2024 GAS LIFT WORKSHOP

Optimization of Gas Lift Compression for Increased Production

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What is the most important component in all gas lift systems?

Gas Lift Compression Unit

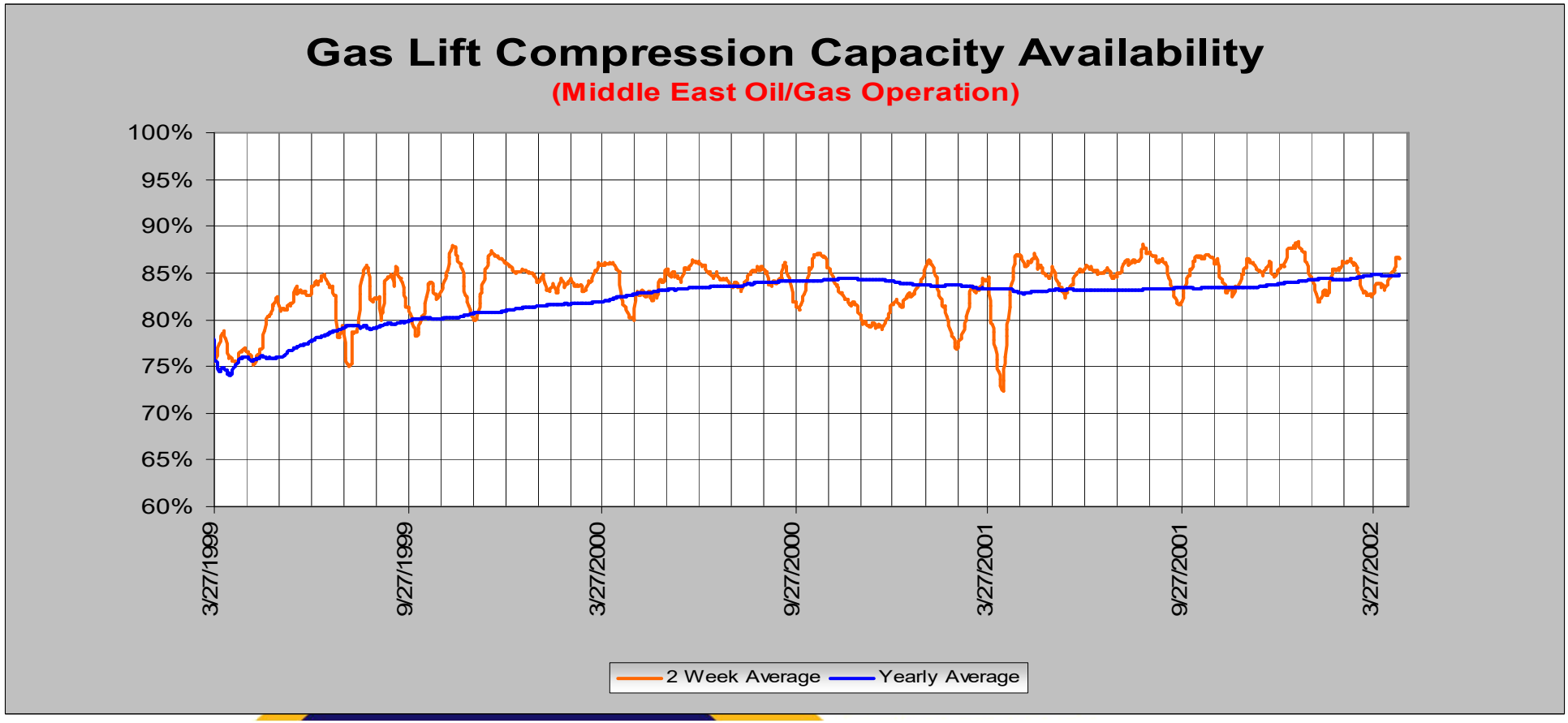
Downtime vs Performance

- Most operations focus on eliminating downtime
- More value can result from focusing on performance related capacity losses
  - Based on data from 2 operations, DT loss was 4% while performance losses were 16-21%

Introducing the Capacity Availability Metric (CAM)

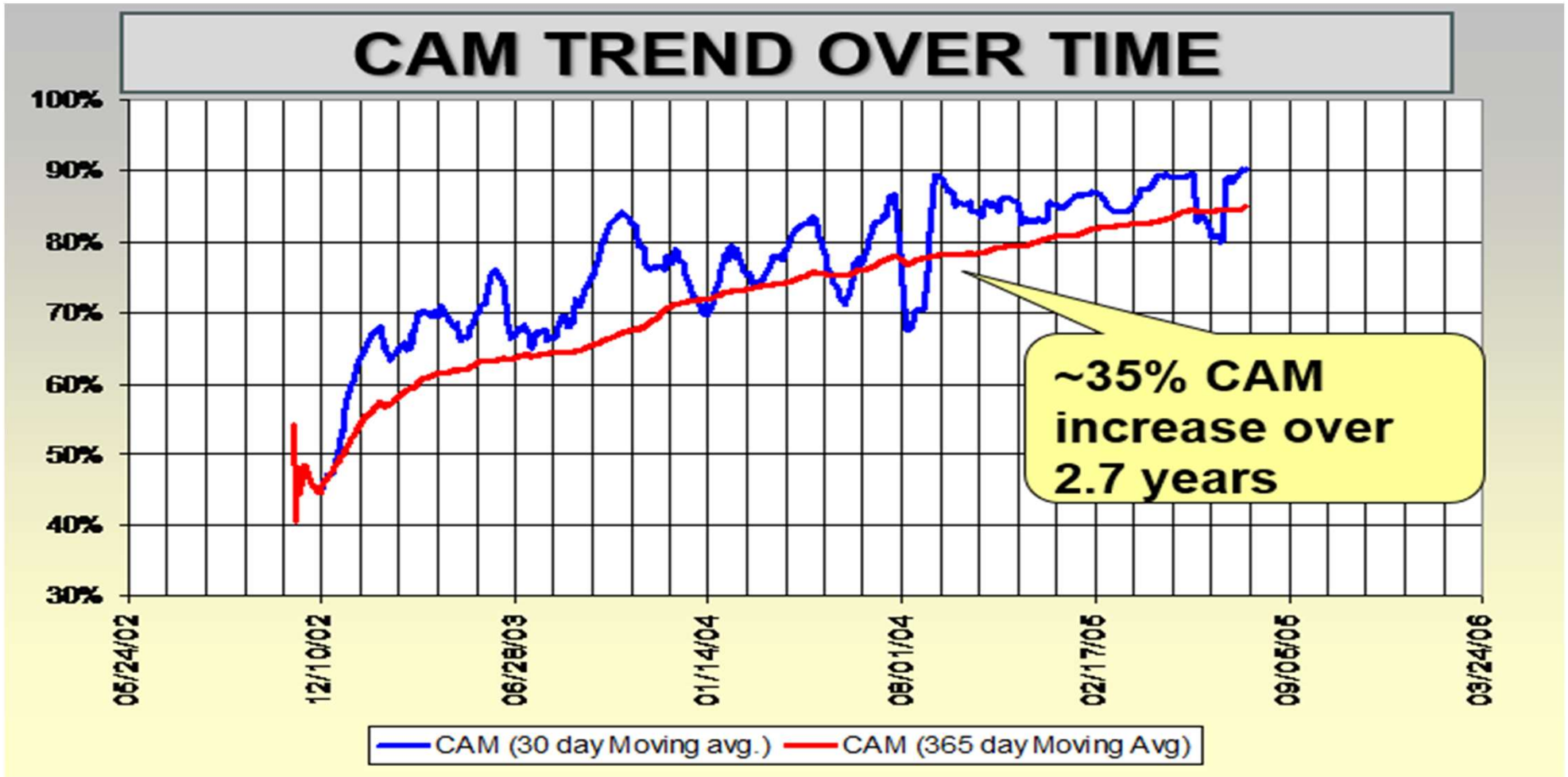
- CAM = Compressor's **measured max** flow versus compressor's **design max** flow (corrected to site operating and atmospheric conditions)

Increased CAM Almost 10% over a 3 year period



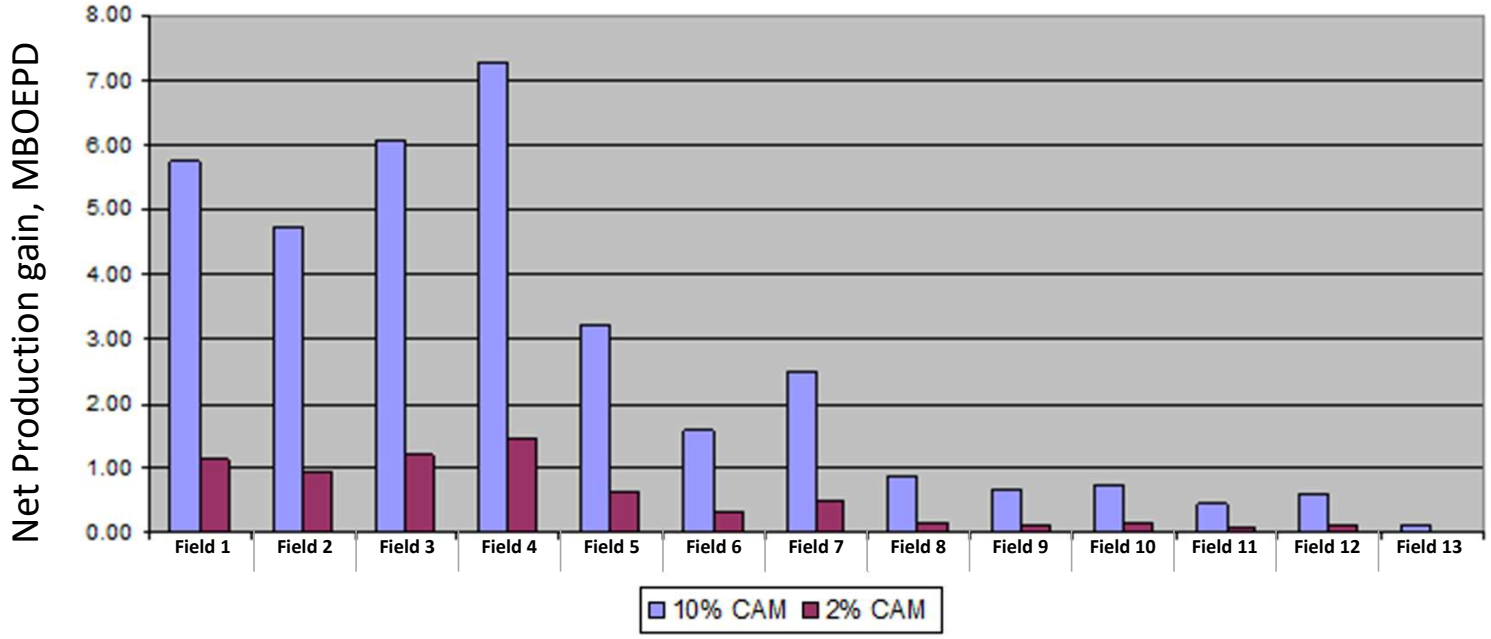
Finding from CAM Monitoring	Measures to Improve	Results
Turbine Inlet Air Filters not functioning as designed	-Initiated filter renovation program	-Extended turbine wash frequency from 1 to 3 months -Improved CAM by +-2% -Reduced engine overhaul costs from foreign object damage
Gas turbine (GT) drivers not operating at max. design capacity	-Revised turbine control systems to control GT speed rather than gas compressor speed, enabling control at max GT base load	-Higher CAM/GL rate/ production - reduced gas turbine thermal cycling -Extended engine life and frequency of overhaul costs

Finding from CAM Monitoring	Measures to Improve	Results
GT output limited by suboptimal Engine/ Power Turbine (PT) Match (aeroderivative)	-Instituted PT/Engine Matching Program	- Higher CAM/GL rate/ Production
Compressor efficiency not as high as expected and rapidly degrading	-Develop stricter overhaul specifications -Monitor compressor recycle valve leakage and replace leaking valves - Replace production separator vanes to reduce oil mist carryover	-Higher CAM/GL rate/production - Slower CAM degradation -Extended compressor overhaul frequency from 6 months to 4 years reducing costs and production losses


CAM TREND OVER TIME
100%
90%
80%
70%
60%
50%
40%
30%
05/24/02
12/10/02
06/28/03
01/14/04
08/01/04
02/17/05
09/05/05
03/24/06
~35% CAM increase over 2.7 years
CAM (30 day Moving avg.)
CAM (365 day Moving Avg)

Perf. Improv. Gain Potential at Various Fields

Net Prod. Gain = Total Compr. Capacity*%CAM Improv. * BOPD/Incremental 1 MMCFD



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In a gas lift field which is more important:
increased lift gas rate or lower separator pressure?

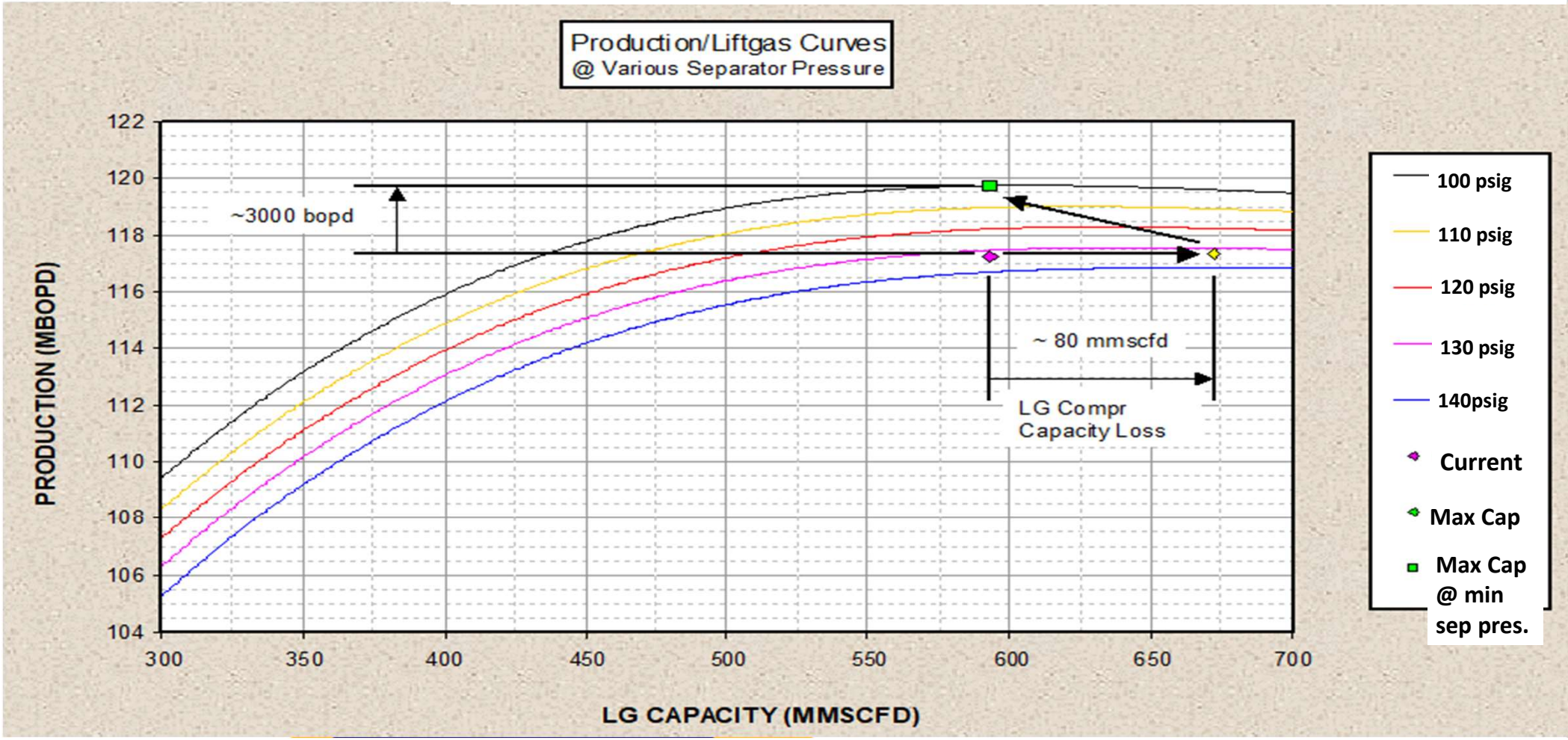
Example of Surface Pressure Importance on High Rate HPGL Well

BLPD	Psurf, psig	GL Rate, MCFD	Pdisch. Psig	Horsepower	Fuel Gas, MCFD
5180	310	2000	2000	240	44
5180	100	700	2000	135	25
5180	50	480	2000	109	20

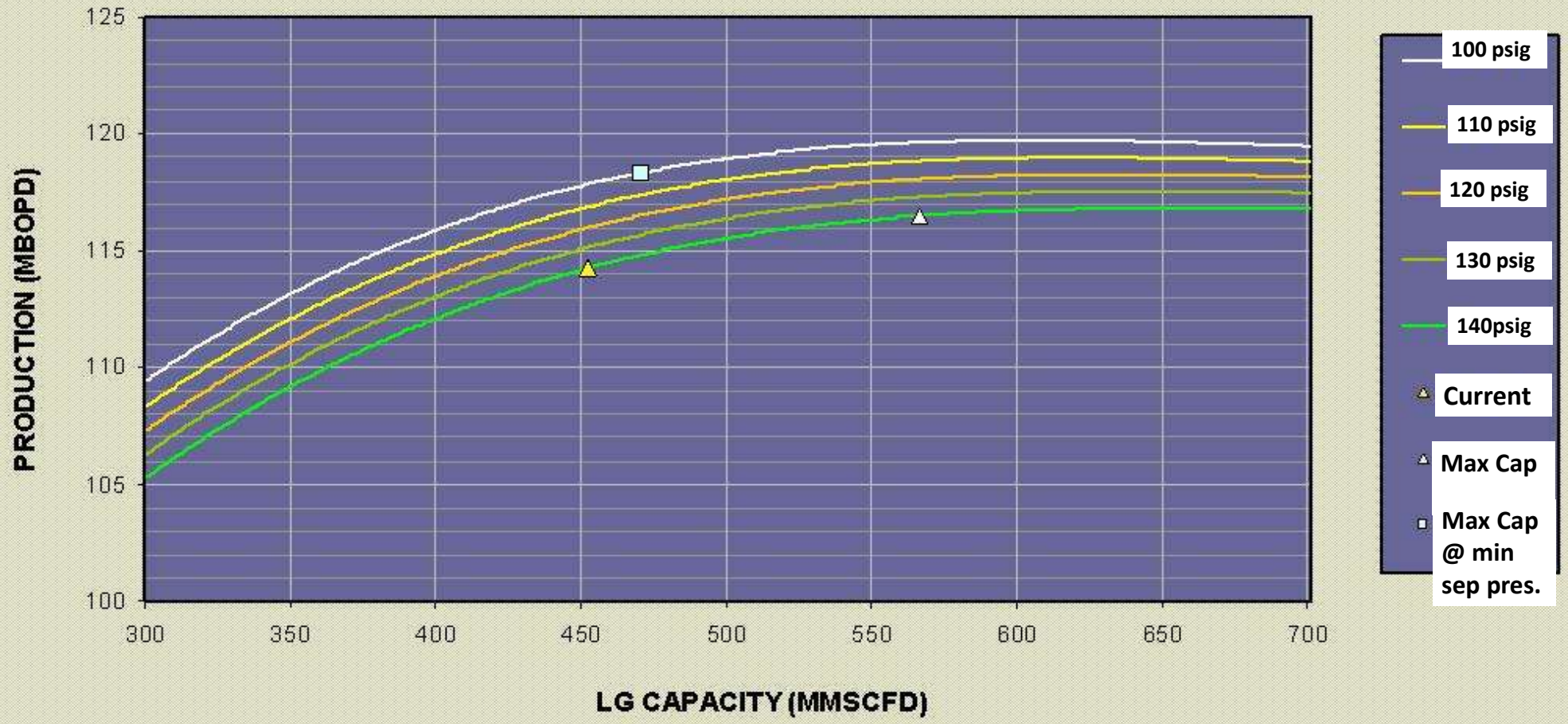
Example of Surface Pressure Importance on Mature SPGL Well

BLPD	Psurf, psig	GL Rate, MCFD	Pdisch, psig	Horsepower	Fuel, MCFD
104	115	600	390	45	10
136	20	300	270	46	10

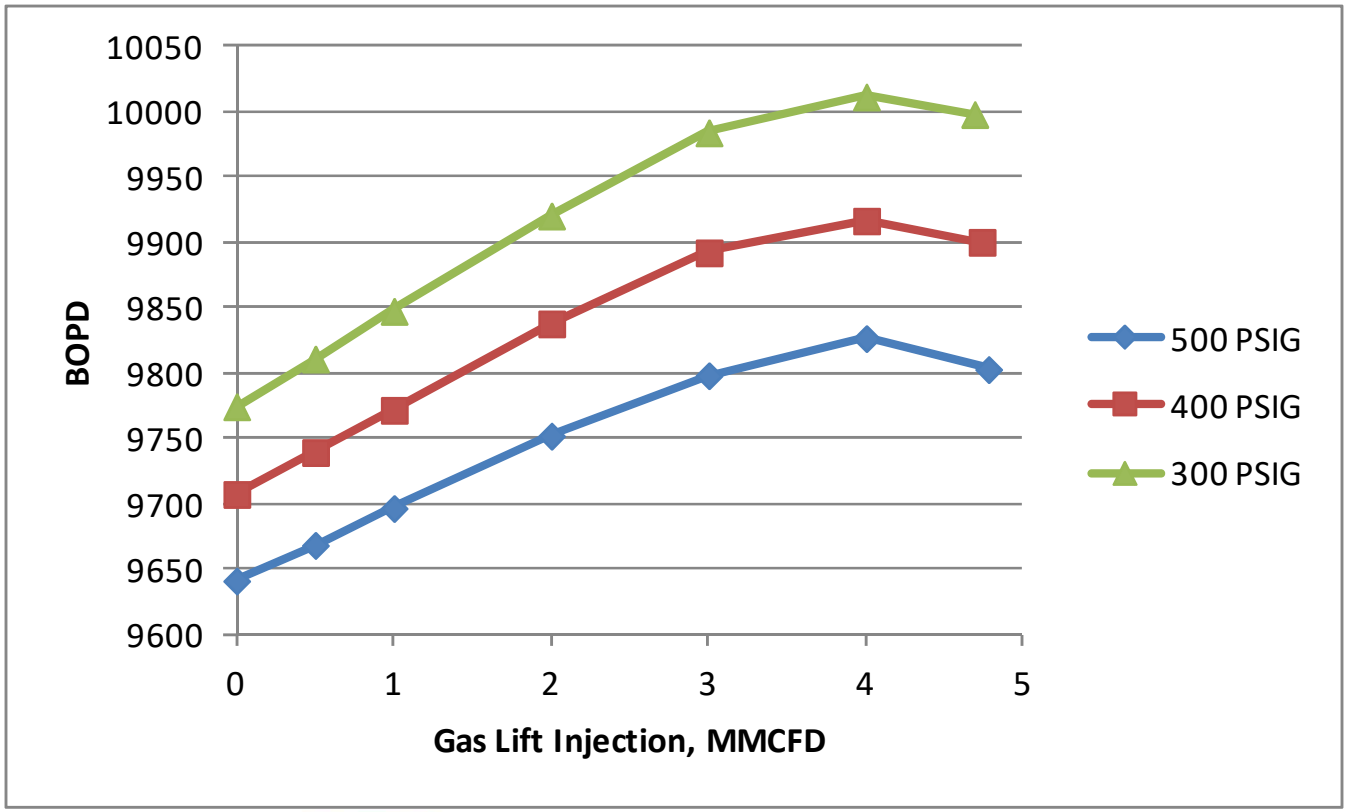
Integrated Production Model (IPM)for ME Field - Winter



IPM for ME Field - Summer



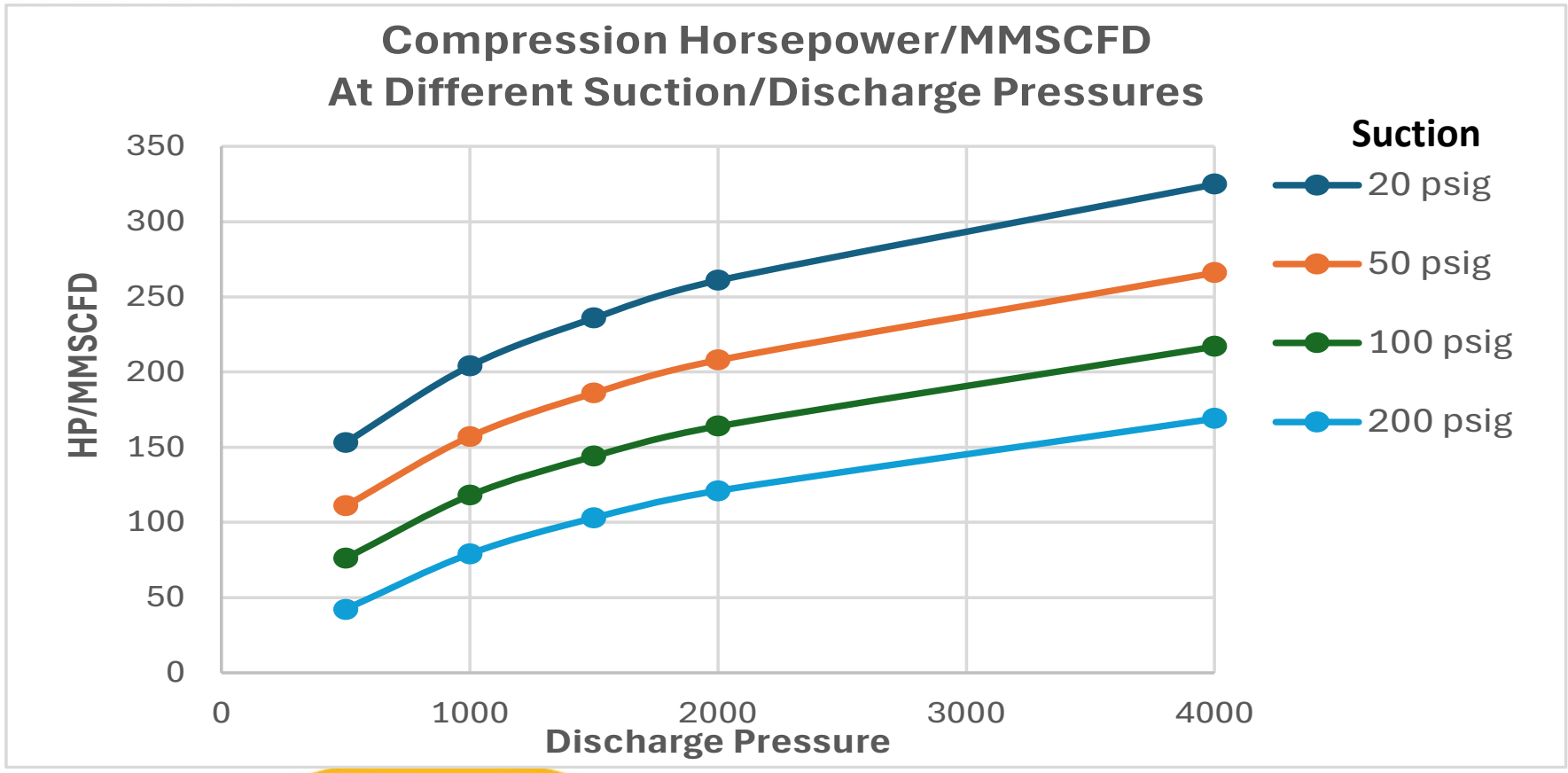
IPM Results


10050
10000
9950
9900
9850
9800
9750
9700
9650
9600
BOPD
0
1
2
3
4
5
Gas Lift Injection, MMCFD
500 PSIG
400 PSIG
300 PSIG

GL Valves Required at Different Surface Injection Pressures (Permian Well)

Inj. Press., psig	Mandrels
1000	14
1500	7
2000	3
3000	2
4000	1

- 2 3/8” Tubing; 625’ Bracket Spacing, TVD = 10,000, FTP = 200 psig


Compression Horsepower/MMSCFD
At Different Suction/Discharge Pressures
HP/MMSCFD
350
300
250
200
150
100
50
0
0
1000
2000
3000
4000
Discharge Pressure
Suction
20 psig
50 psig
100 psig
200 psig

Gas lift supply pressure

- Usually compression discharges to one system
- Designing for high pressures can help kickoff wells, reduce mandrels needed, and increase injection depth
- Once well is kicked off, pressures are usually lower than design, so continuous operation can possibly run @ lower pressures
- Data point from one field: **25% of compression horsepower wasted** across injection control valves

Turbine Output with Increasing Ambient Temp.

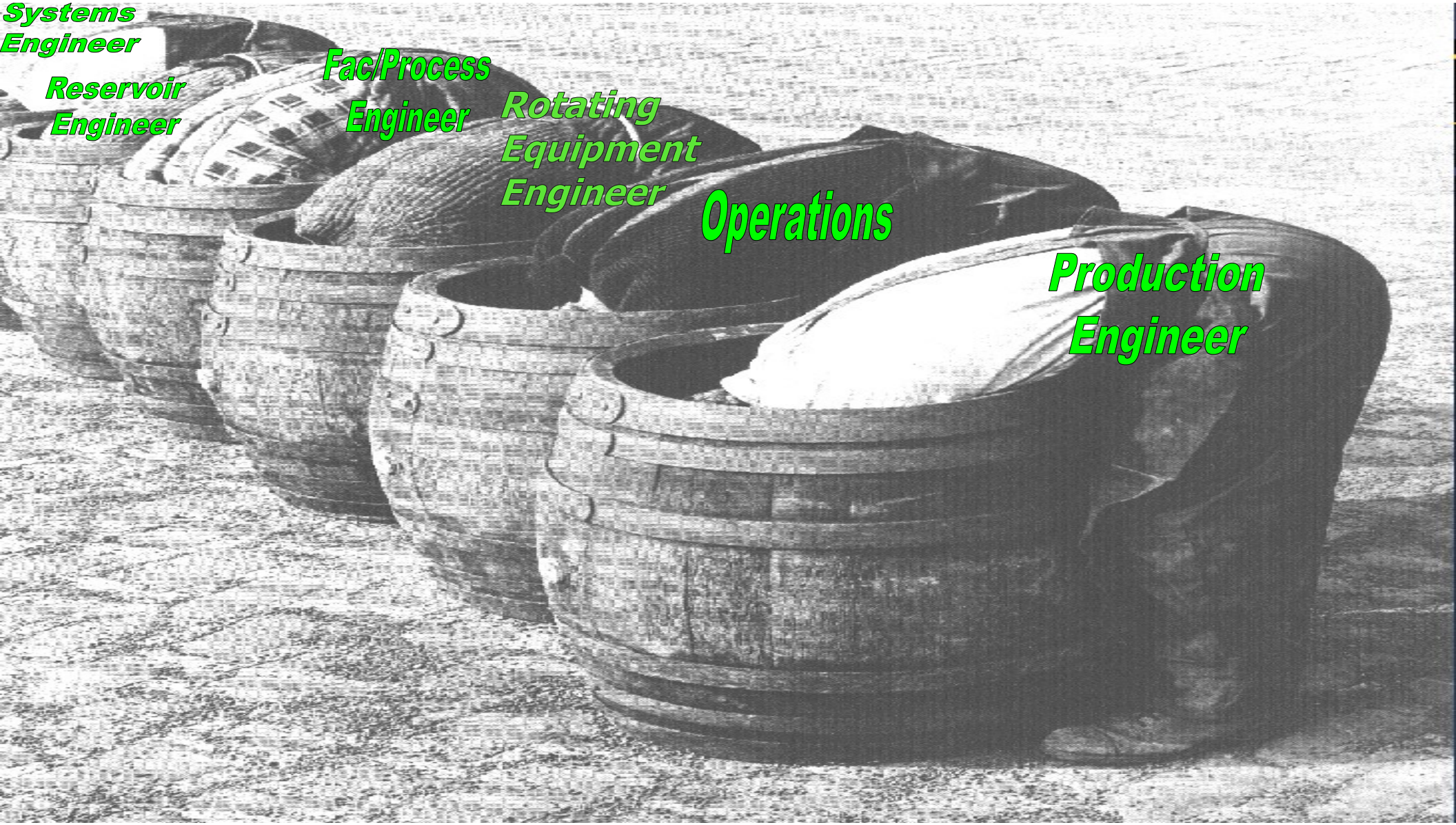
- Rough rule of thumb of a 1% efficiency reduction and 5% reduction in output for every 10 °C change.*

- Overfiring/Running Above Base Load can increase power with reduced turbine life.

*https://adgefficiency.com/energy-basics-ambient-temperature-impact-on-gas-turbine-performance/

Summary of Compression for Production Optimization

- Compression performance improvement is usually more impactful than reliability improvement
- Suction pressure reduction usually provides greater production rate than increasing lift gas flow rates, for a given power.
- If maximum production is the operation's goal, then the lift gas compressors should be operating at the engine driver's maximum base rated output to maintain minimum separator pressures
- Running engines/motors above their “base” power rating may be economical
- Compression discharge pressure optimization can also be useful
- HOW COULD WE EVALUATE/DO ALL THESE THINGS?


Systems Engineer
Reservoir Engineer
Fac/Process Engineer
Rotating Equipment Engineer
Operations
Production Engineer

How can we better optimize gas lift?

- Set up multi-discipline “Gas Lift Strategy Team” and empower them to adjust compression, wells and facilities for maximum economic impact
- Keep a current, high quality integrated production model
  - Make sure min. GL injection rate constraints are only set as necessary to allow model/optimization flexibility
- Identify system constraints when adjusting lift gas compressor operation (i.e. Compressor's operation relative to surge control, production water separation systems, etc.)
- Optimize as often as prudent
- Feedback results to improve model, strategy and economics

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Question Time

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