MURPHY

EXPLORATION DRIVEN

DELIVERY FOCUSED

Production Chemicals Optimization Congress

Implementing a Metric-Driven Chemical Management Program

Presented by:

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Leslie Malone, Senior Staff Engineer

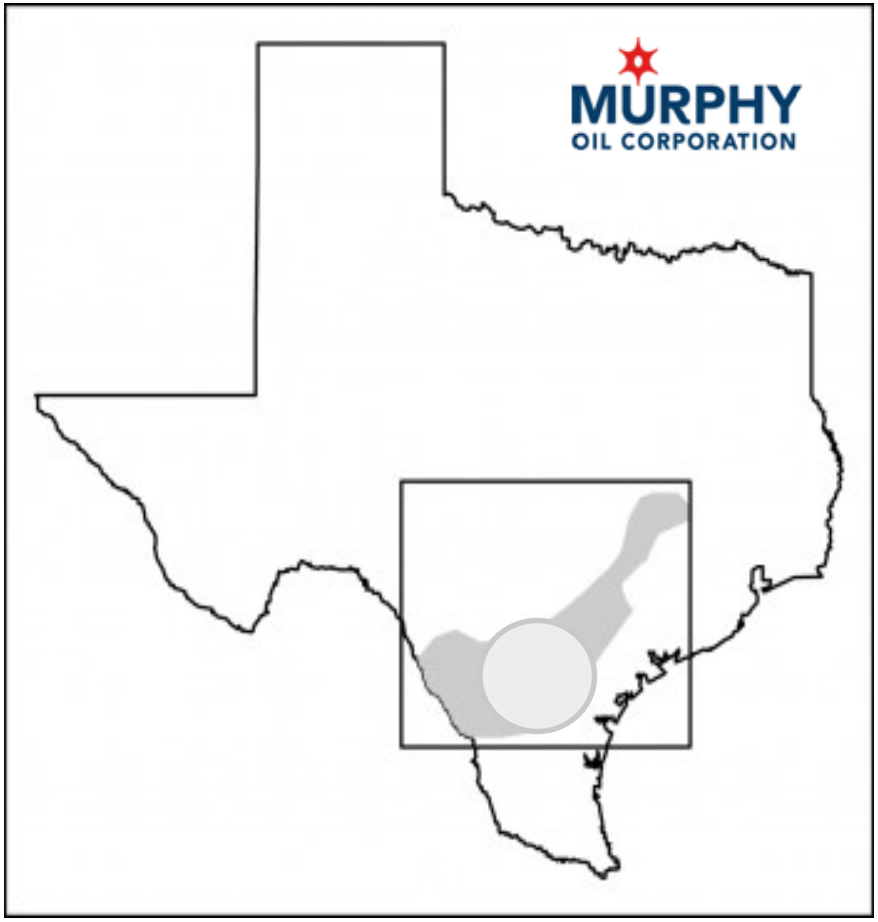
July 29th, 2015

Agenda

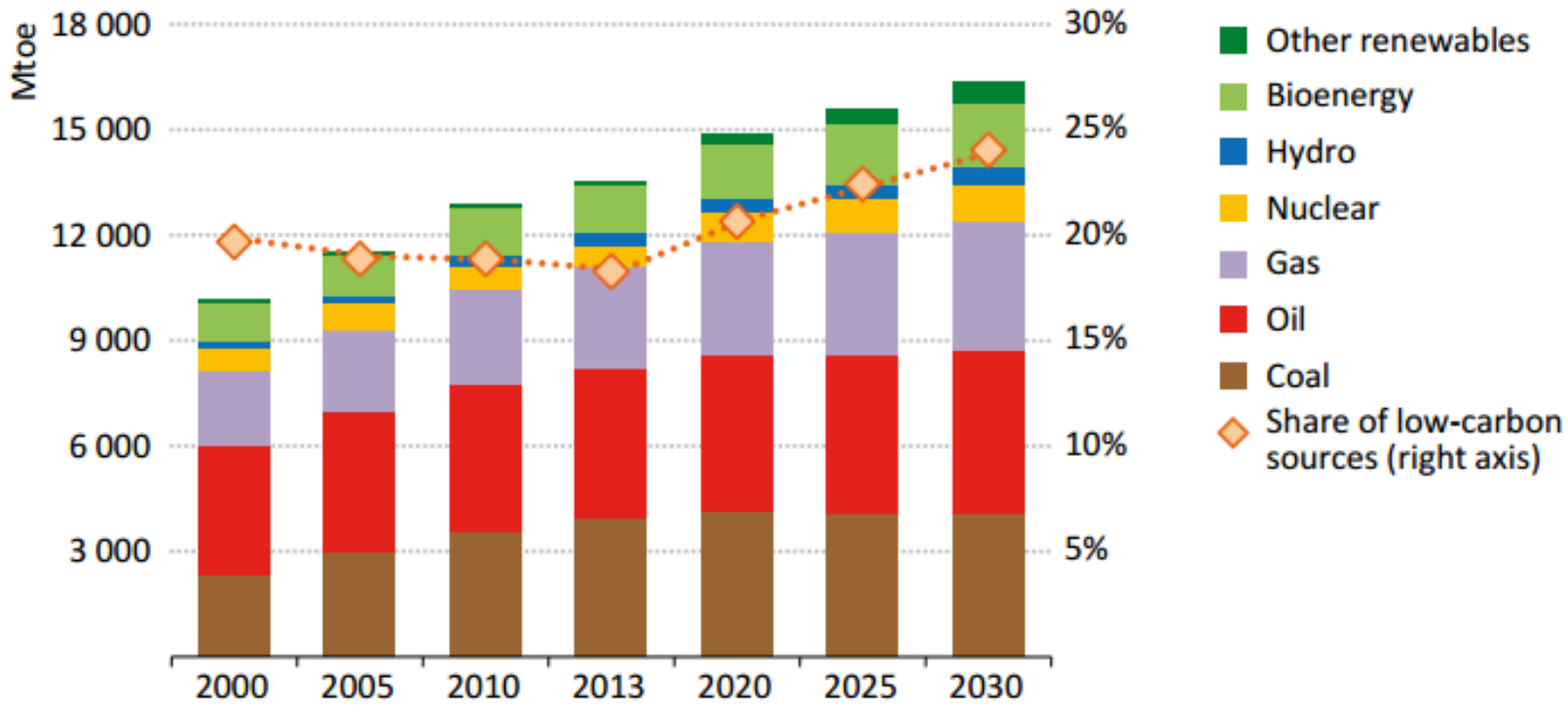
- **Challenge**
- **Chemicals**
  - H_2S
  - Paraffin
  - Biocide
  - Corrosion
  - SI
- **Practical Application**

Murphy Oil-Eagle Ford Operations

- Over 150,000 acres
- 600 + producing oil wells
- H_2S: Range 0 to 7%
- CO_2: 0 to 10%
- Geographically dispersed in the Eagle Ford
- 430 beam pumps operating
- Eagle Ford Head office, Houston, TX



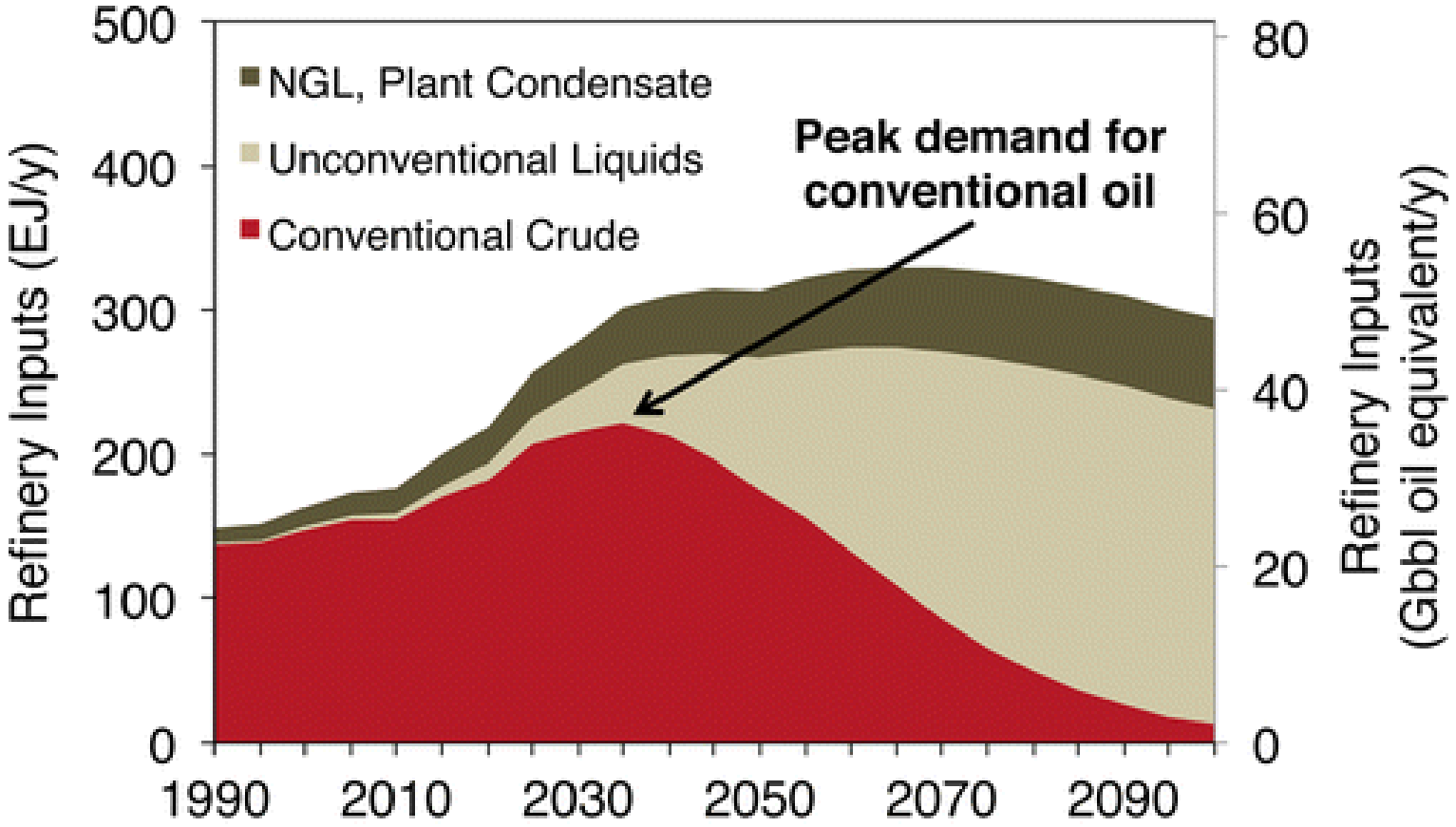
Global Energy Demand



Hydrocarbon still dominate in 2030 and beyond

- **IEA -** World Energy Outlook Special Report 2015: Energy and Climate Change – June 2015

Peak Oil

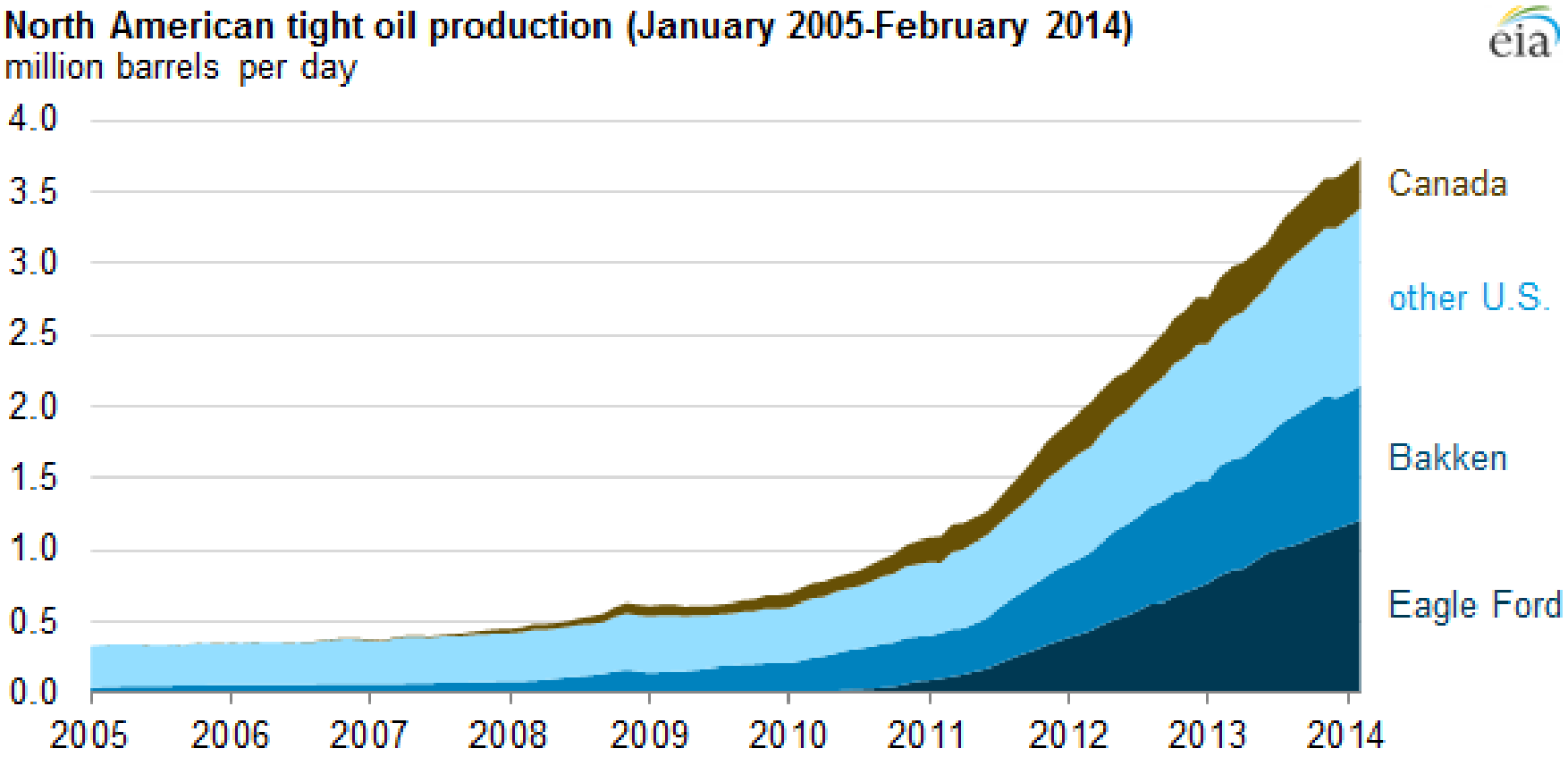


Peak Oil Demand: The Role of Fuel Efficiency and Alternative Fuels in a Global Oil Production Decline

Adam R. Brandt †*, Adam Millard-Ball ‡, Matthew Ganser †, and Steven M. Gorelick §

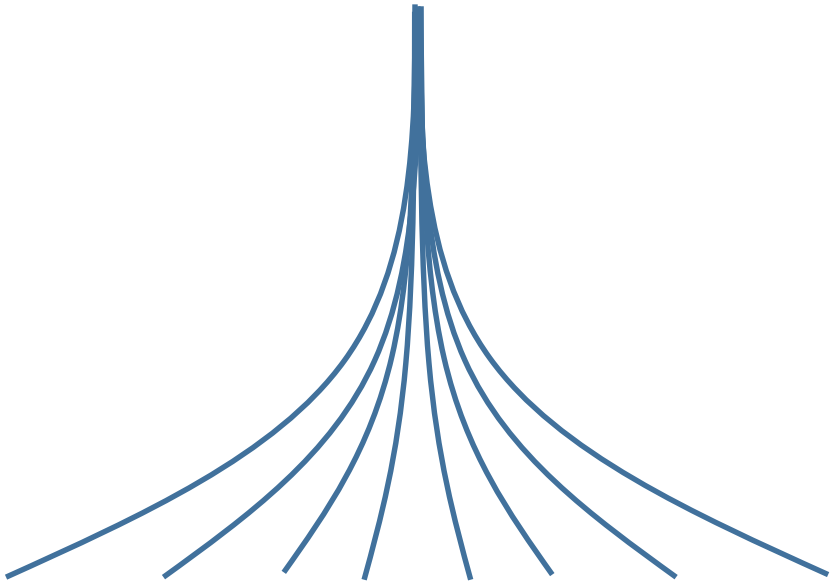
† Department of Energy Resources Engineering, Stanford University, Stanford California 94305, United States

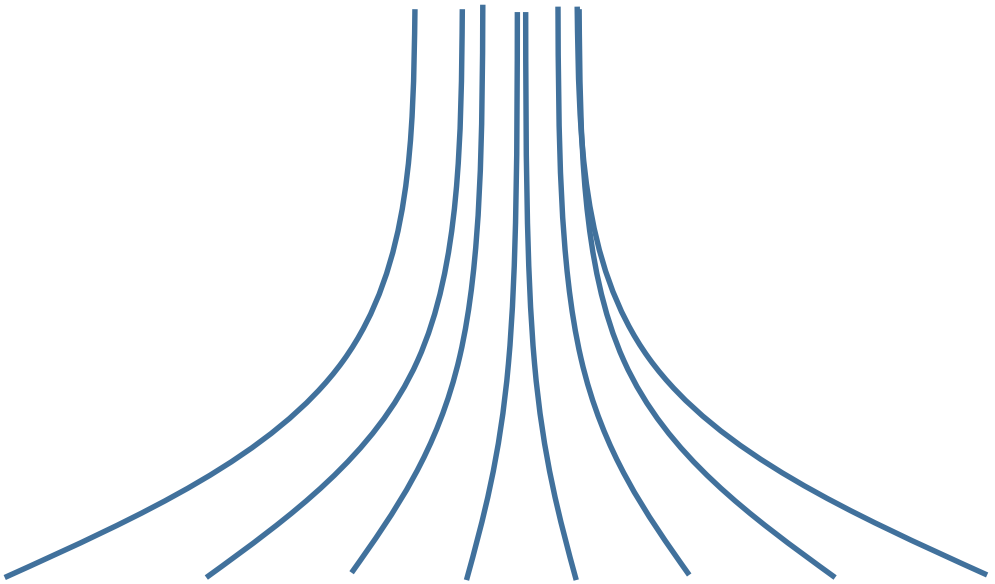
US Unconventional Plays



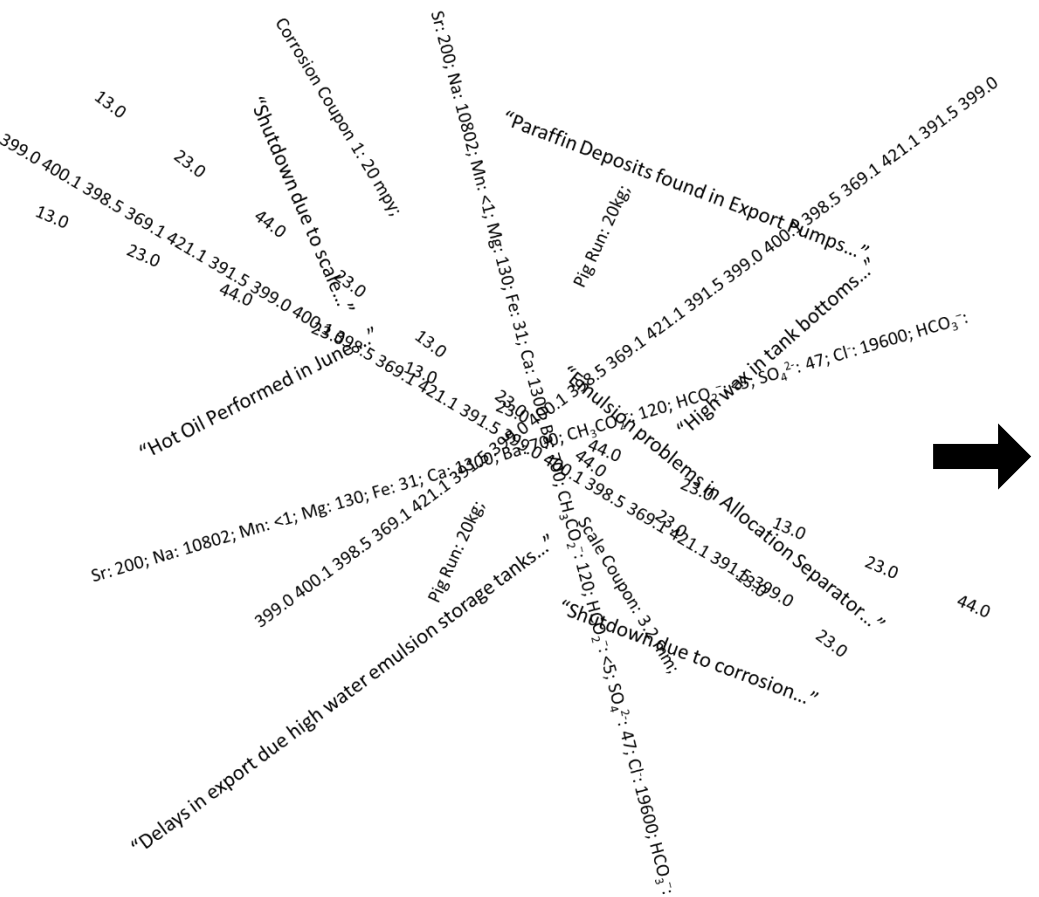
EIA – 2014 Report

Conventional





Database

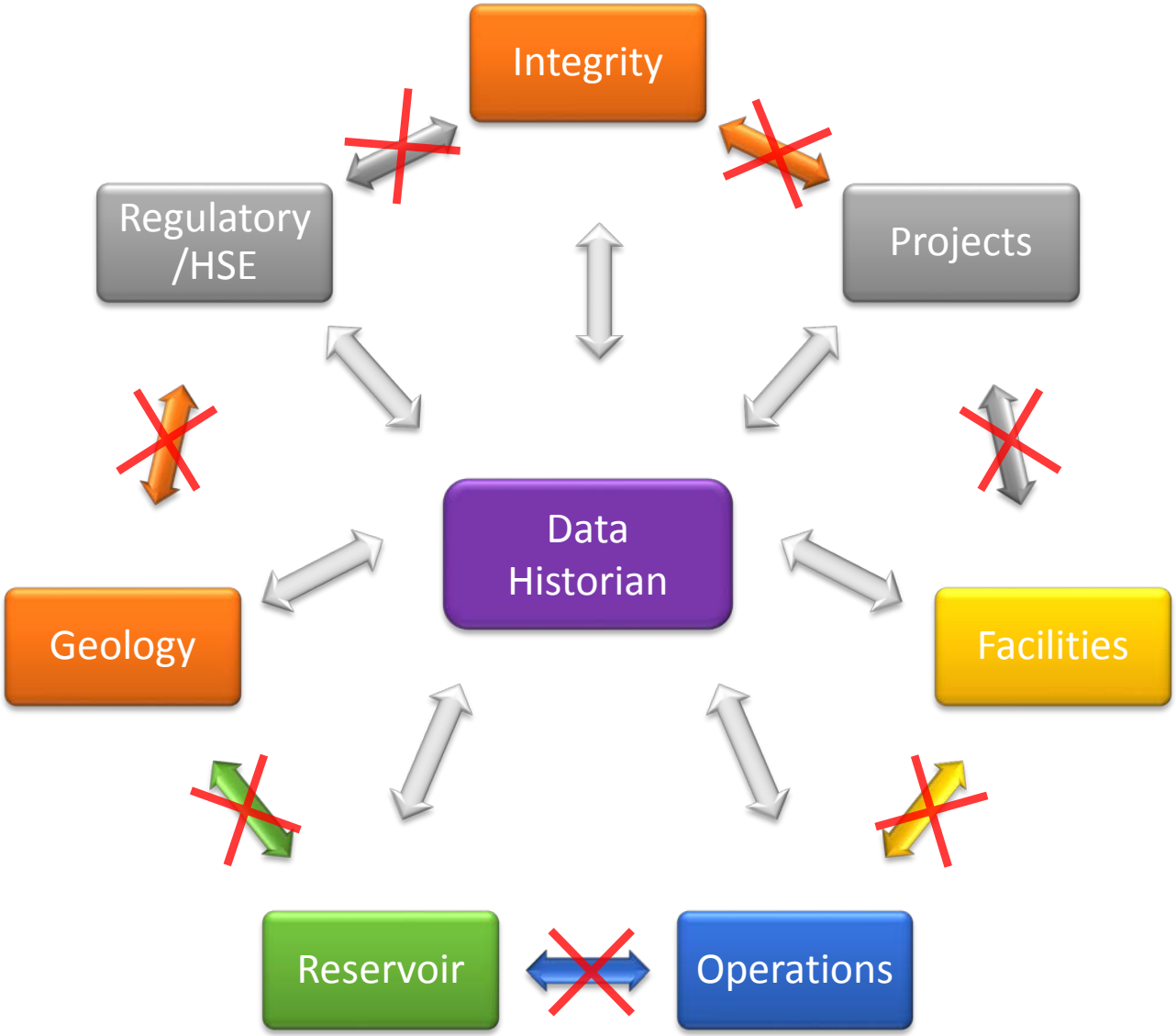


ProductionDate	Oilproduction	WaterProd...	Gas_Produ...	FlareVent
2/15/2014 12:00:00 AM	179.69	0.00	166.67	153.051
2/16/2014 12:00:00 AM	227.01	0.00	213.24	197.253
2/17/2014 12:00:00 AM	226.64	0.00	222.43	205.592
2/18/2014 12:00:00 AM	241.56	0.00	209.25	193.154
2/19/2014 12:00:00 AM	263.69	16.15	219.35	204.888
2/20/2014 12:00:00 AM	244.73	21.64	226.95	211.074
2/21/2014 12:00:00 AM	240.44	8.89	238.41	219.559
2/22/2014 12:00:00 AM	239.01	5.00	222.22	205.809
2/23/2014 12:00:00 AM	281.56	4.30	222.95	207.733
2/24/2014 12:00:00 AM	265.23	0.00	224.77	209.51
2/25/2014 12:00:00 AM	245.64	0.00	216.44	200.393
2/26/2014 12:00:00 AM	212.85	0.00	255.51	240.06
2/27/2014 12:00:00 AM	214.44	0.00	255.73	240.445
2/28/2014 12:00:00 AM	240.04	0.00	258.89	243.288
3/1/2014 12:00:00 AM	238.05	0.00	269.26	254.591
3/2/2014 12:00:00 AM	205.34	28.89	250.48	233.646
3/3/2014 12:00:00 AM	213.03	0.00	191.34	177.246
3/4/2014 12:00:00 AM	195.99	0.00	67.50	62.8838
3/5/2014 12:00:00 AM	205.76	7.31	146.76	135.591
3/6/2014 12:00:00 AM	201.52	16.88	182.81	168.967
3/7/2014 12:00:00 AM	208.56	118.74	185.99	171.98
3/8/2014 12:00:00 AM	201.51	18.60	178.50	164.702
3/9/2014 12:00:00 AM	207.99	11.15	182.47	168.854
3/10/2014 12:00:00 AM	216.60	12.52	190.28	176.564
3/11/2014 12:00:00 AM	223.40	14.54	169.26	156.276
3/12/2014 12:00:00 AM	174.87	6.51	197.39	184.854
3/13/2014 12:00:00 AM	165.58	0.00	174.49	163.78
3/14/2014 12:00:00 AM	184.33	16.92	199.17	185.376
3/15/2014 12:00:00 AM	201.41	0.00	200.40	187.385

Several H_2S Database

- Operations
- Field Service Reports from Chemical Service Provider
- Meters

Integration



Best Practices - Database

- **Drilling**
  - Toe up, toe down…
- **Completions**
  - Frac Water Chemistry, well spacing, guar, proppant…
- **Productions**
  - Oil, Gas, Water Rate, T, P…
  - Water Quality: TSS, TDS, pH, Dissolved Oxygen
  - **Water Chemistry**: Na, Mg, Ca, Ba, Sr, Fe, HCO_3, SO_4…
  - Oil Assay: API, Wax, %Asphaltene, Naphthanate
  - **Production Chemistry**
- **Operational Data**
  - Shut-down, turn around, Pigging…

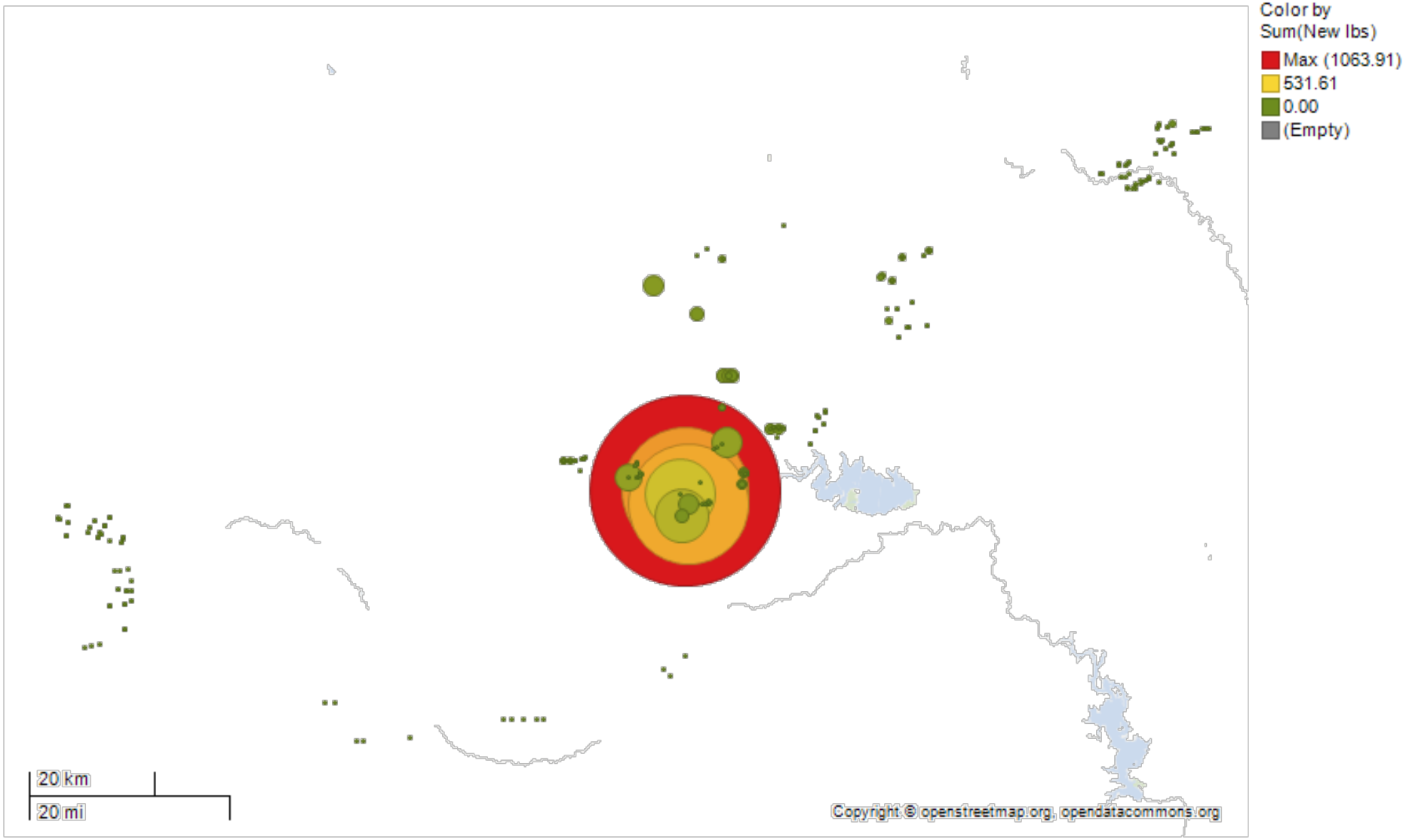
- ~~PDF~~
- ~~Locked Excel~~

- **Standardize** Report formats
- Develop a **Strategy** for monitoring
- **KPI**

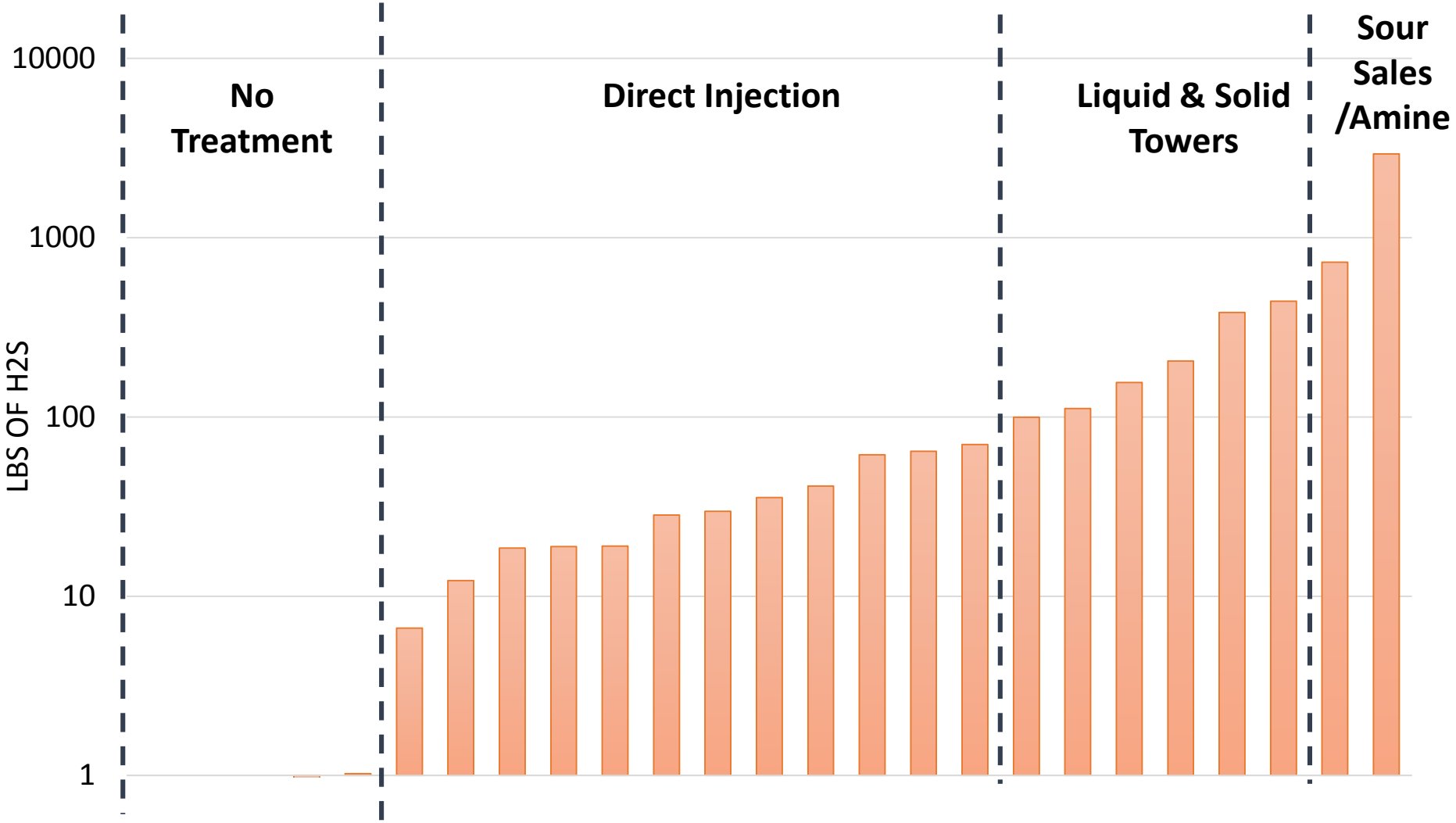
H_2S

Data Visualization

Geographic H2S Profile



Facilities Review



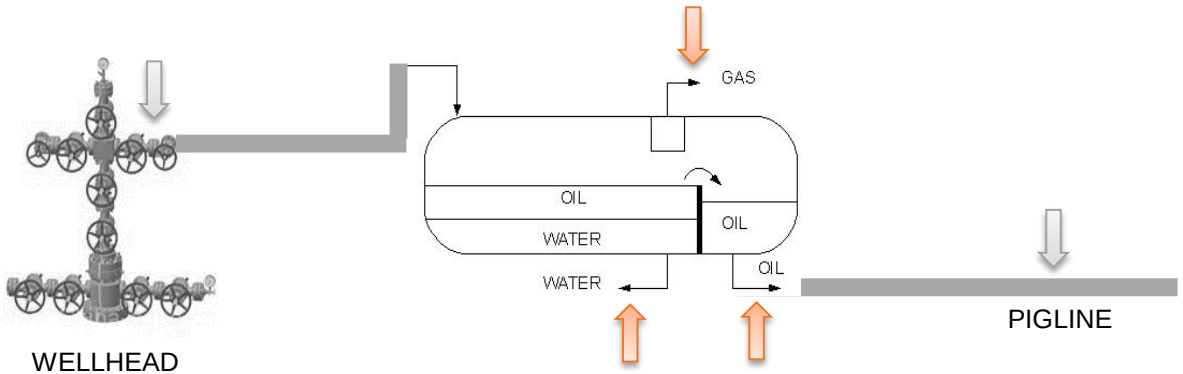
Direct Injection – Water Soluble Scavenger

Key

	Low Injection Rate	Medium Injection	High Injection Rate

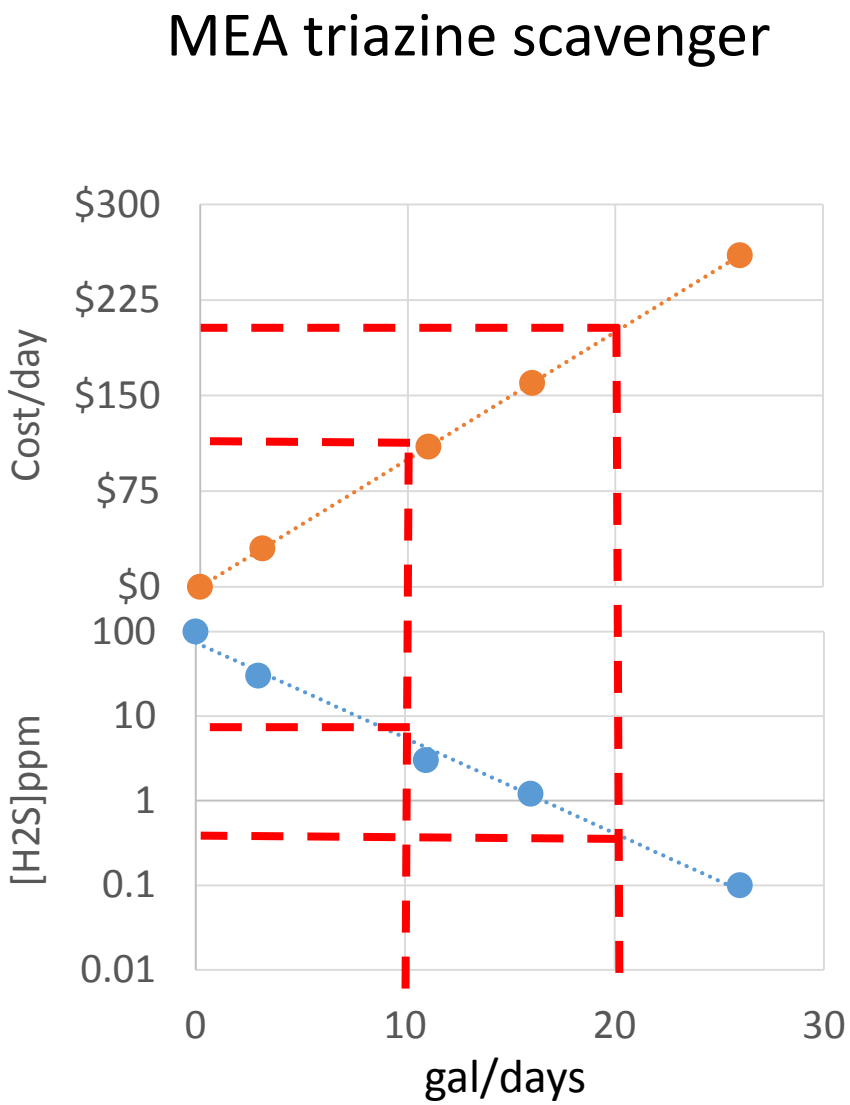
	AM		PM
Day 1	HS&E	Baseline-Well 1	Baseline-Well 2
Day 2	Vendor 1 –Well 1		Vendor 2 –Well 1
Day 3	Vendor 3 –Well 1	Baseline-Well 1	OS-Well 1
Day 4	Vendor 1 –Well 2		Vendor 2 –Well 2
Day 5	Vendor 3 –Well 2		OS-Well 2

- H_2S
  - Oil
  - Water
  - Gas
  - pigline

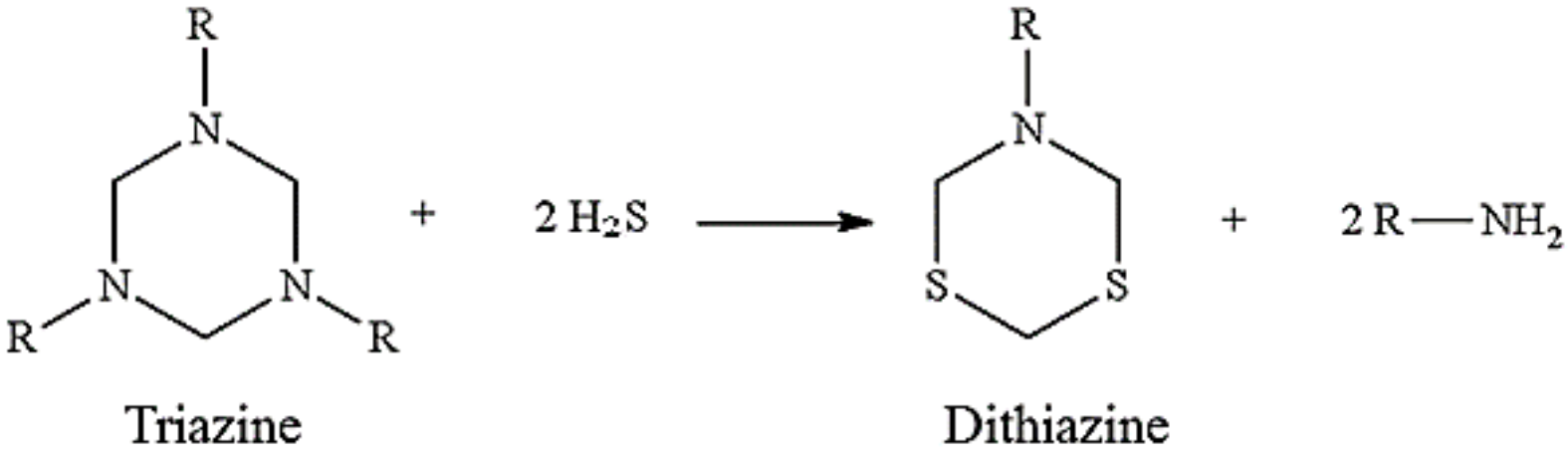


- Water
  - pH
  - Hardness
    - Calcium
    - Magnesium
  - Millipore
  - Emulsion

H_2S Scavenger Performance & Economics



H_2S Scavenger – Flow Assurance



Triazine

5 gal

1 lbs.

Dithiazine

2.4 lbs.

H_2S (ppm)	Gas Rate (MCFD)	Chemical rate (GPD)	dithazine (lbs/day)
100	500	23	11
10000	500	2347	1100

Conclusions – H_2S

- Triazine is still the most economical option for sub-50 lbs H_2S application
- Oil Soluble – poor efficiencies
- Centralized treatment best strategy
- Solid Tower not the best option due to CAPEX

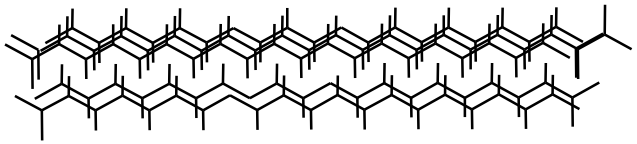
Treatment Technology*	Cases	Expectation ($/lbs of H_2S)	Actual ($/lbs of H_2S)	
			Low	High
Direct Injection	50	$18	$ 31	$ 202**
Liquid Tower	8	$13	$ 15	$ 21
Solid Media Tower	4	$ 6	$ 20	$ 41

*CAPEX + OPEX – 3 year payout

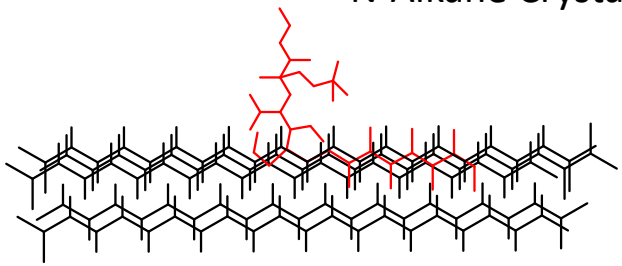
**when managed by service provider

Paraffin

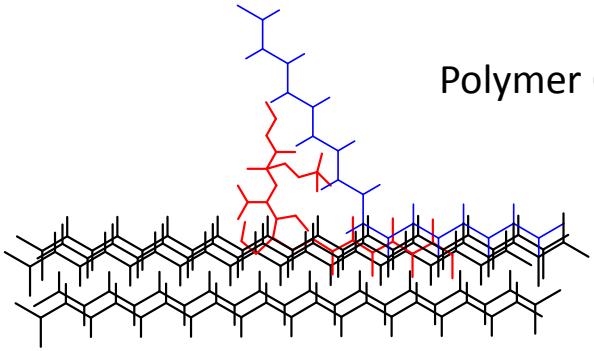
Paraffin Inhibitor



N-Alkane Crystal Formation

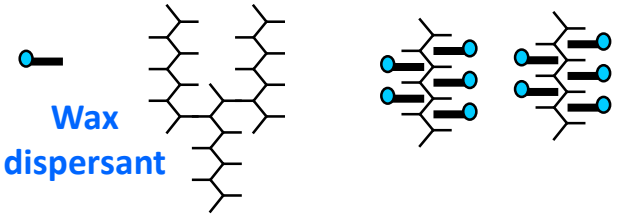


Polymer Co-crystallisation

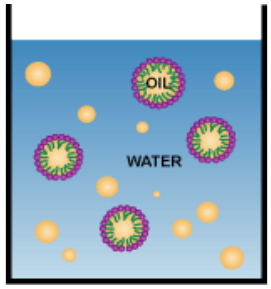


Crystal Distortion

Wax Dispersants



Wax crystal agglomerate



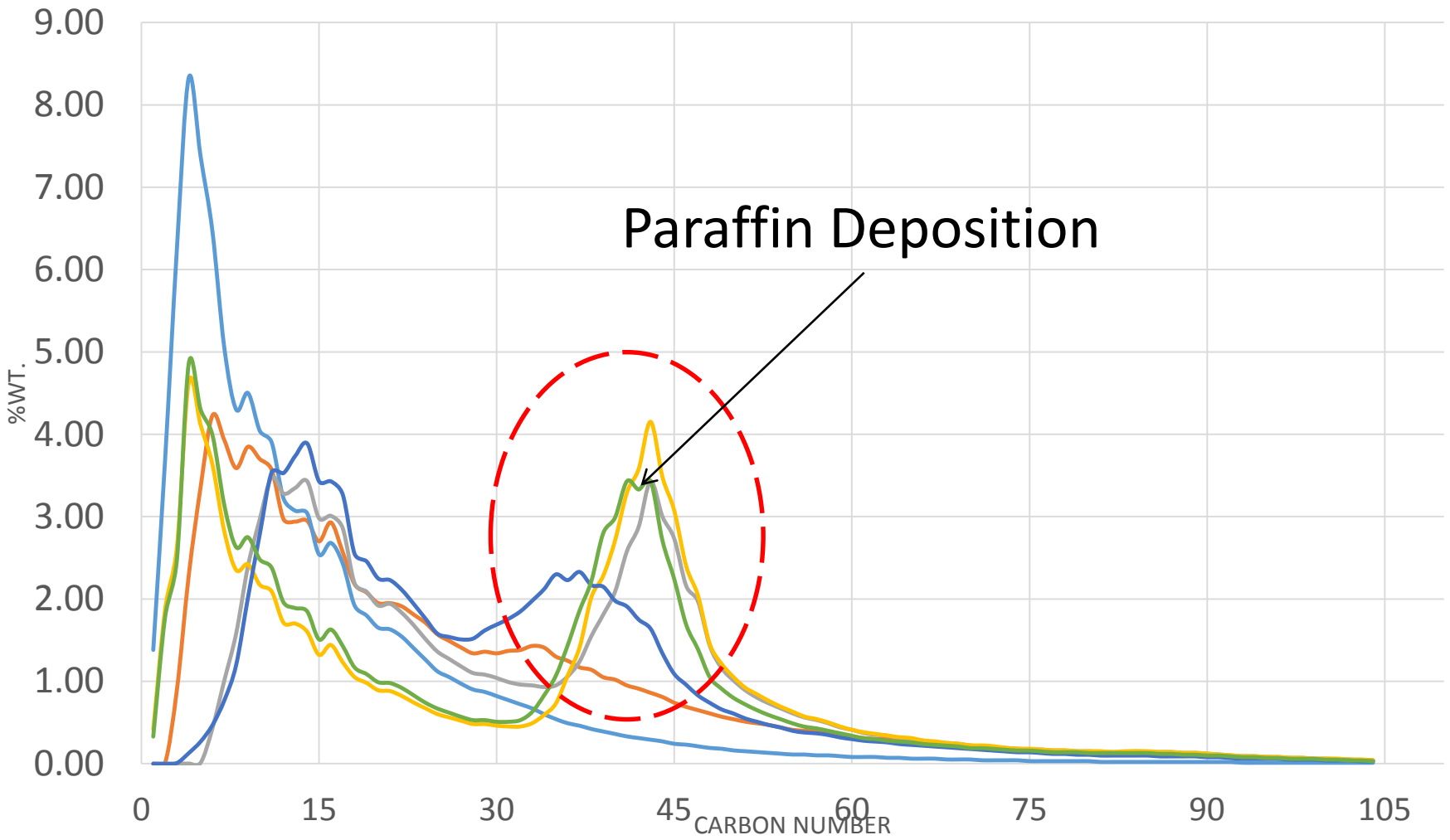
Advantages over conventional paraffin inhibitors:

- Lower dosages required
- Can be applied below the Wax Appearance Temperature

Solvents

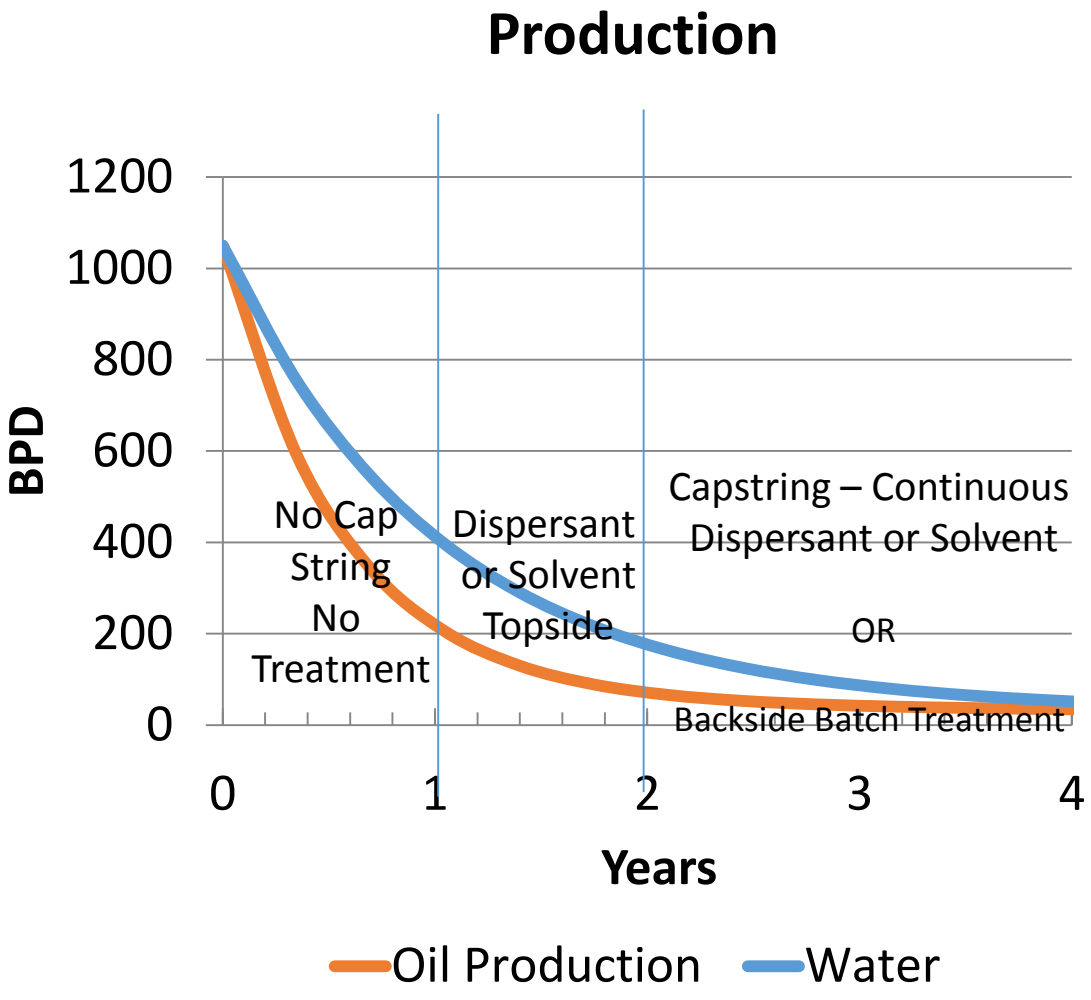
- Xylene
- Diesel
- Kerosene
- Tolune
- Naphtha

HTGC

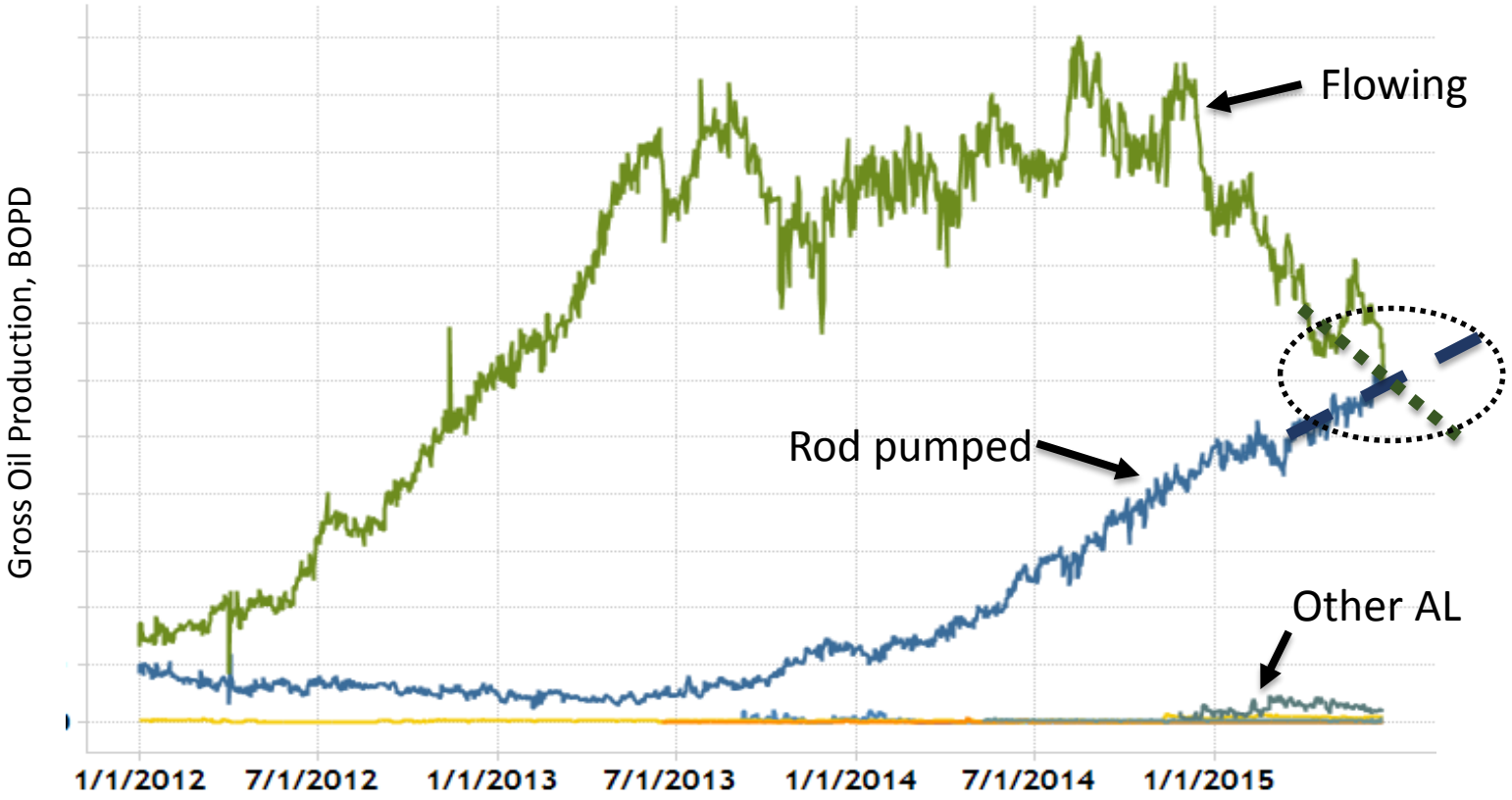

Paraffin Deposition
%WT.
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0
15
30
45
60
75
90
105
CARBON NUMBER

Conclusions from the Model

- Dispersant should the best results
- Solvent also provide good results but high dosage made it uneconomical
- Crystal Modifier shows poor results



Artificial Lift Production Equals Flowing Production



Practical Applications

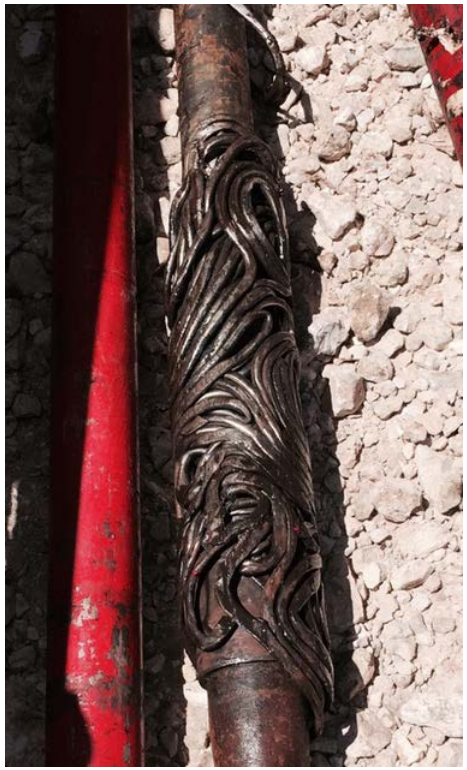
Chemical Pumps

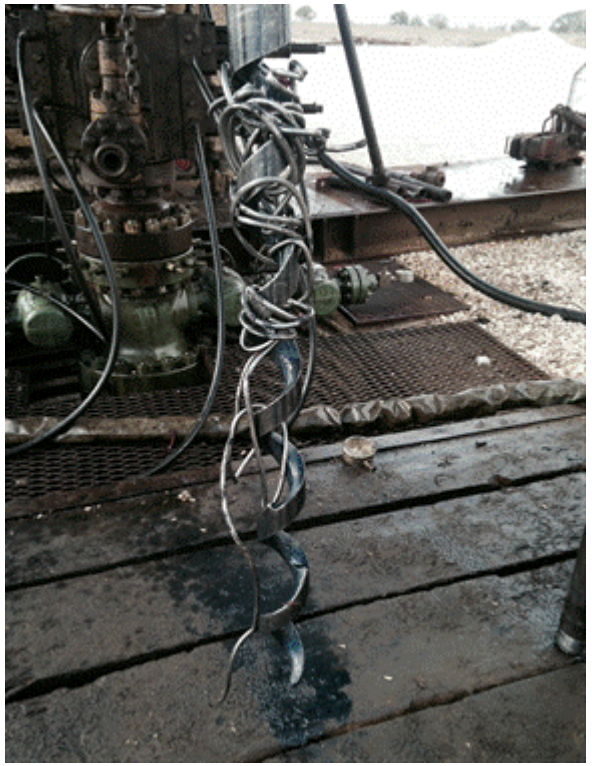
- Fit for purpose
- Maintenance
- Injection Rate

Practical Applications

Cap Strings

- Installed at 5000 ‘
- Connected
- Plugged
- Failures





Practical Applications

Hot Water - Batch Treatments

- Management
- Tracking
- KPI’s

Practical Application

Automation

- VSD to automate injection rate
- Adjust rate based on production
- Shut off chemical automatically when well is down

- **Questions**