MEG ENERGY

Christina Lake Regional Project

2022 Directive 54 Performance Report
Experimental Scheme Approval No. 12528

June **2023**

Confidential

Experimental eMVAPEX Scheme

- MEG has patented a solvent-based recovery process called eMVAPEX (enhanced Modified VAPour EXtraction), which is a modification of VAPEX (VAPour EXtraction) invented by Butler and Mokrys (Butler, 1994)
- Approval in place for Class III co-injection of propane and/or non-condensable gas (NCG) in addition to the existing steam injection on well pairs AP1-AP10
- Commercial grade propane injected at a rate not exceeding 200 m^3/d (standard liquid volume) per well
- The initial scheme (Phase 1) was limited to well pair AP2 and associated infill wells AP1N, AP2N, and began operation in November 2016
- The operating scheme was expanded to Phase 2 in August 2017 to include well pairs AP1, AP2, AP3 and associated infill wells AP0N, AP1N, AP2N, AP3N
- The Phase 3 expansion includes additional well pairs and infills operating on eMVAPEX, and a propane recycle facility
- Phase 3 commenced operation in the 2nd half of 2018 and propane is currently being injected into 9 injector wells
- Experimental Scheme No. 12528E has been extended through to September 2023 (Application No. 1933352)

Why eMVAPEX*?

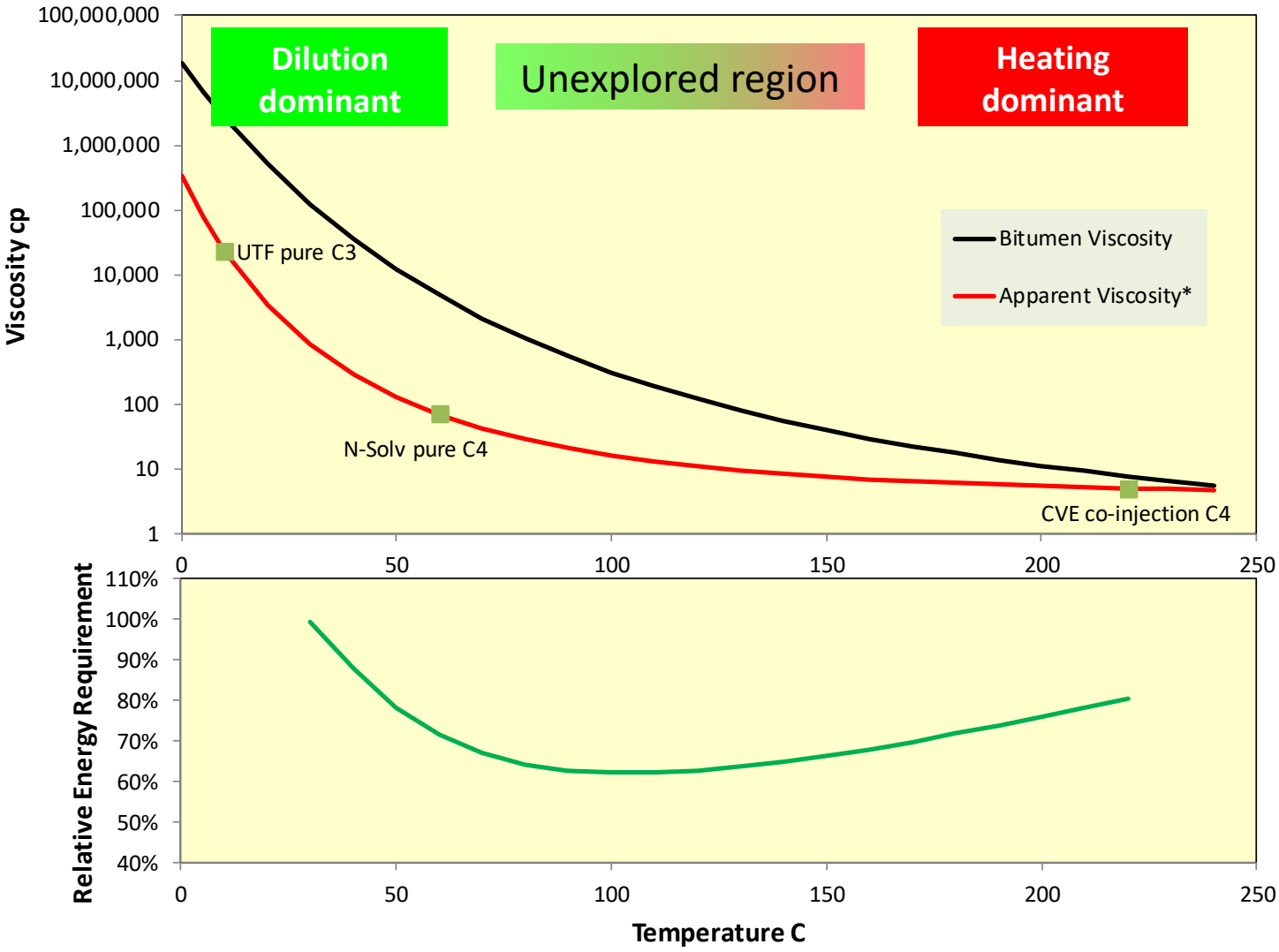
- Solvent processes are anticipated to reduce GHG emissions intensity relative to SAGD
- Solvent mixing with bitumen, solvent retention in reservoir and cost of solvent are critical factors that have been preventing the commercial applications of solvent in bitumen *in situ* recovery
- eMSAGP (enhanced Modified Steam and Gas Push) has successfully demonstrated
  - Better oil rate and recovery with significantly reduced SOR as compared to SAGD
  - High NCG transport rate beyond chamber due to convective flow
  - Most of injected NCG is being pushed from chamber to infill well resulting in high recovery of NCG
- eMVAPEX is a logical extension of eMSAGP by replacing NCG/steam with a condensable solvent
- Propane price is anticipated to remain depressed for a long period of time.

* Canadian patent No. 2,912,159

Balancing Heating and Dilution

What differentiates eMVAPEX from other solvent based processes?

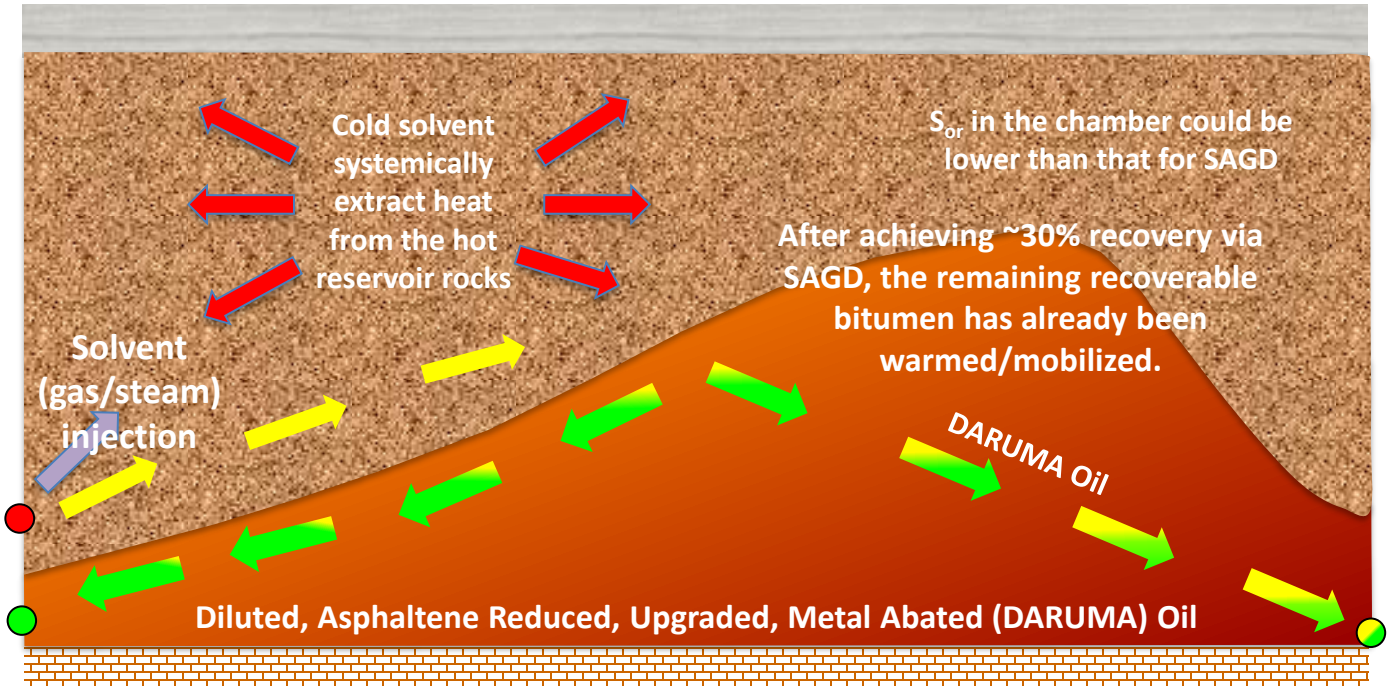
- Use SAGD for ~2-3 years to input heat rapidly into reservoir such that remaining recoverable oil reaches mobile temperatures
- Utilize SAGD & infill wells combination to increase oil and solvent recoveries



* "Apparent viscosity" is the estimated viscosity using SAGD theory to match observed field production rates.

eMVAPEX Conceptual Model

- At about 20% - 30% recovery, remaining oil in reservoir has been heated to ~60 – 100°C; a temperature region that has not been explored previously and is expected to be an optimum balance between heating and dilution
- Oil rate should be higher than SAGD because gravity drainage is augmented with pressure drive
- Solvent retention is significantly reduced because the infill serves as a collection point

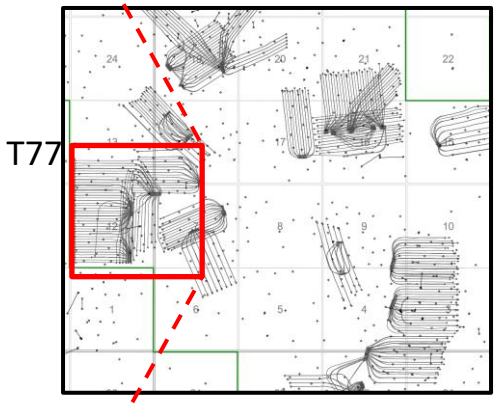


SAGD producer continues to produce bitumen with no (or significantly reduced) steam injection

Infill well produces the DARUMA oil driven by pressure gradients in addition to gravity with virtually no steam injection.

- eMVAPEX is a logical extension of eMSAGP
- eMSAGP uses non-condensable gas (NCG) to maintain pressure and push warmed oil into infill well.
- eMVAPEX utilize condensable solvents (light hydrocarbon) in place of NCG
  - Injected solvent extracts heat stored in the formation from previous SAGD heating
  - Vaporized solvent penetrates into the undrained region similar to steam condensate in the SAGD phase
  - Solvent condenses and mixes with warmed oil to further reduce the oil viscosity by dilution
  - Diluted (and perhaps deasphalted) oil is collected at the infill well as well as the SAGD producer

eMVAPEX Pilot



Phase 1+2: AP1-AP3 and infill wells AP0N-AP3N

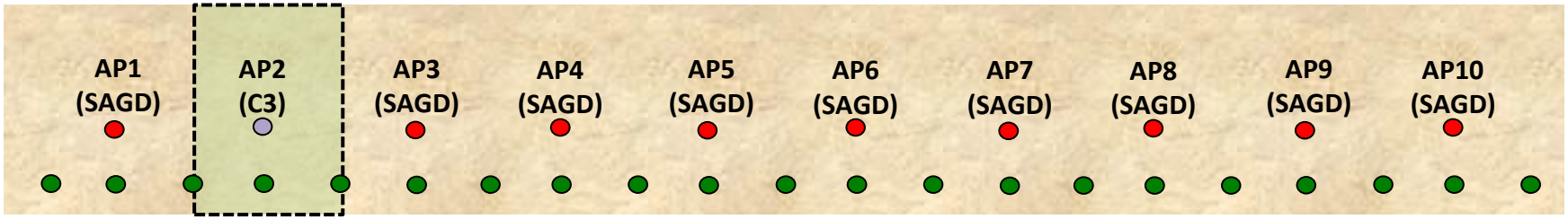
Phase 3: Potentially add AP4-AP10 and infill wells AP4N-AP9N,AQ1N

Phase 3 start-up commenced in the 2nd half of 2018

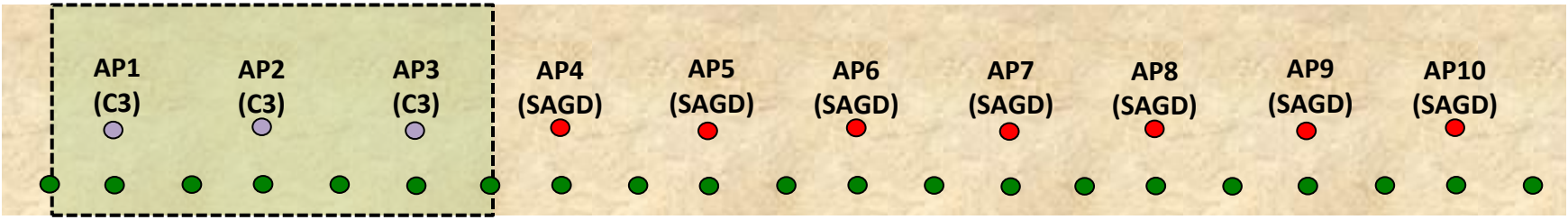
APXX – SAGD Well Pair (100m Spacing) APXXN – Infill Well (Between SAGD Well Pairs) Delineation Wells

eMVAPEX Phased Approach

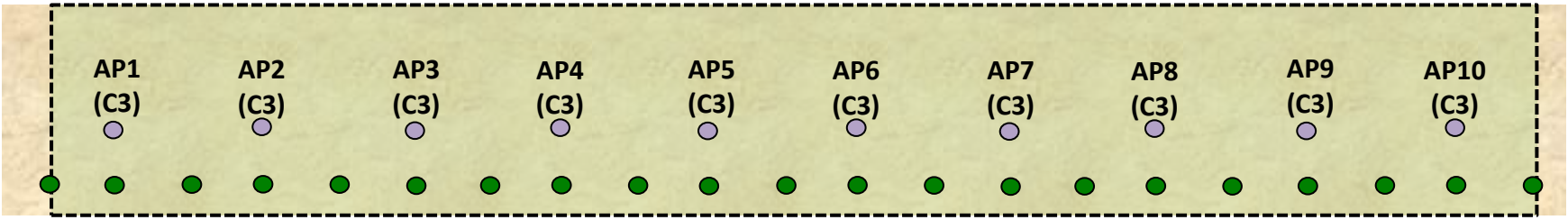
Phase 1: Unconfined pattern & proof of concept



Phase 2: One confined pattern (AP2) to confirm performance

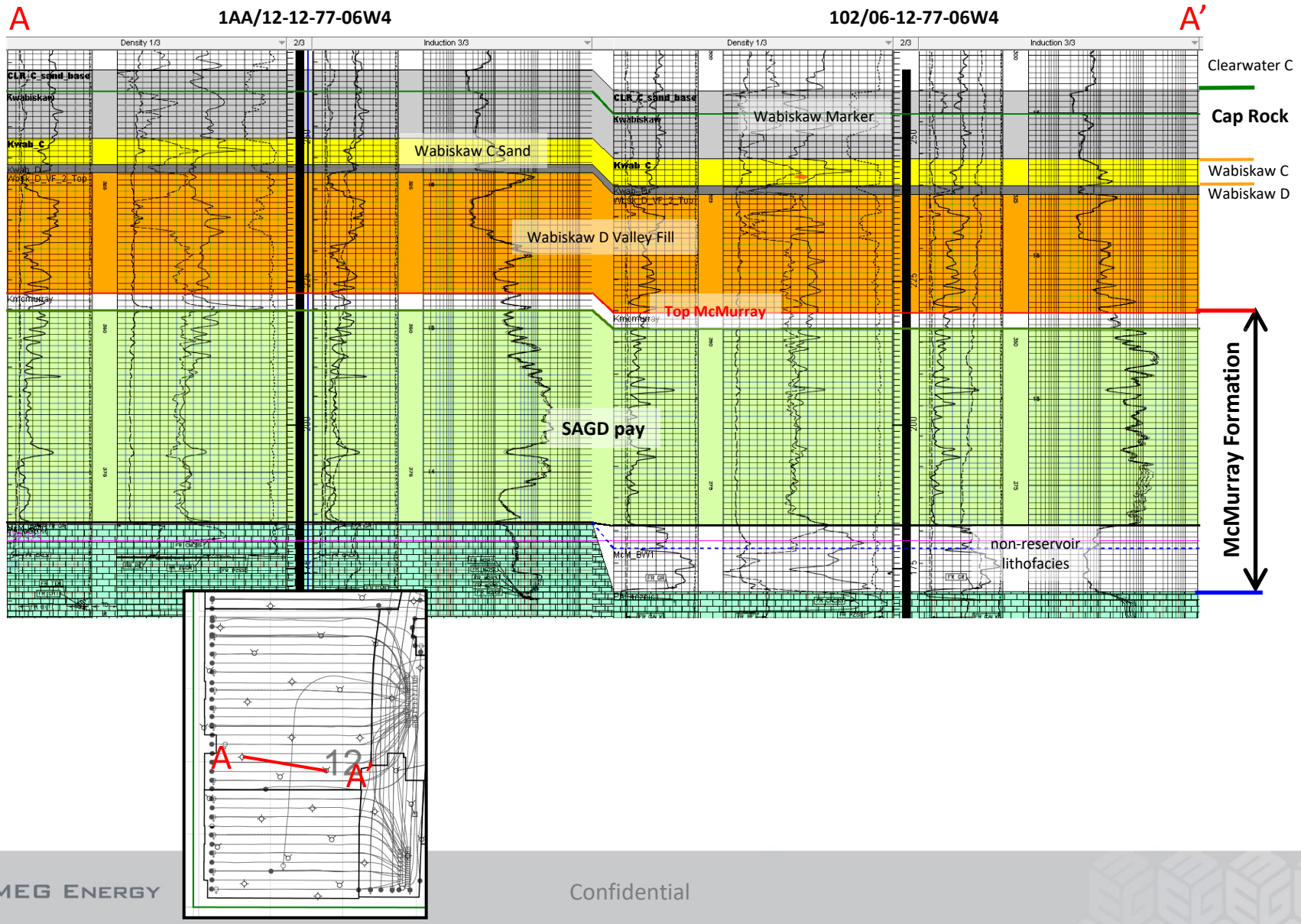


Phase 3: Multiple confined patterns (AP2 to AP9) to ascertain commercial viability*

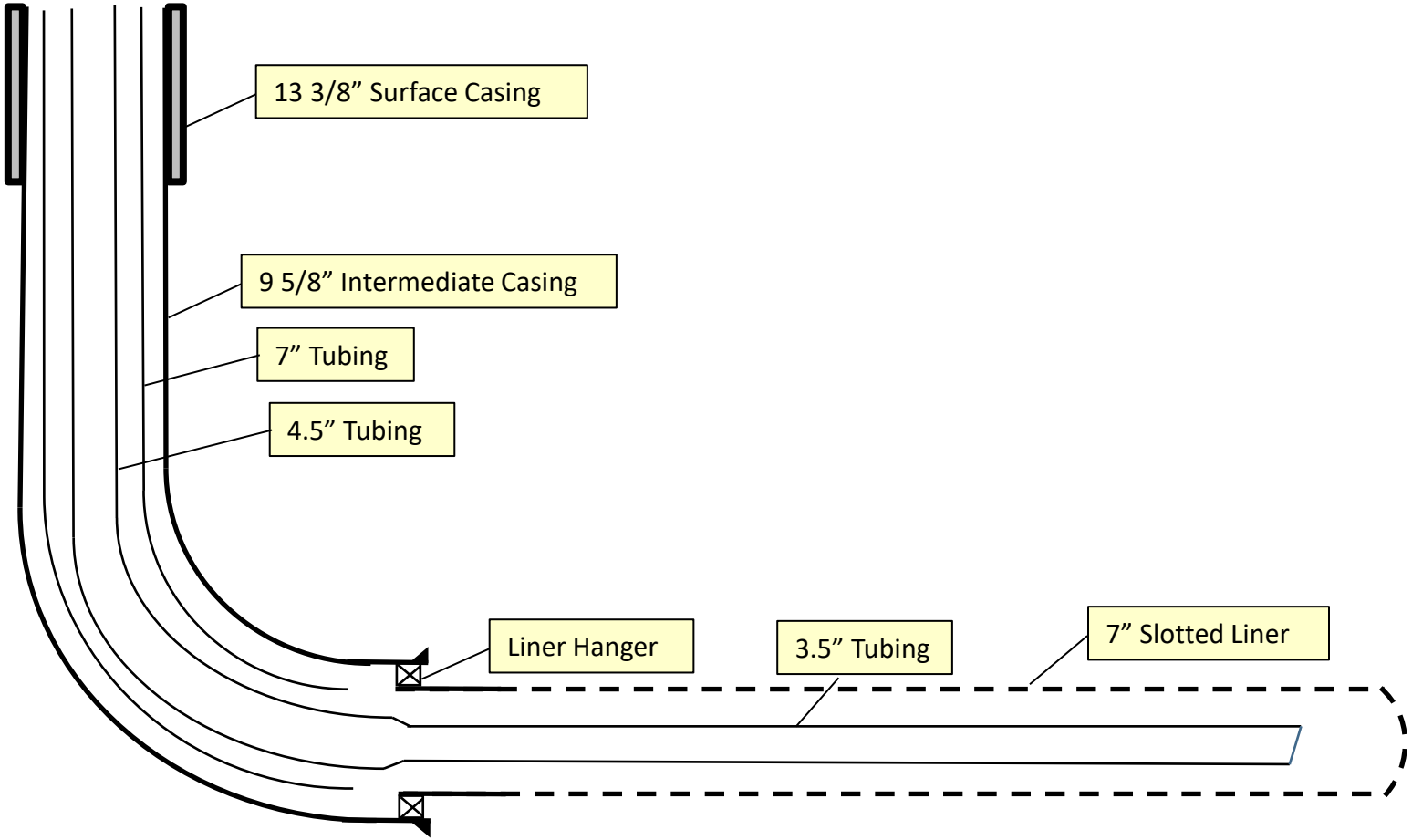


*9/10 patterns were injecting propane as of the end of December 2022

CLRP: Structural Cross Section A-A’

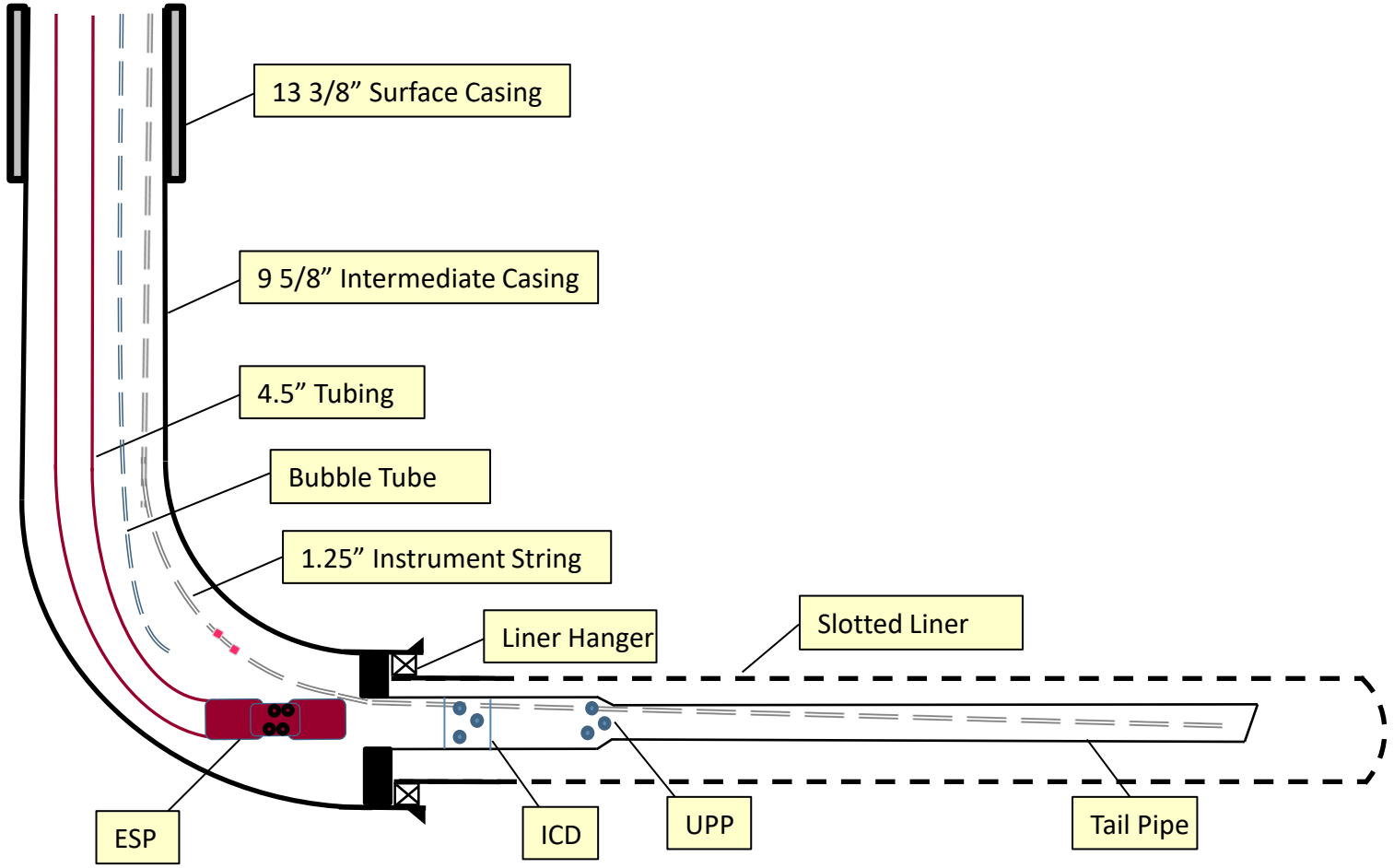


Well Completion – AP1I, AP2I, AP3I



- Steam and/or solvent can be injected into both long tubing and short tubing
- Blanket gas on annulus

Well Completion – AP1P, AP2P, AP3P

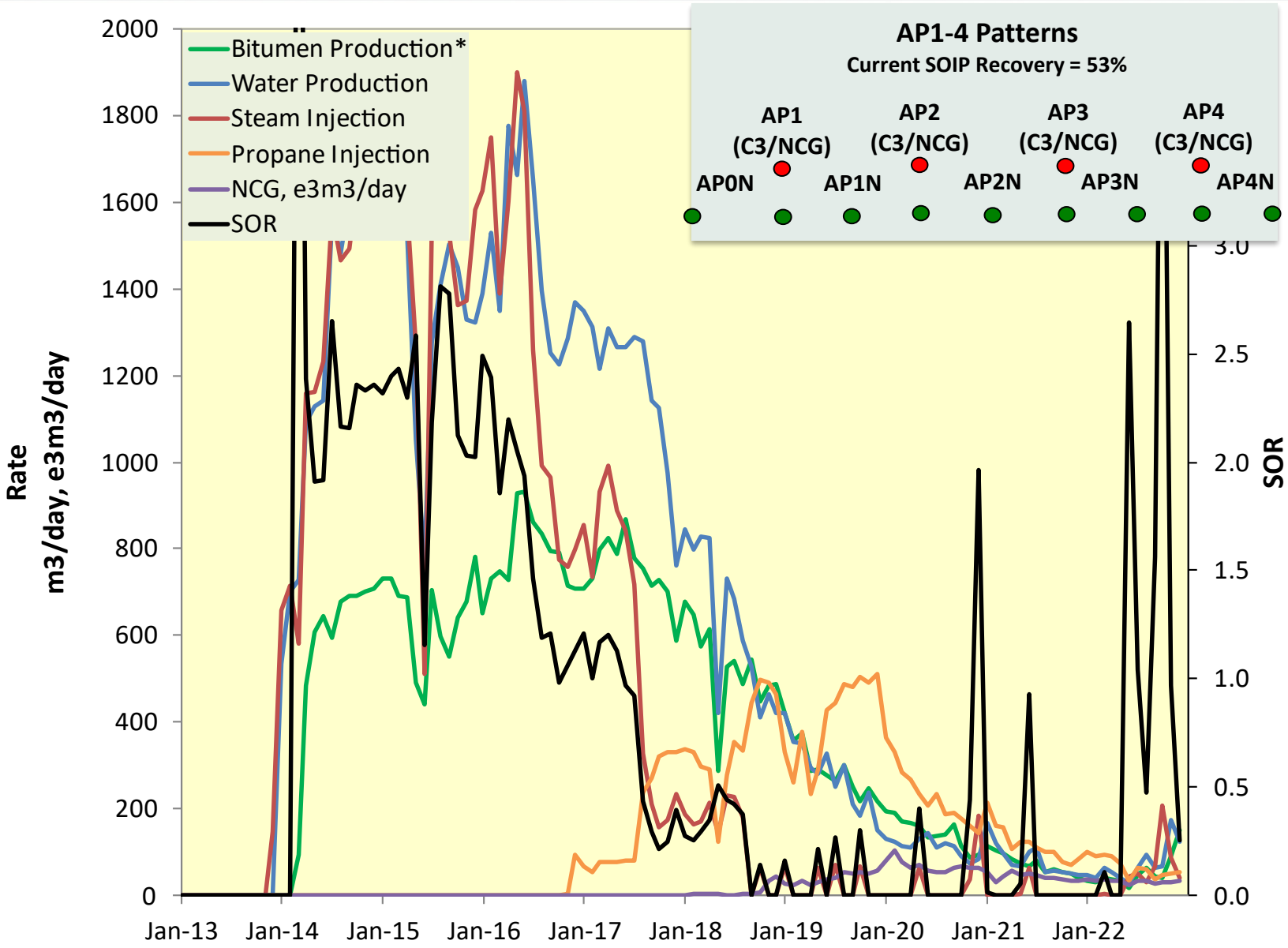


- Thermocouples are inside the instrument string to provide temperature measurements at selected locations
- Bubble tube is landed near ESP to provide pressure measurement for SAGD producer
- Upset production port (UPP) typically consists of holes located at the crossover from 4.5” to 3.5” tubing and is always open
- Inflow control device (ICD) consists of a sliding sleeve with holes that is initially closed and later opened when the well is mature

eMVAPEX Objectives

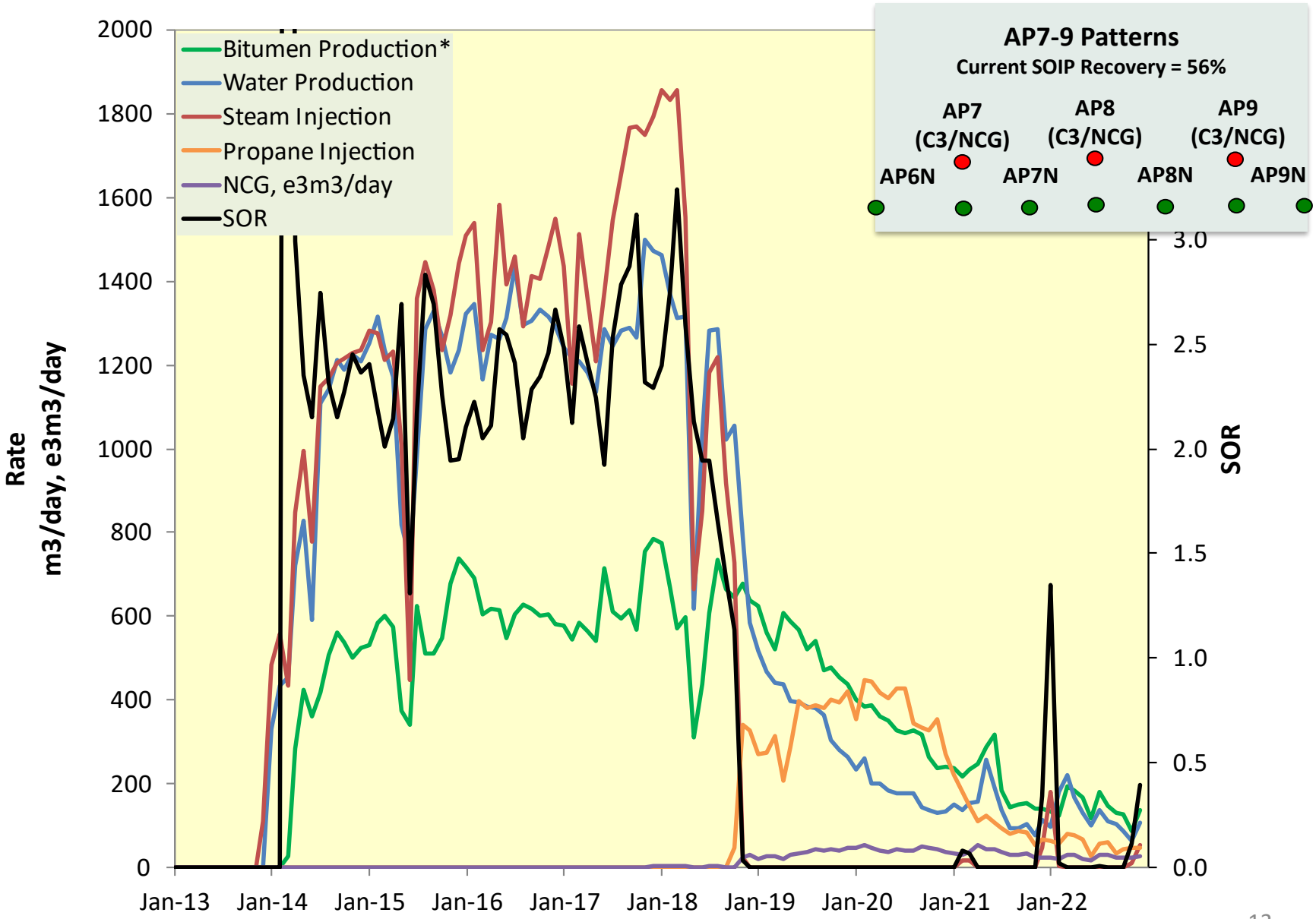
- **Reservoir performance**
  - Improve SOR, allowing for production growth
  - Maintain or increase bitumen production and recovery
  - Injected & produced solvent-oil-ratio and solvent recovery
  - Enhance oil quality
- **Solvent recycling**
  - Optimize propane recycle facility design and operation
- **Environmental benefits**
  - Reduce per barrel greenhouse gas intensity
  - Decrease water use intensity by requiring less steam for SAGD
  - Utilize existing infrastructure within current footprint to increase overall production

eMVAPEX AP1-4 Pattern Performance



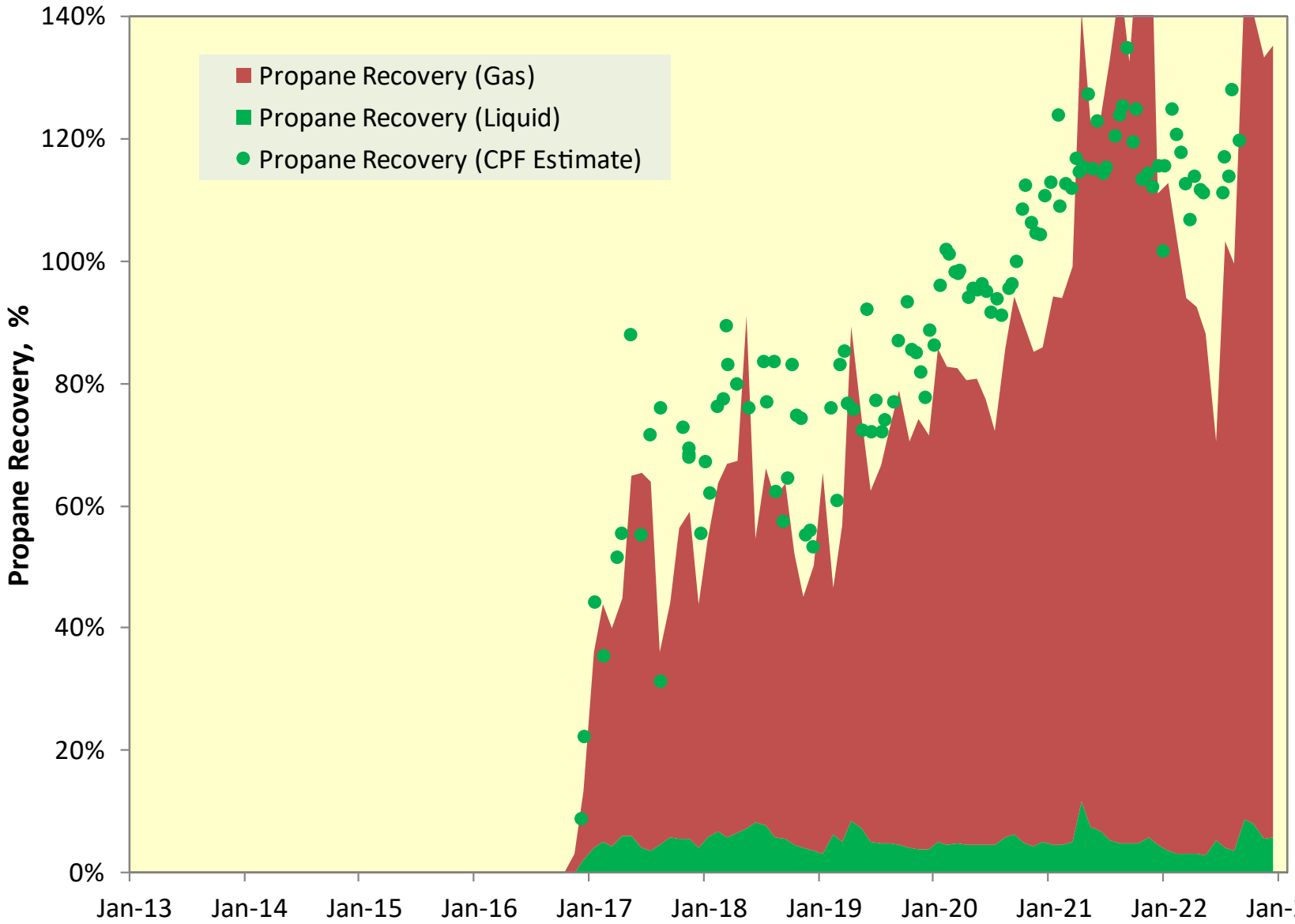
* Net produced solvent

eMVAPEX AP7-9 Pattern Performance



* Net produced solvent

eMVAPEX Estimated Propane Recovery from Reservoir



eMVAPEX Phase 3 Update

- Make-up propane purchases paused in January 2021 and since then only recycled propane has been injected
- AP1-4 and AP7-9 continue to be monitored to understand eMVAPEX performance
- AP5 and AP6 also commenced recycled propane/NCG injection in February 2021 to allow for more AP produced gas to be captured and limit the amount of propane sent to the Central Processing Facility by providing additional injection locations for recycled propane/NCG