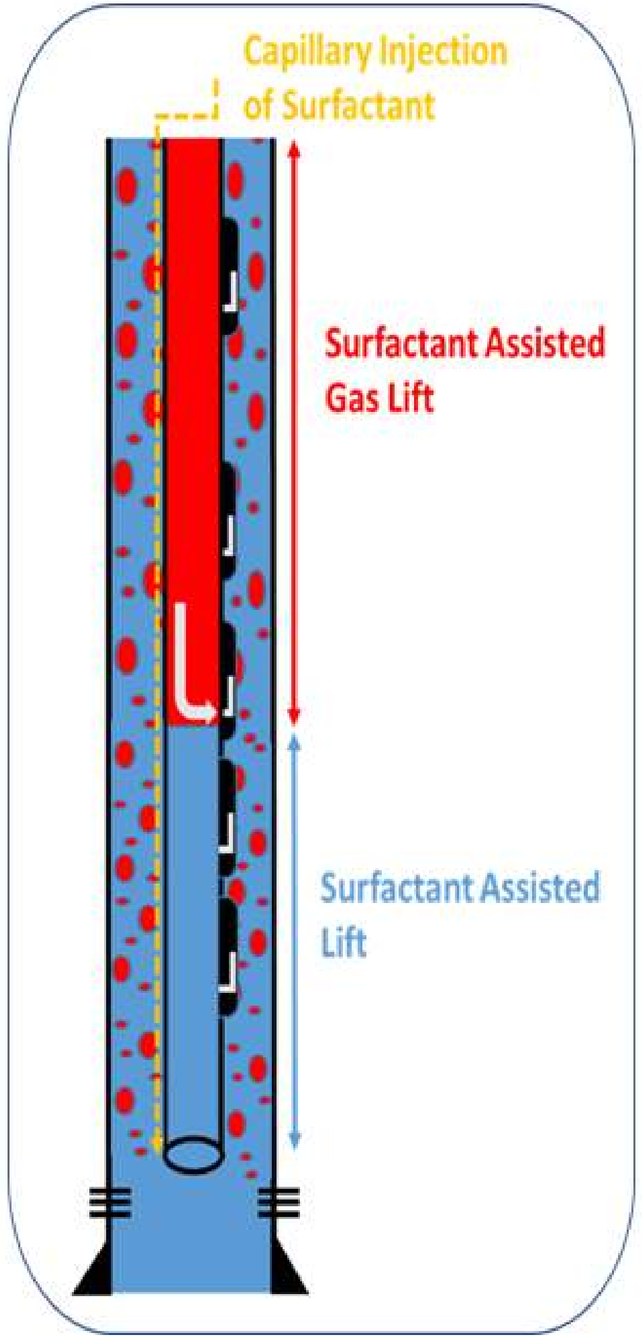
- Applied in MB and Canada and previously Niobrara
  - Primarily for higher perm unconventionals more sensitive to back pressure.
  - Toe down uplift observed
  - Stability improves during annular flow time.



Ref	Description
1	2-3/8" SPM – Tubing Injection GLV's
2	2-3/8" Closed Sliding Sleeve
3	2-3/8" X Profile
4	2-3/8" Internal Gas Lift Mandrels (x2)
5	Bull plug

Surfactant Assisted Gas Lift

- Focused on reducing slip and gravity pressure gradient.
- Has improved production rates in some cases and has helped to deepen injection point also improving production rates.
- Some improvement on Gas Lift injection rate requirements.
- With practice and focus we have managed to improve usage requirements both on surfactant and defoamer to improve economics.

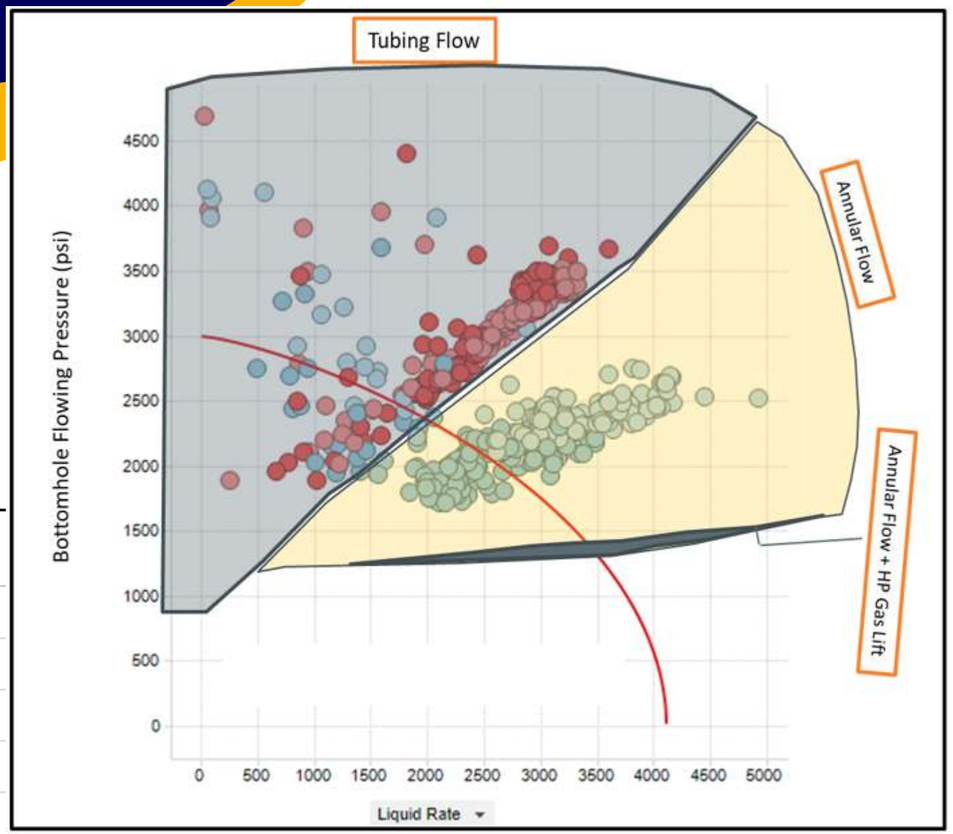


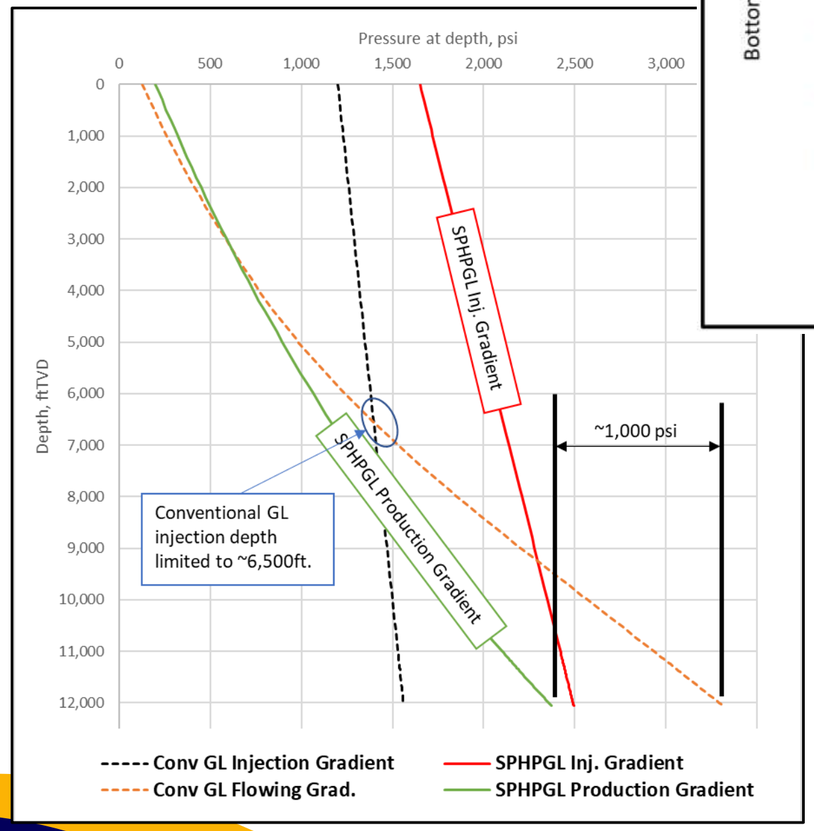
GLOAT, AGLO and Integrated Modelling Tools

- Nearing 90% of all wells have some form of automated model workflow occurring everyday on gas lift wells
- Tools do some degree of surveillance modelling (if the predicted pressures and rates don't match actual they are flagged)
- Has been very useful in optimization and trouble shooting.
- Coupled with AGLO for rate testing and further trouble shooting.

Annular flow and High-Pressure Gas Lift

- A tool in our toolbox for lower GLR wells (<2000) to avoid ESP early life failure.
- Our approach as been for it to be early life up to the first year then proceed to normal GL operations to reduce compression cost.
- Reduces early life lifting costs on average by $2 BOE.





Slide 3 Acknowledgements/Thanks & Questions

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