Presented By: Trey Moore

January 17, 2018

HISTORY

- Ownership has a background in O&G production and processing equipment (Cimarron Energy 1977-2012)
- Urged by customers in early 2000's to provide evaporative solution for produced water in the Piceance Basin
- Began utilizing submerged combustion technology in 2009
- Founded Logic Energy Solutions in 2012 with a focus on oil and gas wastewater evaporation
- Operated evaporators in the following producing areas:
  - STACK (Oklahoma)
  - Permian (Texas)
  - Fayetteville (Arkansas)
  - Bakken (N. Dakota)
  - Marcellus (Pennsylvania)
  - Utica (Ohio)
  - Powder River (Wyoming)

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STRATEGY

- Evaporate close to the source, and reduce truck traffic as a result

- Provide modular equipment that can be easily relocated

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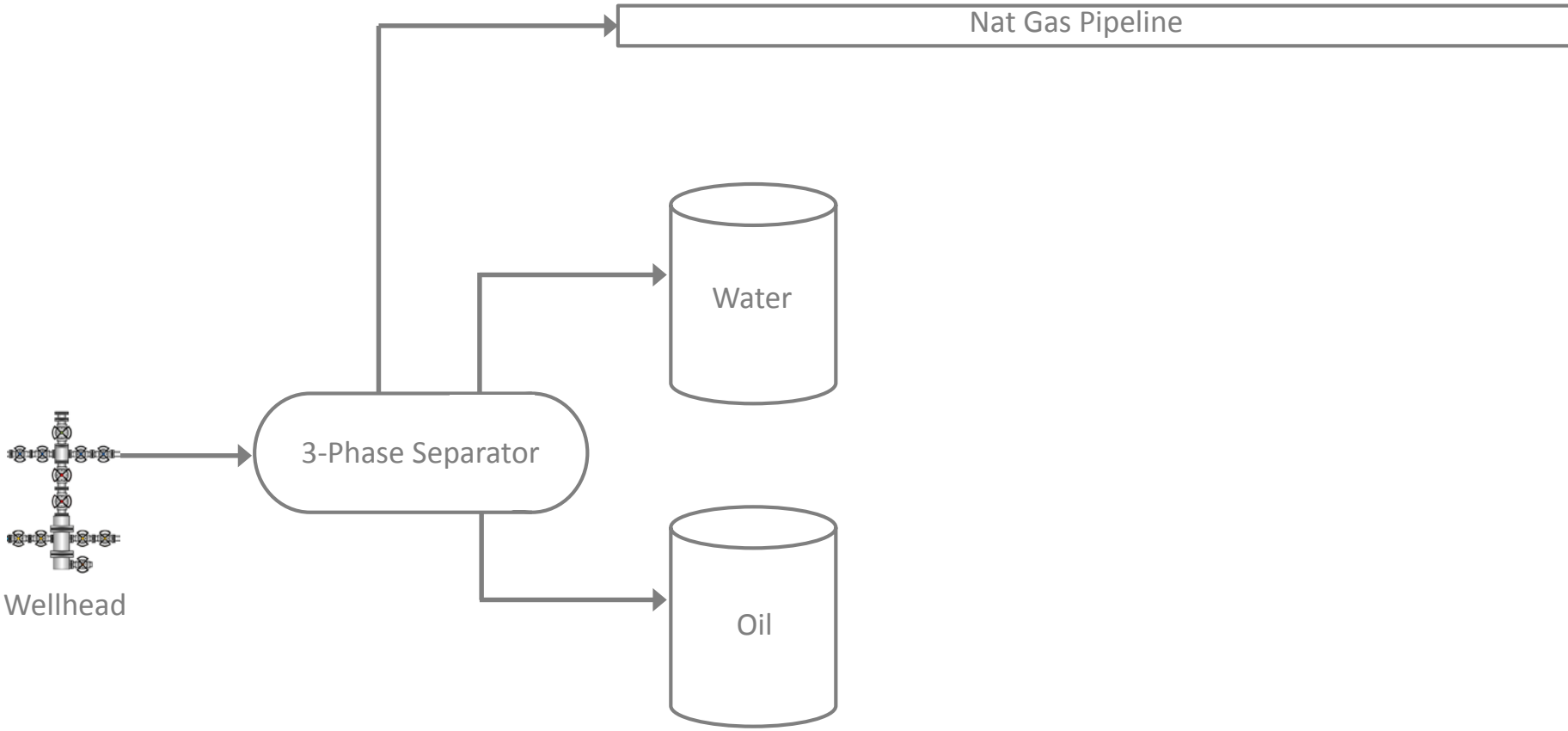
STRATEGY

Well Site Flow Diagram



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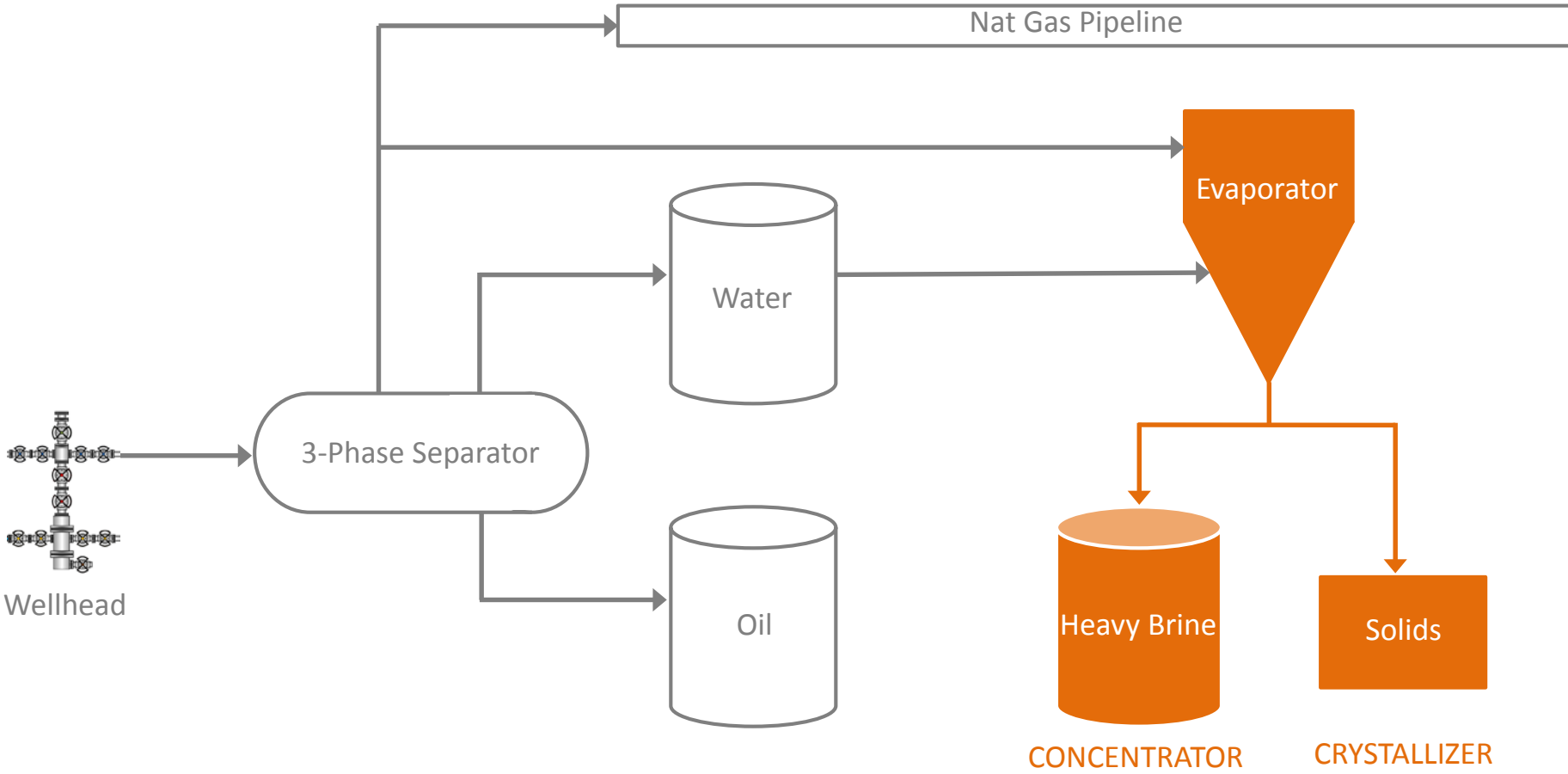
STRATEGY

Well Site Flow Diagram



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STRATEGY

Volume Reduction via Concentration

Influent TDS (mg/L)	325,000mg/L Concentrate
30,000	91%
50,000	85%
100,000	69%
150,000	54%
200,000	38%
250,000	23%

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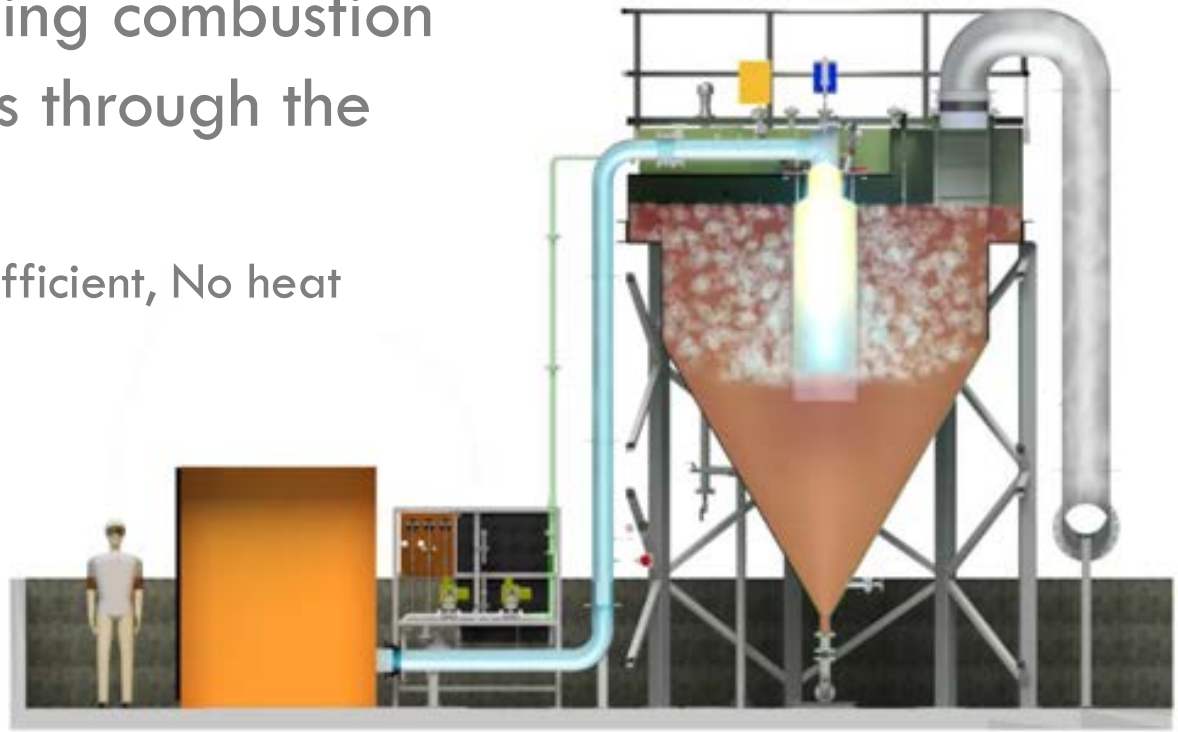
PROCESS

Submerged Combustion is a thermal process which heats a liquid by forcing combustion exhaust gases through the solution

Primary Benefits: Efficient, No heat transfer surfaces



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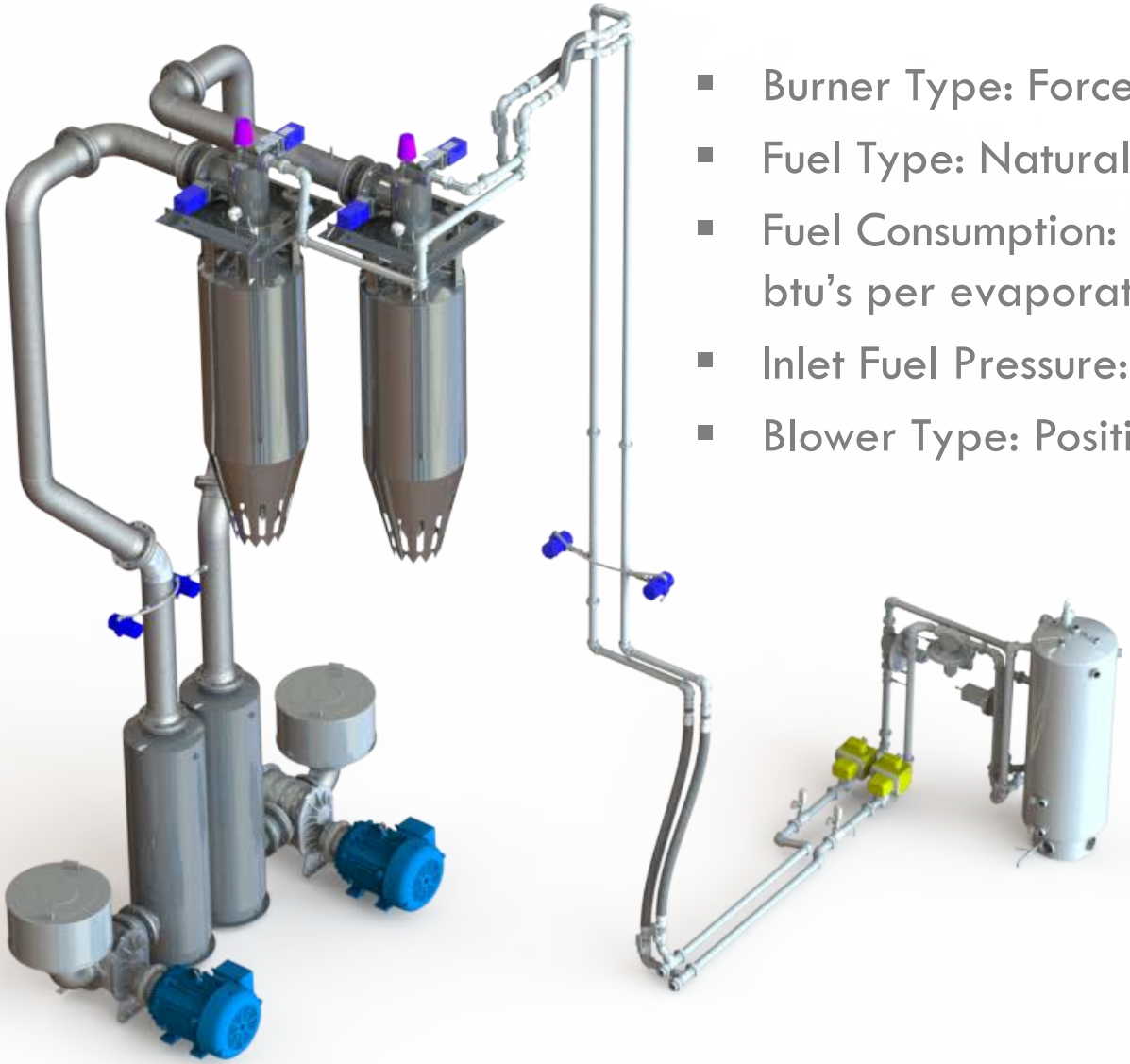
PROCESS



- Burner Type: Forced Air
- Fuel Type: Natural Gas
- Fuel Consumption: 400,000-450,000 btu's per evaporated barrel
- Inlet Fuel Pressure: 15 psi
- Blower Type: Positive Displacement

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PROCESS

- Evaporate up to 1,000 bpd (1,750 gal/hr)
- 1 Day Mobilization
- 25'W x 25'L x 30'T
- Dry Weight of 45,000 lbs
- Operating Pressure: 10 Oz.
- Operating Temp: 180°F
- Materials of Construction:
  - Carbon Steel
  - 2205 Stainless Steel
  - Fiberglass

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IMPACTS

- NOISE: <85 dBA
- VISUAL: White plume that varies in size depending on atmospheric conditions and evaporation rates; never had a complaint
- SURFACE: TDS of water vapor is less than 500 mg/L
- ODOR: Little to no smell, unless VOC's are in the vapor plume

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MANAGING EMISSIONS

- Particulate Matter (PM): Carryover of droplets containing solids
- Combustion Gases: Incomplete combustion causes the release of organic compounds to atmosphere
- Organic Compounds (Entrained in the Water): Organic compounds with a boiling point equal to, or less than the evaporator operating temperature (methanol is a challenge)

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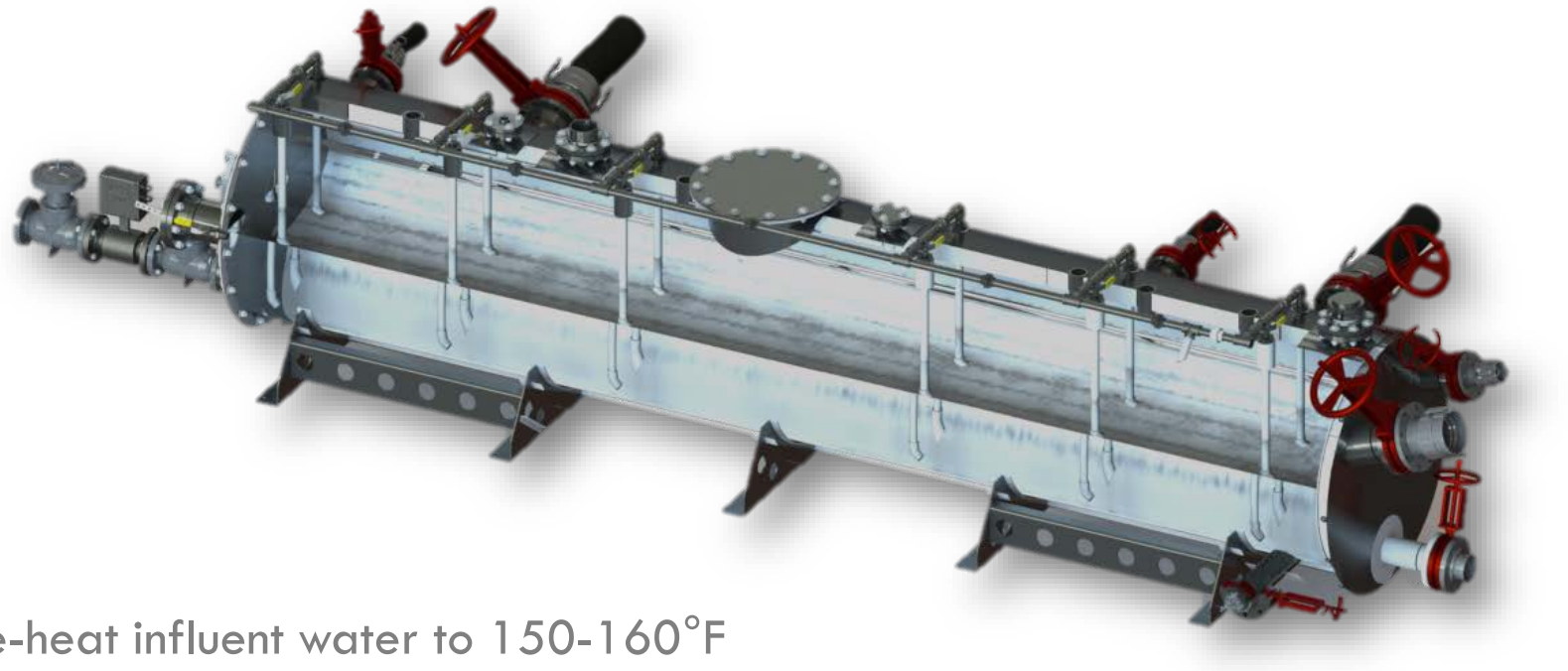
MANAGING EMISSIONS



- Pre-heat influent water to 150-160°F
- Sparge water with blower air
- Recover volatilized organic compounds and inject into burner

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WHERE IS THE CATALYST?

- Disposal wells are inexpensive and easy; the default for producers
- Forced evaporation is relatively new and unfamiliar to the O&G industry; still kicking the tires
- Penetrating a market requires:
  - Cheaper than injection (T&D) on a direct cost basis; forget the hidden / soft costs
  - Easy for the producer to implement

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GETTING CREATIVE

- Price reduction for evaporation
  - Design
  - Scale
  - Volume through quantity
  - Product mix
- Investing in product mix
  - Bundle production and flowback services with evaporation yields cheap and easy

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CONTACT INFORMATION

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