



Frac Water Solutions

ATHENA GLOBAL ENERGY SOLUTIONS

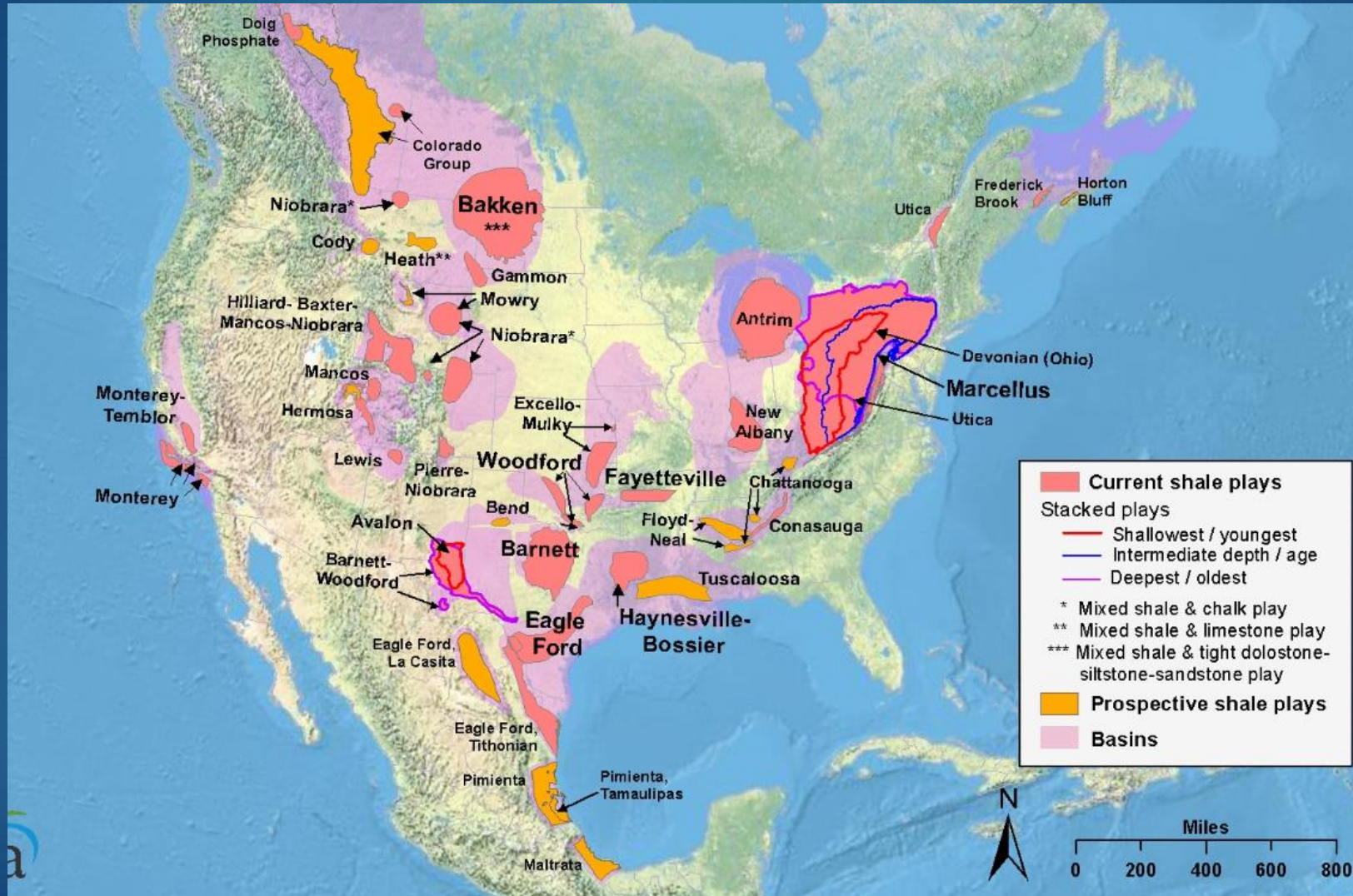
JUNE 2014

Problems in the oil field

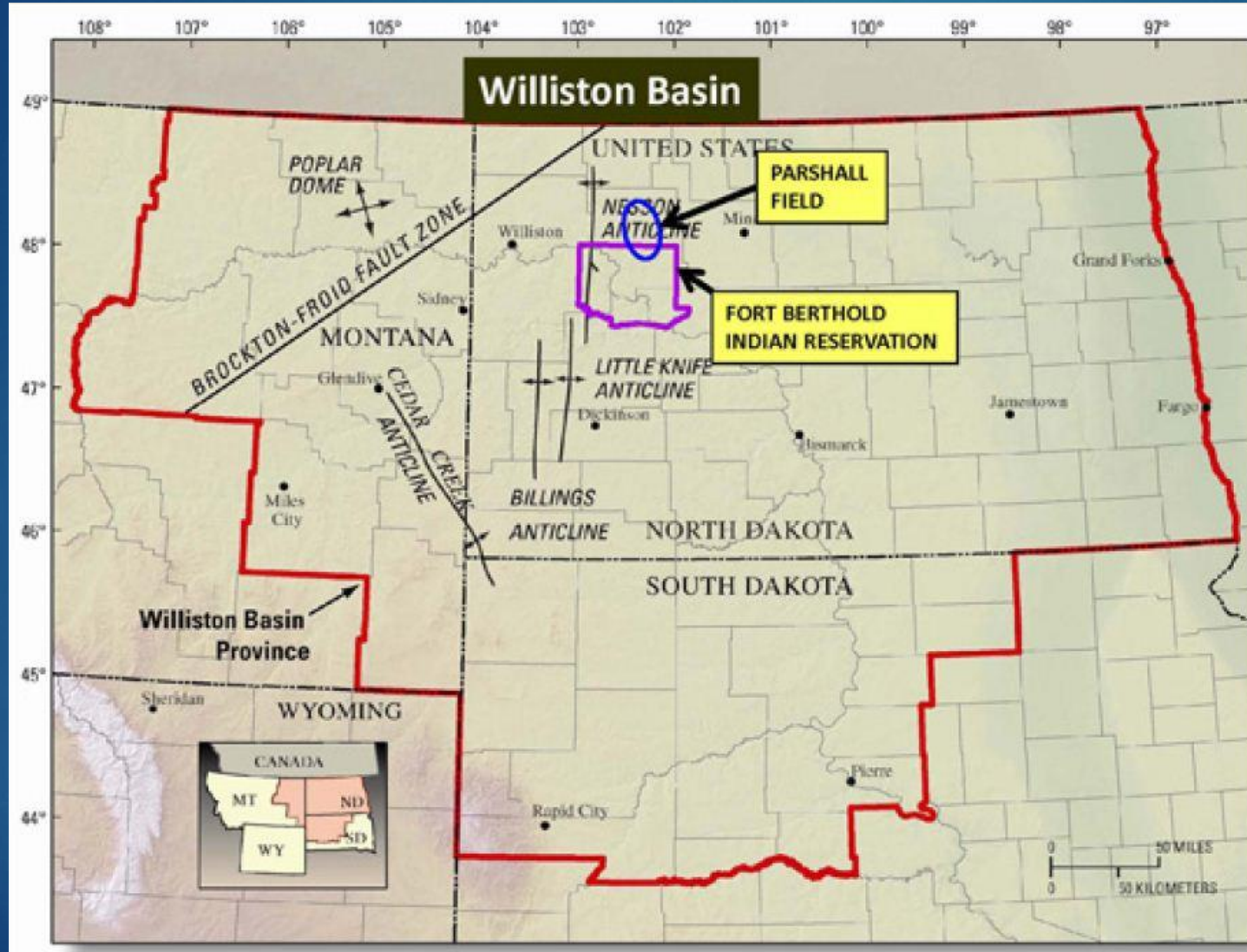
- ▶ 3-5 million gallons are needed to complete a well which creates further problems
- ▶ Flow back volumes have reached to 2 million gallons
- ▶ Water supply (aquifers depletion)
- ▶ Disposal costs & logistics
- ▶ Trucking costs
- ▶ Regulations



Active Drilling Regions in the USA



Bakken Shale Play Map



Disposal Concerns

- Costs are continuing to increase
- Increased truck traffic on the roadways
- Have now created safety concerns

Trucks used to haul frac water



Typical Frac Drill Site



Why the growing concern in the Bakken?

Issues

- ▶ Difficulty in water sourcing
- ▶ Water costs
- ▶ High cost of trucking and increased truck traffic to site
- ▶ Truck Rates: US\$100-110 per hour
- ▶ Disposal: US\$3-7 per barrel on the front-end
- ▶ Reaching up to US\$16 per barrel including disposal fees
- ▶ Water disposal issues
- ▶ High salinity
- ▶ Need for additional disposal wells
- ▶ Cost of transport
- ▶ Mounting public concern
- ▶ Environmental concerns
- ▶ Road traffic and truck emissions
- ▶ Increased regulation

Escalating water demand and costs

Typical Marcellus Well	100,000 gallons water/frac
Average Well Requires	3.0 million gallons of water
Typical Water Truck Holds	4,620 gallon/load (110bbls/load)
Each Well Requires	~650 truck trips
Average Truck Trip Time	3 hours
Average Cost of Trucking	US\$110/hour
Estimated Water Truck Costs	US\$1215,000/well

With over 1,700 wells anticipated to be drilled by y/e 2014, this could require over one million truck trips annually

This equates to an average of 500 trucks per day on the roads for water alone

Trucking costs could escalate further as frac stages increase and road traffic (time) mounts

Media - Headlines

New Drilling Technologies Shake Up Global Market
Part 4: Is Drilling a Threat to Idyllic Landscape?
'Who Will Want to Live Here Anymore?'
'We Have to Answer Questions'

SPIEGEL ONLINE

Pennsylvania blowout fuels fracking fears

UPI.com

Frack and ruin: the rise of hydraulic fracturing

Telegraph.co.uk

Shale gas 'worse than coal' for climate **BBC**

Fracking regulations could ease public concerns:
White House **REUTERS**

Fracking on public radar

Technique is controversial but not new

TimesCall.com

**Obama Forms Panel to Improve
Fracking Safety**

**SCIENTIFIC
AMERICAN**

Shale gas drilling likely to be banned in France

EurActiv

EPA Starts Work on Diesel Fracking Guidance
The New York Times

Environmental groups host hearing on 'fracking'
washington**examiner.com**

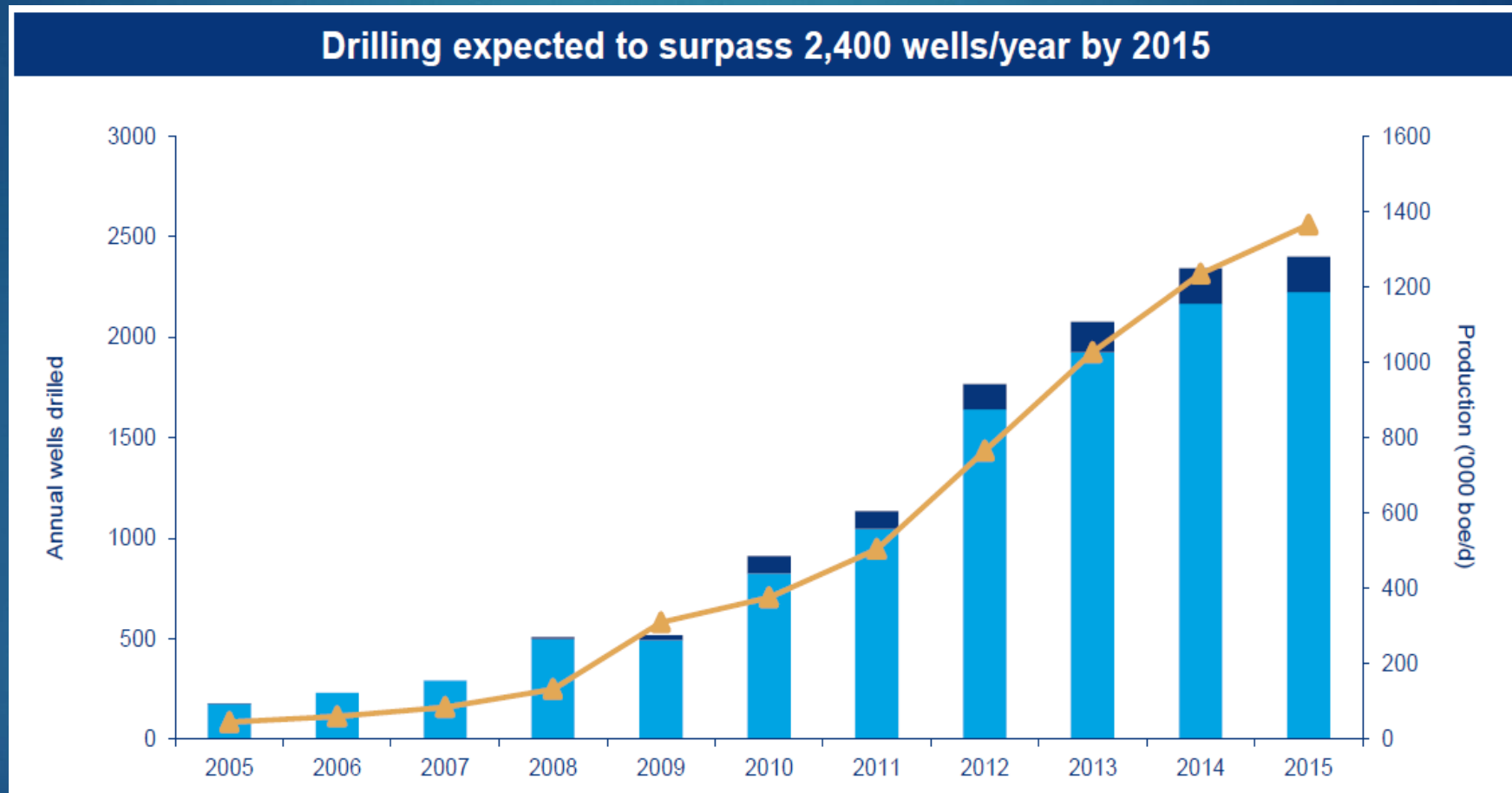
Hundreds Rally in Albany to Protect New
York's Water & Communities from Fracking

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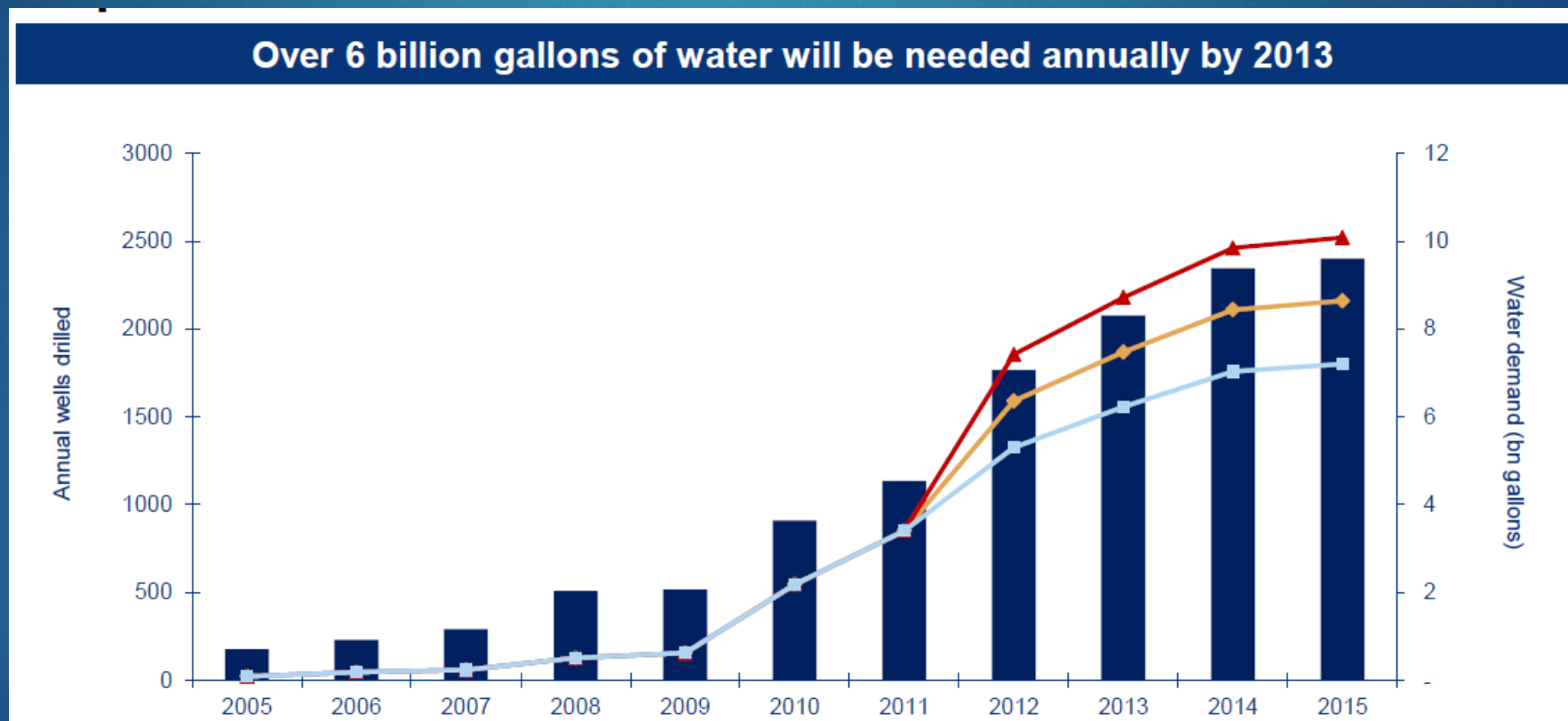
Farmers say 'no fracking way'

Mail & Guardianonline

Bakken drilling has grown dramatically in the last few years



Bakken water management will become increasingly important as the well count continues to climb





What is the solution for
minimizing frac water disposal?

Water Treatment System !

Athena Global Energy Solutions - Water Management Philosophy

Maximize Reuse

- Increase % of produced water reused in frac fluids
- Reduce volume of water sent for disposal
- Lower fresh water demand by 25% by 2014

Minimize Waste Stream and costs for Producers

- Use on-site water treatment technology
- Reduce trucking
- Change frac fluid formulation to adjust to higher salinity

Frac Water Treatment Solutions

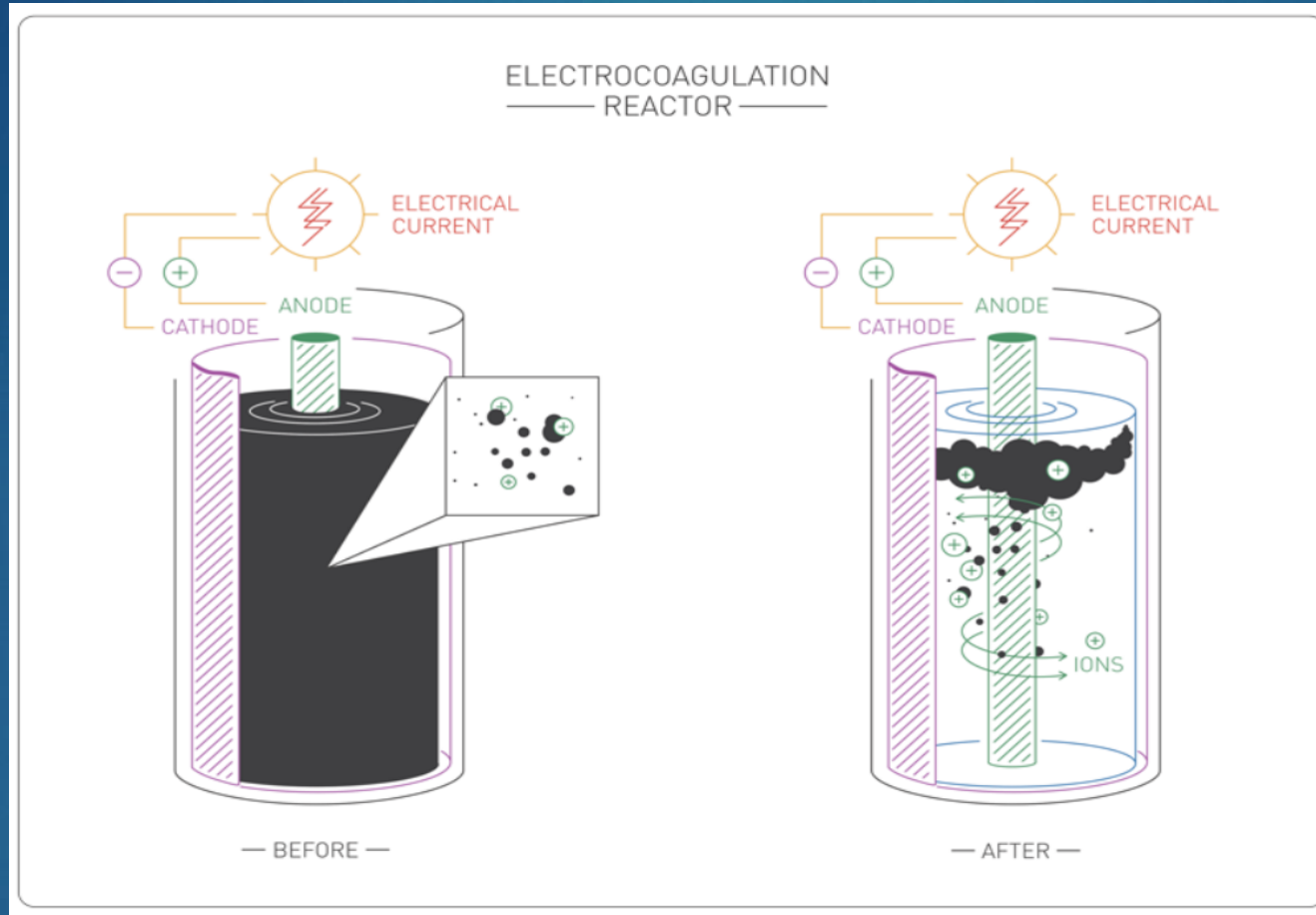
Electrocoagulation



Solar Distillation System



How does Electrocoagulation work?

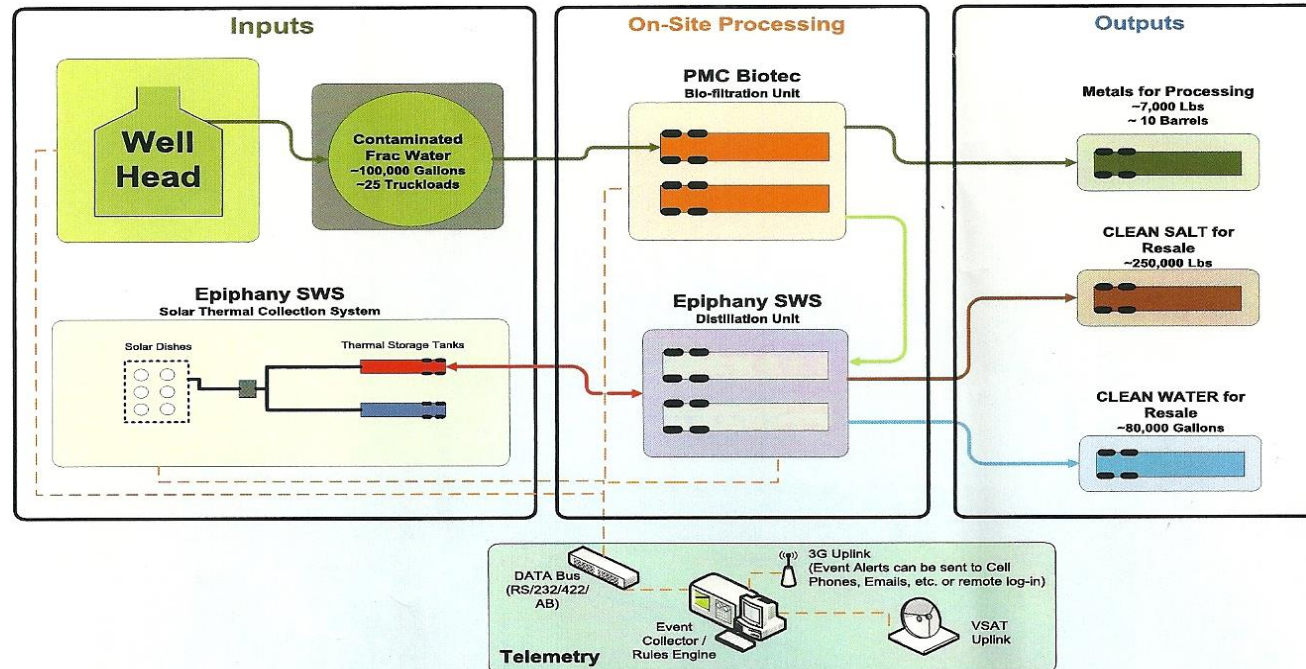


Electric current applied to the reaction plate causes contaminant separation.

How does Solar Distillation work?

How It Works

E3H SOLAR/HYBRID, ON-SITE PRODUCTION WATER REMEDIATION



System Advantages

Electrocoagulation

1. Ideal for treating frac water
2. Cost only \$0.06/bbl
3. Mobile system – 20' containerized
4. Fully scalable
5. 30 GPM to 1000 GPM
6. Monitor system functions remotely
7. Redundant inputs valves
8. 480VAC power supplies
9. Self-cleaning reaction chamber

Solar Distillation

1. Ideal for treating frac produced water
2. With solar (10hrs) – no cost to operate
3. Just \$0.88/bbl (14hrs) – to operate at night
4. Mobile system – 20' containerized
5. Fully scalable
6. Treats 41bbls/day (single system)
7. Treat 357 bbls/day (10 systems)
8. Monitor system functions remotely
9. Solar operation – no operational cost
10. Propane/Natural Gas generator

Electrocoagulation

Typical Operational Cost

Per barrel (including electricity)

- ▶ \$0.063

Configuration

- ▶ 150 GPM system
- ▶ Processing Flow Rate:
 - ▶ - 214 bbls/hour
 - ▶ - 5,153 bbls/day
 - ▶ - 36,000 bbls/week
 - ▶ - 154,286 bbls/month
 - ▶ - 1,877,143 bbls/year

Electrocoagulation

Typical System Costs

VEP System

- ▶ \$150,000 – 2 GPM
- ▶ \$200,000 – 30 GPM
- ▶ \$350,000 – 100 GPM
- ▶ \$450,000 – 300 GPM
- ▶ \$600,000 – 500 GPM

Configuration

- ▶ 20 foot container
- ▶ Reactor chamber(s)
- ▶ Control panel
- ▶ Pumps
- ▶ Power supplies
- ▶ Connections
- ▶ Control valves
- ▶ Environmental system

Electrocoagulation

Typical Lease System Costs

Lease Overview – 150 GPM

- ▶ \$ 7,500 – Monthly service fee
- ▶ \$ 1.50 – Per every 1000 gals processed

Operate (annually)

- ▶ \$ 2,500 – Startup fee/year
- ▶ \$ 6,000 – Training/year
- ▶ \$10,000 – Site prep, engineering & test/year
- \$25,000 – Electrodes/Plates
- \$19,000 – Electricity
- \$ 7,500 – Technical Support

Configuration

- ▶ 20 foot container
- ▶ 150 GPM Reactor chamber
- ▶ Control panel
- ▶ Pumps
- ▶ Power supplies
- ▶ Connections
- ▶ Control valves
- ▶ Environmental system
- ▶ Maintenance

Solar Distillation

Typical System Costs

Epiphany E3H System (cascaded)

- ▶ \$ 58,000 – **41** bbls/day (1 system)
 - ▶ \$118,000 – **82** bbls/day (2 systems)
 - ▶ \$178,000 – **123** bbls/day (3 systems)
 - ▶ \$238,000 – **165** bbls/day (4 systems)
 - ▶ \$298,000 – **206** bbls/day (5 systems)
 - ▶ \$358,000 – **247** bbls/day (6 systems)
 - ▶ \$418,000 – **288** bbls/day (7 systems)
 - ▶ \$478,000 – **329** bbls/day (8 systems)
 - ▶ \$538,000 – **370** bbls/day (9 systems)
 - ▶ \$598,000 – **411** bbls/day (10 systems)
- ▶ NOTE: **Leasing this equipment is also available**

Configuration/System

- ▶ 20 foot container(s)
- ▶ Three (3) 8' Concentrators/container
- ▶ Remote Monitoring & Management System/container
- ▶ Pump equipment/container
- ▶ Thermal Storage Tanks/container
- ▶ Vapor Compression Crystallizer/container
- ▶ Control valves/container
- ▶ Generator/container

For more information



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