TOTAL ARGENTINA GAS SHALE WELLS , IMPLEMENTATION OF CLEAN BASED FLUIDS

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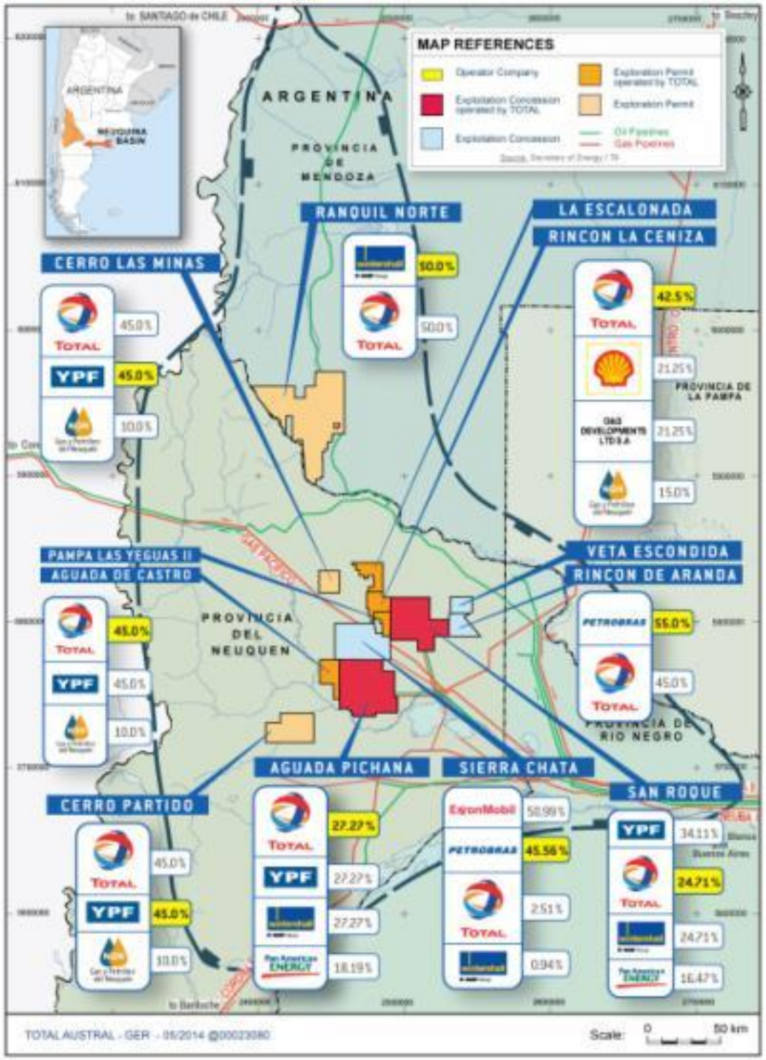
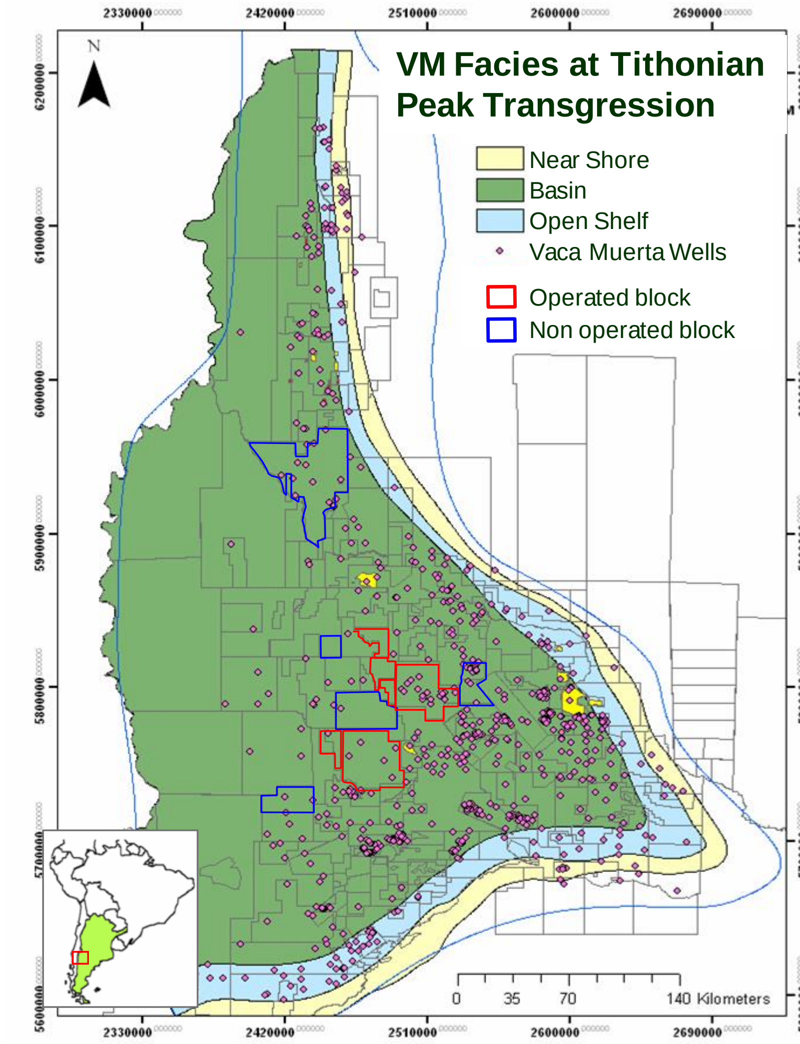
AADE FMG meeting , 21st February, 2019 - Alternatives to Diesel Based Fluids (Onshore)

PROJECT OVERVIEW

NEUQUEN BASIN – AGUA PICHANA (AP) BLOCK

VACA MUERTA (VM) ACREAGE





- **VM play area: 28,500 km^2**
- **Total operated area: 3,256 km^2 (11%) = 804,571 acres (vs. Utica JV: 660k acres)**
- **Total net share: 1,535 km^2 (5.2%) = 379,305 acres (vs. Utica JV: 155k acres)**

AGUADA PICHANA WELLS TIMELINE

2011 · 2012 · 2013 · 2014 · 2015 · 2016 · 2020

- **AP.xp-1001**
  - Vertical well - 4 fracs
  - Producing since May-12

EXPLO → ✓ **DISCOVER**

- **AP.e-1002(h) & AP-1007**
  - Horizontal well - 5 fracs & Vertical well - 4 fracs
  - Producing since Apr-14 & Jun-14

DELINEATION → ✓ **DEMONSTRATE PRODUCTIVITY**

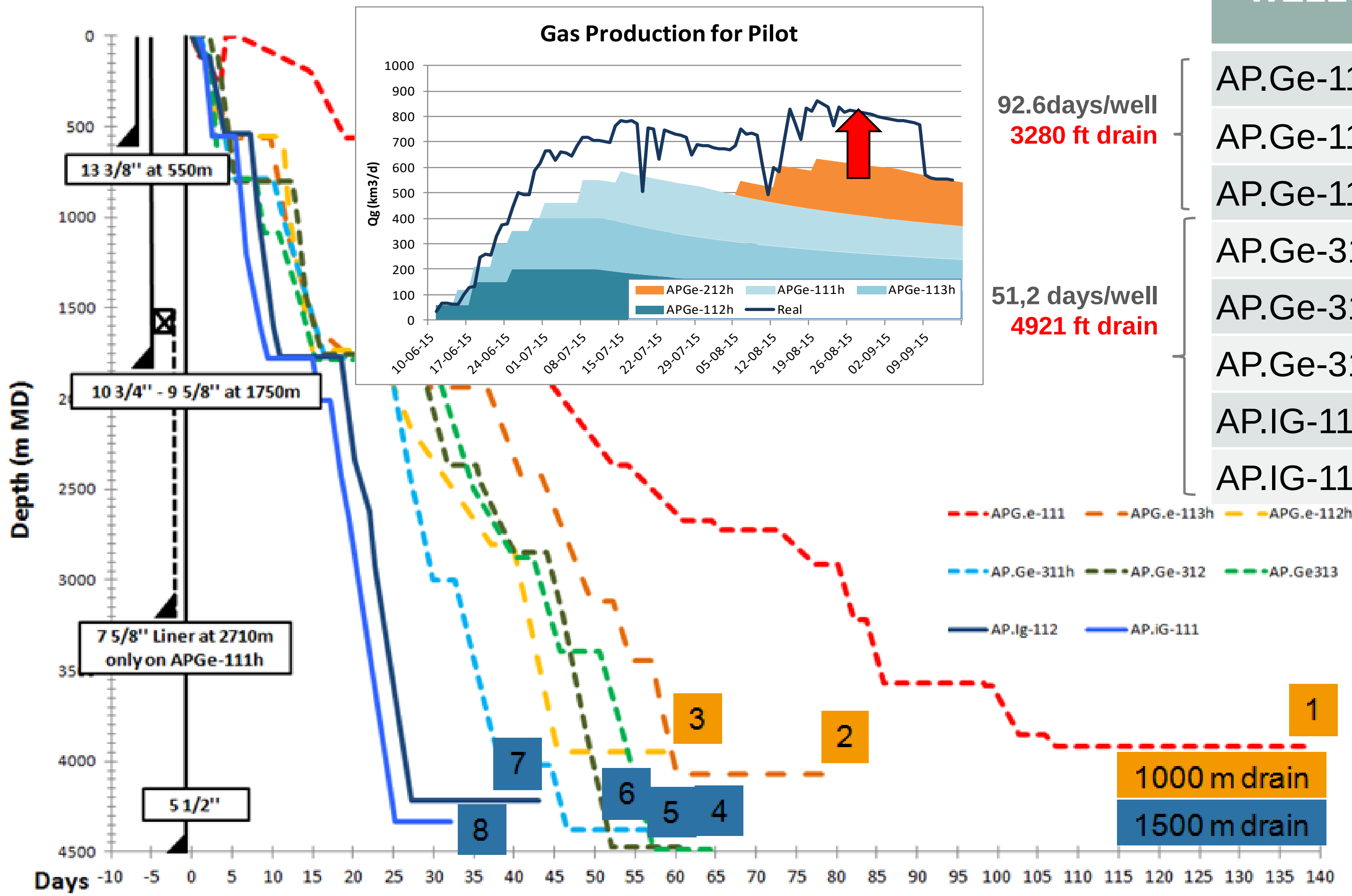
- **AP Pilot: PADs 1/2/3/4**
  - 10 Horizontal wells - 10 to 15 fracs per well
  - Producing since Jun-15 (PAD 1)
- **AP Pilot: PAD 5**
  - 2 Horizontal wells - 10 to 15 fracs per well
  - Gas-in Mar-16

PREDEVELOPMENT → ✓ **DEMONSTRATE COMMERCIALITY**

- **AP Shale Development 2 phases - 2016/2020**
  - Phase 1 2016: 20 wells / 2000 m drain / 20 fracs
  - Phase 1B 2018 - 2020: 32 wells / 25 fracs / 2500 m drain
    + 8 wells / 30 fracs / 3000 m drain

DEVELOPMENT → ✓ **LAUNCH PROFITABLE DEVELOPMENT**

AP PILOT WELLS CONCLUSION



92.6days/well
3280 ft drain

51,2 days/well
4921 ft drain

WELLS	NPT	Days
AP.Ge-111	42%	139
AP.Ge-113	14%	79
AP.Ge-112	17%	60
AP.Ge-313	20%	64.5
AP.Ge-312	17%	60.6
AP.Ge-311	20%	56.7
AP.IG-112	8%	41.8
AP.IG-111	9.8%	32.7

✓ Very encouraging results obtained with AP pilot confirm feasibility of a profitable development

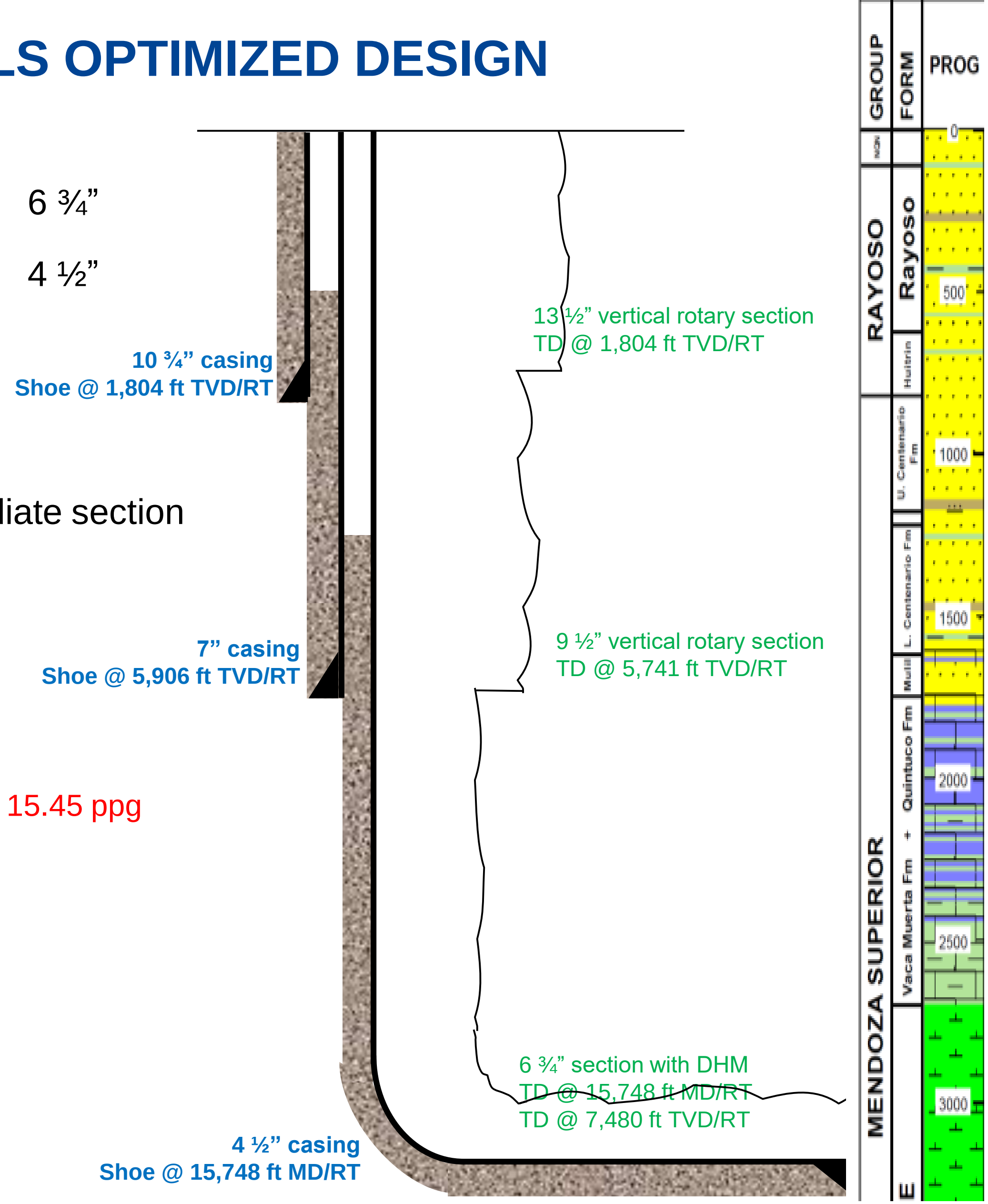
→ Approve & Launch Profitable Development

TOTAL

DEVELOPMENT WELLS
WELL ARCHITECTURE & PERFORMANCES

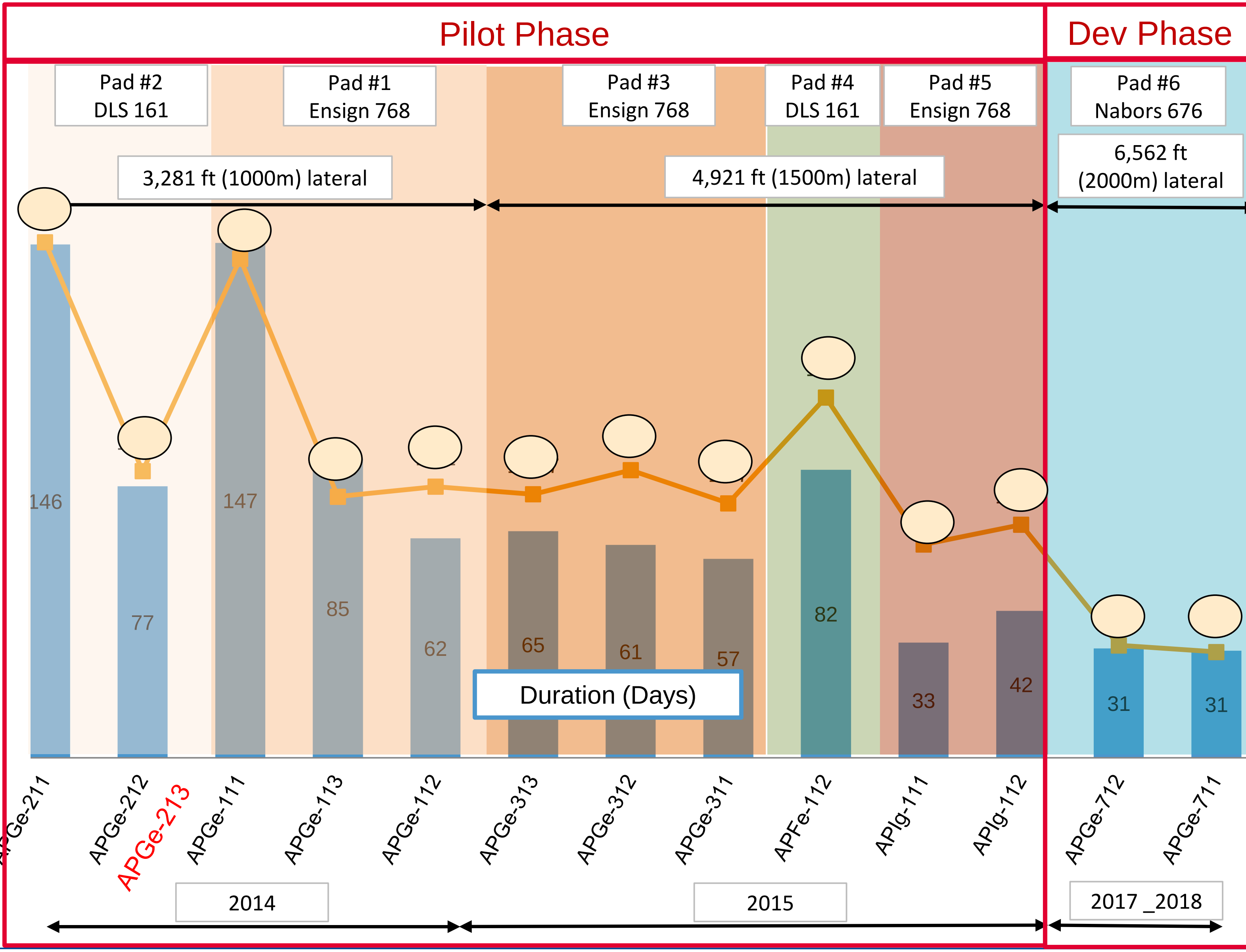
WELL ARCHITECTURE AP WELLS OPTIMIZED DESIGN

- Open hole sizes: 13 ½" 9 ½" 6 ¾"
- Casing diameters: 10 ¾" 7" 4 ½"
- Drain length: 6,500 ft / 8,620 ft
- KOP as low as possible, R planned = 8º/100 ft
- Rotating Circulating Device used from intermediate section
- Drilling Fluids:
  - 13 ½" section: WBM @ 9.2 ppg
  - 9 ½" section: Clean Based Fluids @ 10.85 ppg
  - 6 ¾" section: Clean Based Fluids @ 14.20 ppg - 15.45 ppg
- < 3% CO_2: Use of Carbon Steel
- No DHSV, Modified Well Head system
- 60 ft WH-to-WH distance

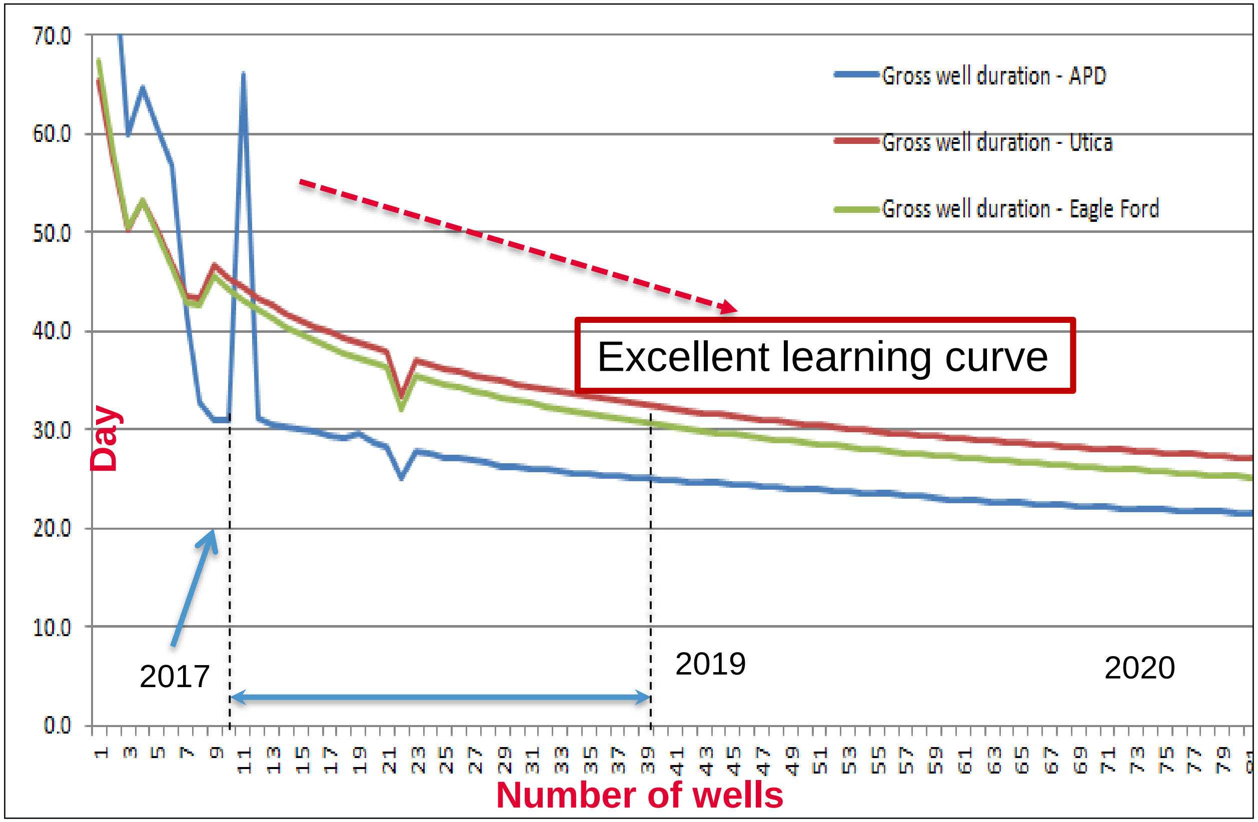


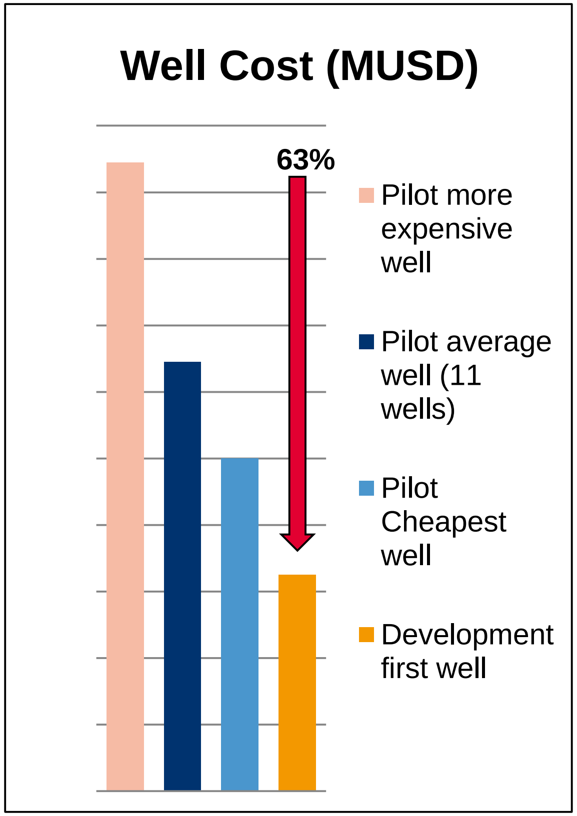
TOTAL

FROM PILOT TO PHASE 1-A WELLS



COST & LEARNING CURVE DEVELOPMENT PHASE WELLS

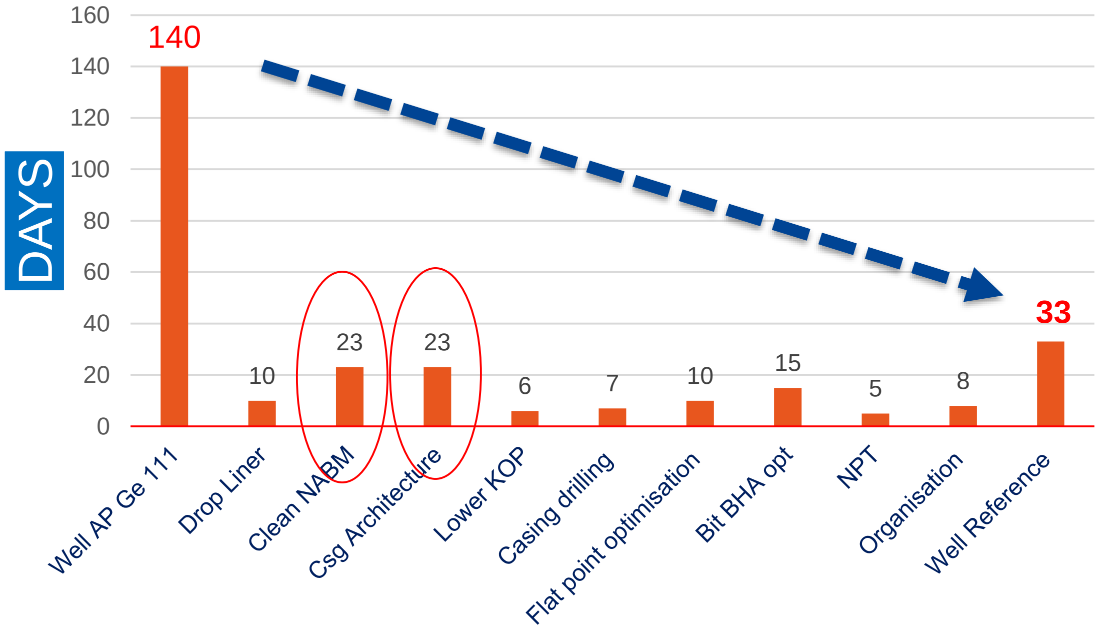




Major step change prior starting 2017 drilling campaign

Implementation of Clean NABM & Standardization of casing size architecture

DURATION PERFORMANCE ANALYSIS



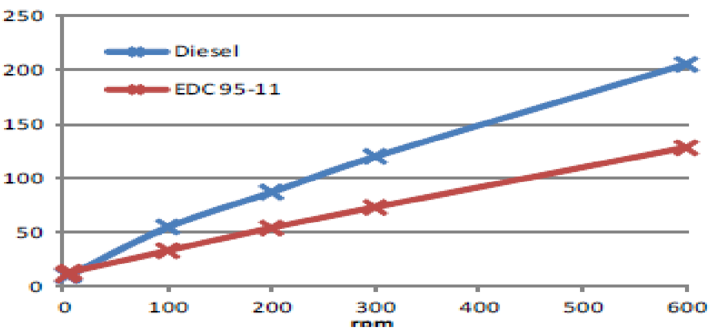
- Reduction of 107 drilling days from Explo well #1 to development phase well #1
- Clean Based Fluids implementation contributed up to 12% of the well duration reduction
- One of the most important parameter associated to drilling performances

Clean Based Fluids is a key player to decrease your DRILLEX

FLUIDS PROPERTIES DIESEL VS. CLEAN BASED FLUIDS

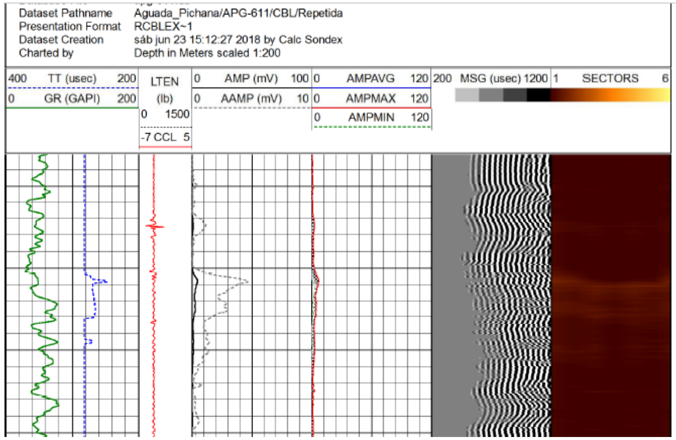
Mud properties	Diesel OBM	Clean Based Fluids
Feet drilled	8,100 ft	**9,100 ft**
Mud weight	14.20 ppg → 15.45 ppg	**14.20 ppg → 15.45 ppg**
Plastic viscosity	31 cP → 72 cP	**35 cP → 47 cP**
Yield value	11 → 26 lb/100ft²	**15 → 17 lb/100ft²**
Pressure losses (ECD)	16.52 ppg @ 265 gpm	**< 16 ppg @ 265 gpm**
Low gravity solids	2.0 % → 5.6 %	**2.5 % → 2.7 %**
HPHT Fluid loss - 250°F	< 4.0 cc	**< 4.0 cc**
Electrical stability	1,200 V	**800 V**
Oil Water Ratio (%)	81/19 to 92/8	**72/28 to 78/22**

	Diesel	EDC 95-11
MW (sg)	1.88	1.86
PV @ 50°C	85	55
YP	35	18
600	205	128
300	120	73
200	87	54
100	55	33
6	11	13
3	10	11
Oil % vol.	60	53
OWR	92/8	78/22



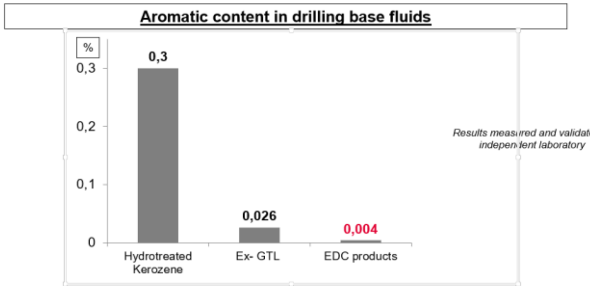
CLEAN BASED FLUIDS ADVANTAGES

- HSE Aspects (Low Aromatic and Benzene content)
- Clean Based Fluids has more stable properties than Diesel OBM:
  - → Reduced mud dilution / maintenance which leads to mud cost service savings;
  - → Avoids expensive mud losses in loss circulation zones;
  - → Minimizes formation damage.
- Pressure losses decrease which allow to deliver longer drains
  - → **Increased wells productivity so profitability**
- Better cementing operations
  - →To Optimize fracking operations and long term well integrity
- **DRILLEX Reduction**

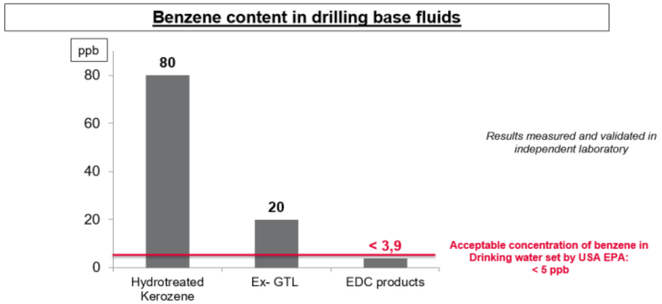


AROMATIC CONTENT

- Some Aromatic components found in hydrocarbon products are known to have bad effect on health of human beings



BENZENE BTEX CONTENT



- Only EDC Drilling base fluids meet the requirement of cleanliness of drinking water