



# Saltworks<sup>TM</sup>

## True Zero Liquid Discharge Treatment of Oil and Gas Wastewaters

IPEC

November 2016

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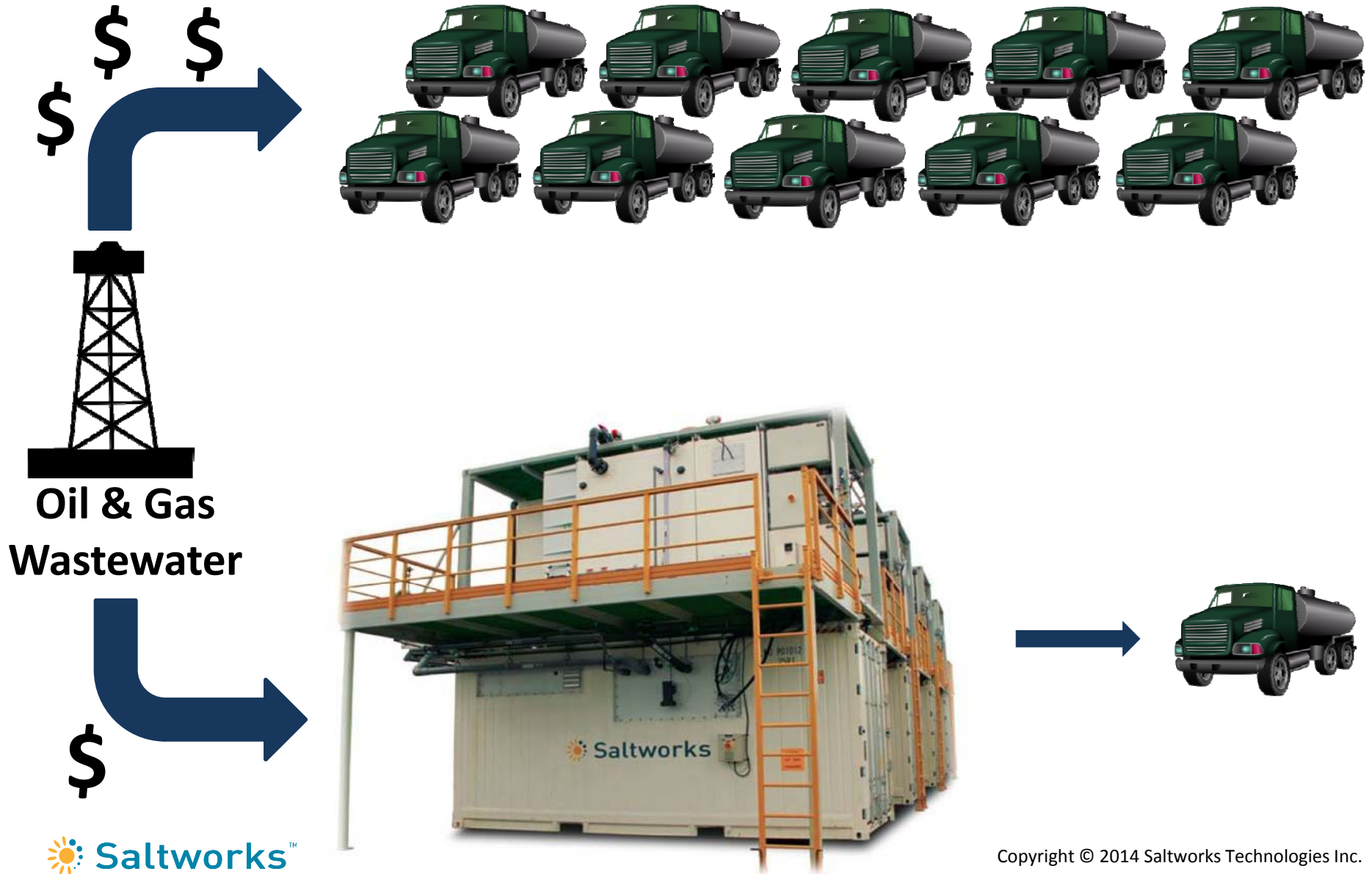
# SaltMaker: Economic Alternative



**Long Distance  
Disposal**

**No or  
Constrained  
Disposal Wells**

# SaltMaker: Volume Reduction, Lower Cost





# Low Temperature Evaporator Crystallizer



**630 bbl/day Containerized and Modular Plant**



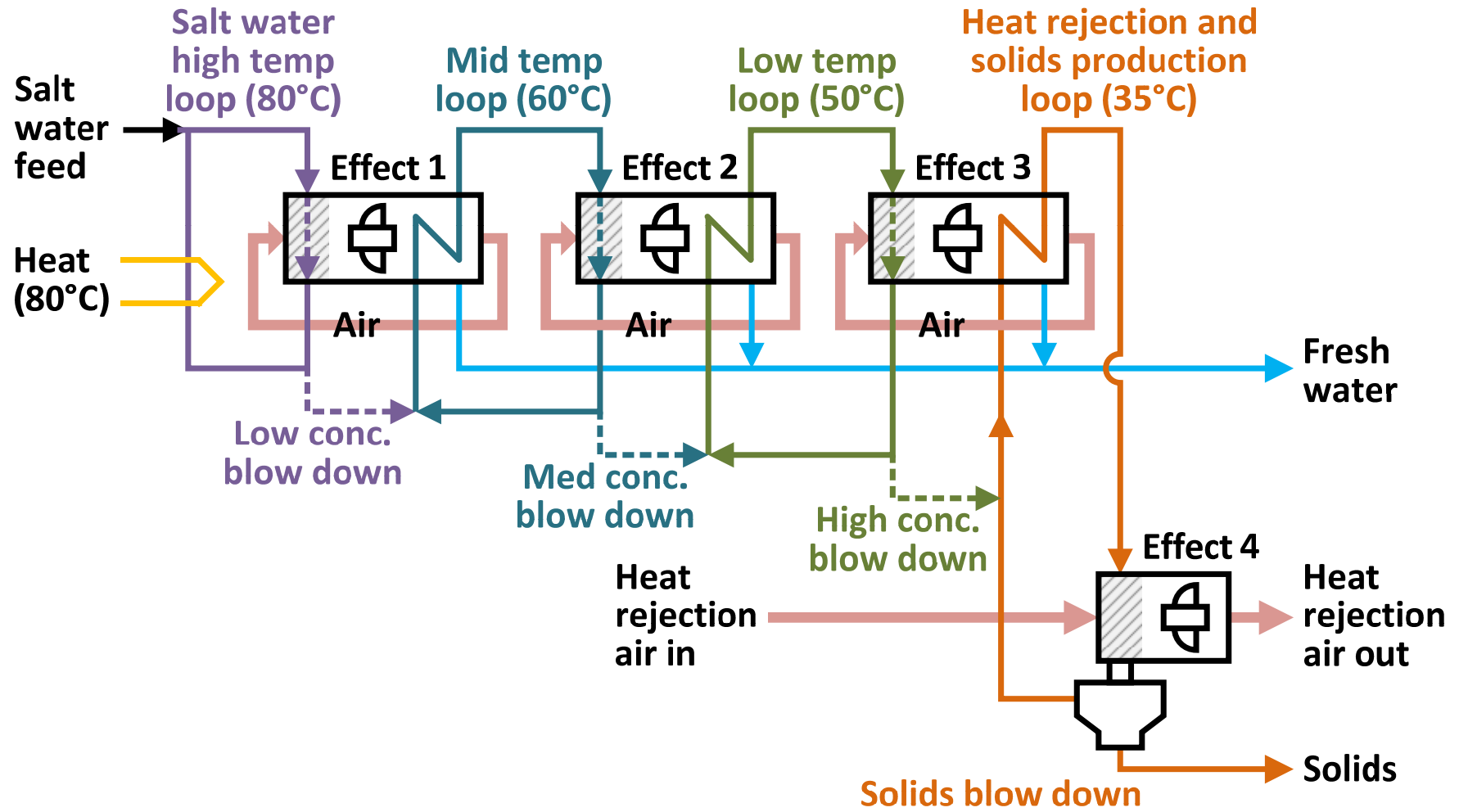
**Raw Water (left)  
Produced Freshwater (right)**



**Produced Solids**

# SaltMaker Evaporator Crystallizer: Process

- Multiple effect to recycle heat of evaporation
- Energy requirements: electrical 20 kWh<sub>e</sub>/m<sup>3</sup> & thermal 860 MJ/m<sup>3</sup> @ 90°C



# SaltMaker Attributes

- ¼ energy of open to atm evaporators
- No membranes: treat any wastewaters
- Low temperature/pressure: engineered plastics
- No steam ticketed operators required
- Automated smart self cleaning and operation



**Engineered Plastic  
Construction**

# SaltMaker Crystallizer: Modular Building Blocks

- ISO shipping container dimensions
- Standard transportation vehicles and construction machinery
- Easy assembly / disassembly
- Modular plant expansion





# SaltMaker: Easy Cleaning and Replacement

- Modules slide in and out for easy removal
- “power washing” and reinstallation
- Servicing without confined spaces



**Assembled Set**



**Module Removed by Forklift**



# SaltMaker Production & Services



SaltMaker Factory



SaltMaker Module Mass Production



SaltMaker Assembly



Quality Assurance



Plant Operations



Customer Training Center

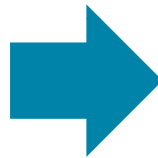


24/7 Remote Support

# Pilot to Full-Scale



**Pilot SaltMaker**

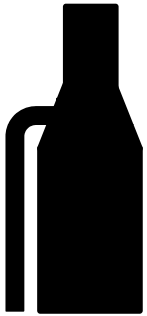


**Full-Scale SaltMaker**



# SaltMaker: Successful Oil and Gas Pilots

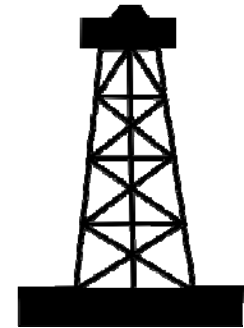
Alberta Oil Sands  
Evaporator  
Blowdown



SaltMaker Pilot



Texas and BC  
Shale Gas  
Produced Water



Freshwater  
&  
trueZLD



# Oil Sands Pilot Results

- Freshwater < 500 mg/L TDS
- Brine concentrated to +40%



Parameter (mg/L)	Raw Evaporator Blowdown	SaltMaker Concentrated Brine	SaltMaker Recovered Freshwater
pH	9.5 - 11.5	9.23	7.44
Total Dissolved Solids	90,000 - 300,000	413,000	55.6
Total Suspended Solids	50 - 30,000	2,152	<2
Total Hardness (as CaCO <sub>3</sub> )	35 - 1,500	3,960	1.00
Total Organic Carbon	15,000 - 50,000	60,500	133
Alkalinity	25,000 - 70,000	81,400	43.0
Calcium	10 - 400	1,580	0.313
Chloride	5,000 - 150,000	137,000	11.9
Magnesium	1 - 5	3.70	<0.05
Silica (Reactive)	100 - 25,000	379	0.317
Sodium	15,000 - 150,000	140,000	12.5
Sulfate	500 - 15,000	2,490	2.57



# ZLD Solids Production and Disposal at Class II Landfill



**Extracted Solids**

Solids reliably produced and extracted from the SaltMaker

Solids accepted and disposed at Class II non hazardous landfill

- ✓ Paint Filter Test: Passed
- ✓ pH Test: Passed
- ✓ Flash Point Test: Passed
- ✓ Leachable Metals Test: Passed
- ✓ Leachable BTEX Test: Passed



**Dewatered Solids**

# Produced Water Pilot Results

- Freshwater < 500 mg/L TDS
- Brine concentrated to 37%



Parameter (mg/L)	Raw Shale Gas Produced Water	SaltMaker Concentrated Brine	SaltMaker Recovered Freshwater
pH	4.6 - 8.5	6.79	7.90
Total Dissolved Solids	54000 - 193000	367000	203
Total Suspended Solids	270 - 730	3520	2
Total Organic Carbon	4800 - 9200	35500	1180
Total Hardness (as CaCO <sub>3</sub> )	7300 - 37000	84300	5
Alkalinity (as CaCO <sub>3</sub> )	45 - 1100	<10	<1
Calcium	2500 - 13100	29100	1.64
Chloride	27000 - 120000	189000	16.4
Magnesium	200 - 1200	2830	0.18
Silica (Reactive)	5 - 40	87	<0.01
Sodium	13000 - 55000	83500	5.9
Sulfate	70 - 700	733	0.7

# Your Project?

- Contact us with your project needs:  
[malcolm.man@saltworkstech.com](mailto:malcolm.man@saltworkstech.com)
- Engineering studies (free), pilots, full scale plants



**Mobile Pilot**

