



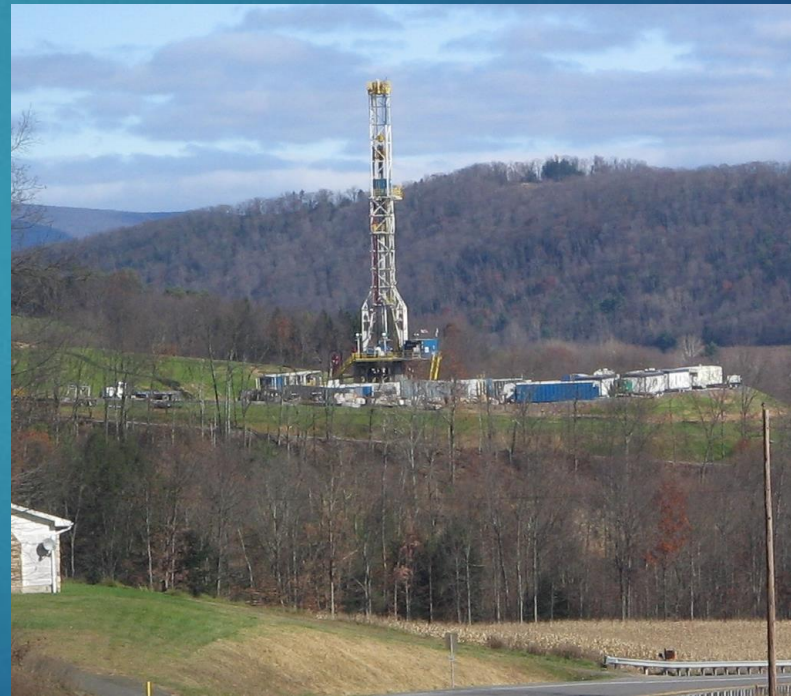
# Frac Water Solutions

ATHENA GLOBAL ENERGY SOLUTIONS

JUNE 2014

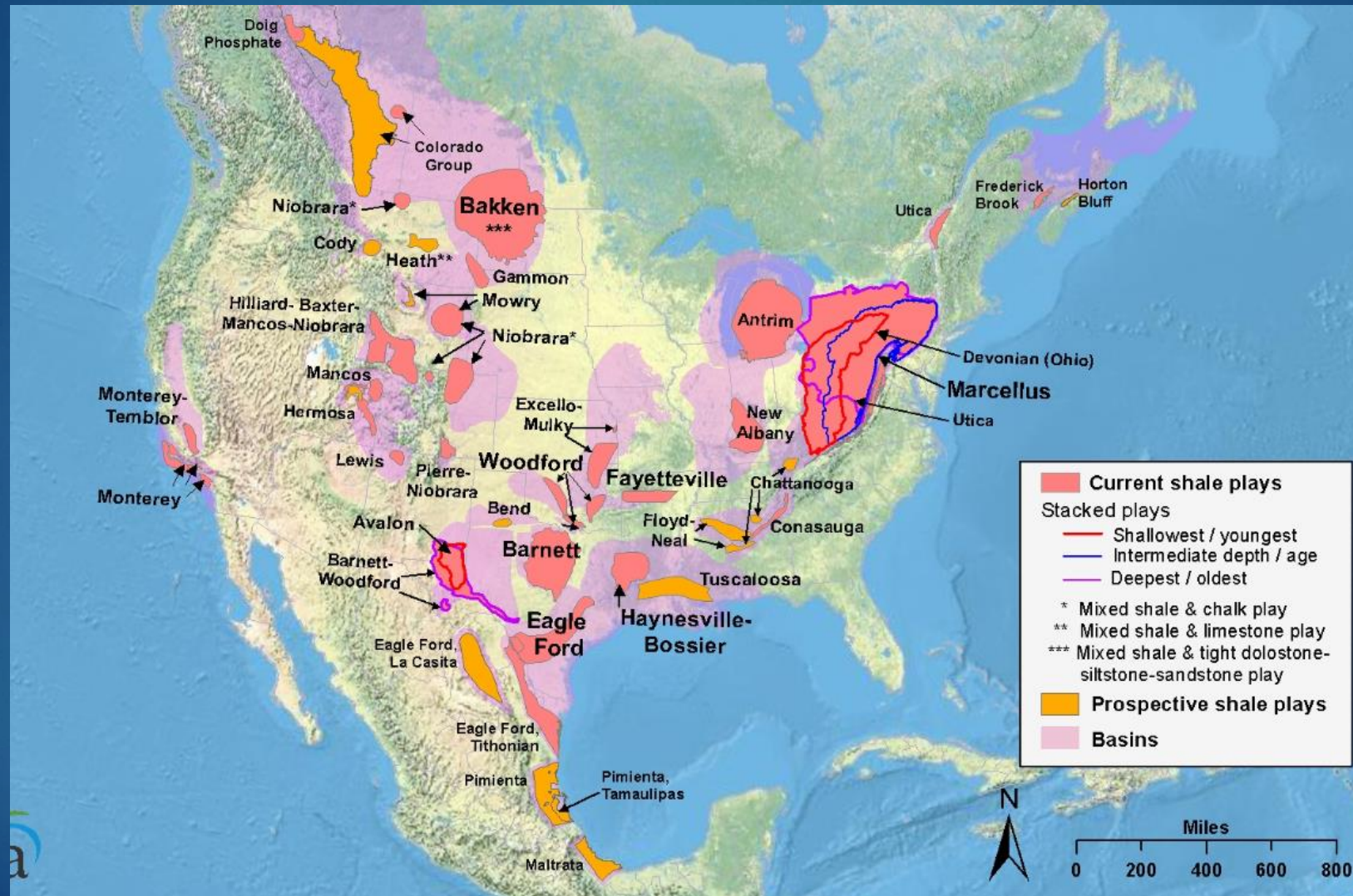
# Problems in the oil field

- ▶ 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

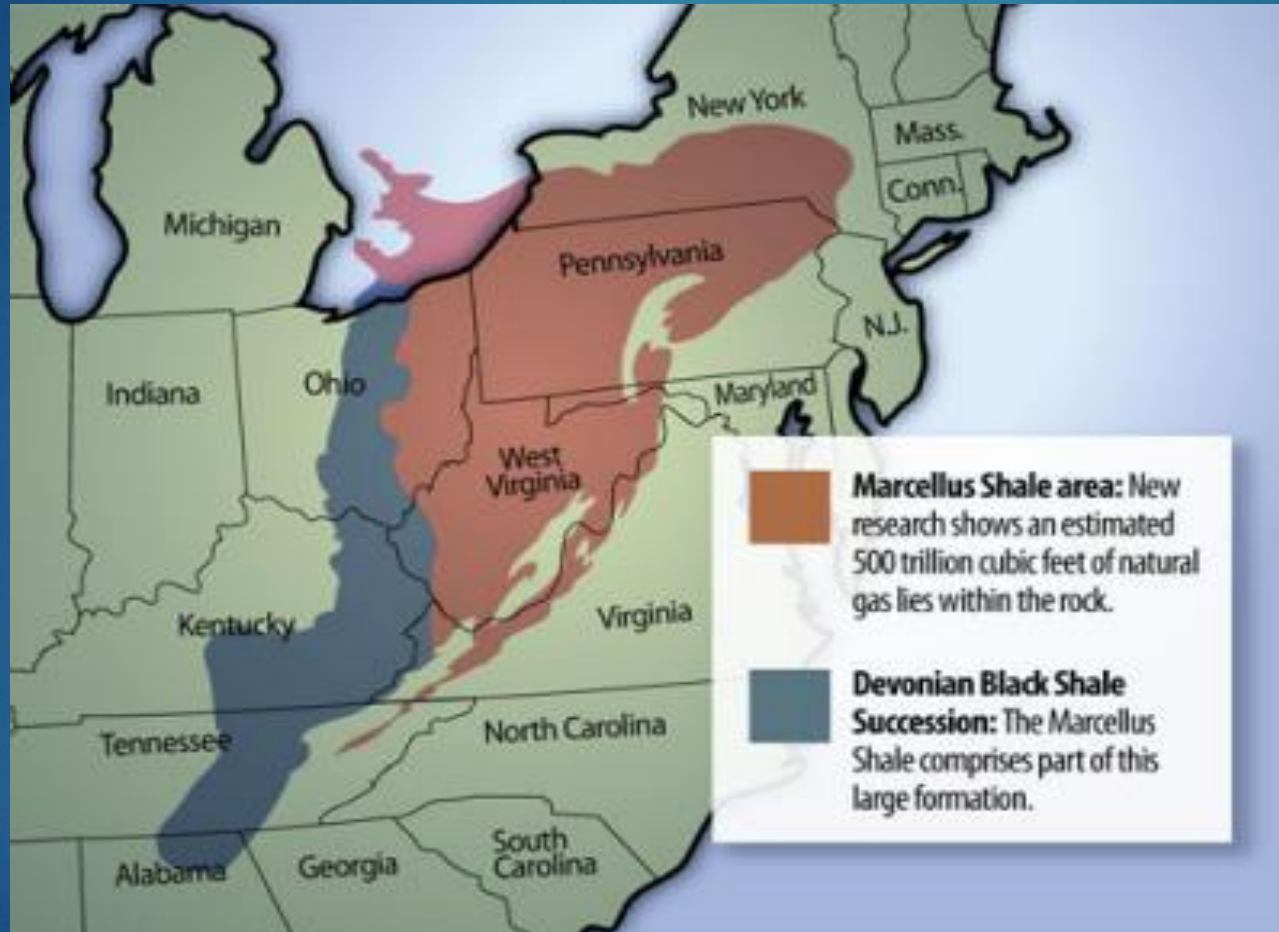




# Active Drilling Regions in the USA



# Marcellus 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 Marcellus?

## 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 2012, 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**

Environmental groups host hearing on 'fracking'

washington**examiner.com**

EPA Starts Work on Diesel Fracking Guidance  
**The New York Times**

Farmers say 'no fracking way'

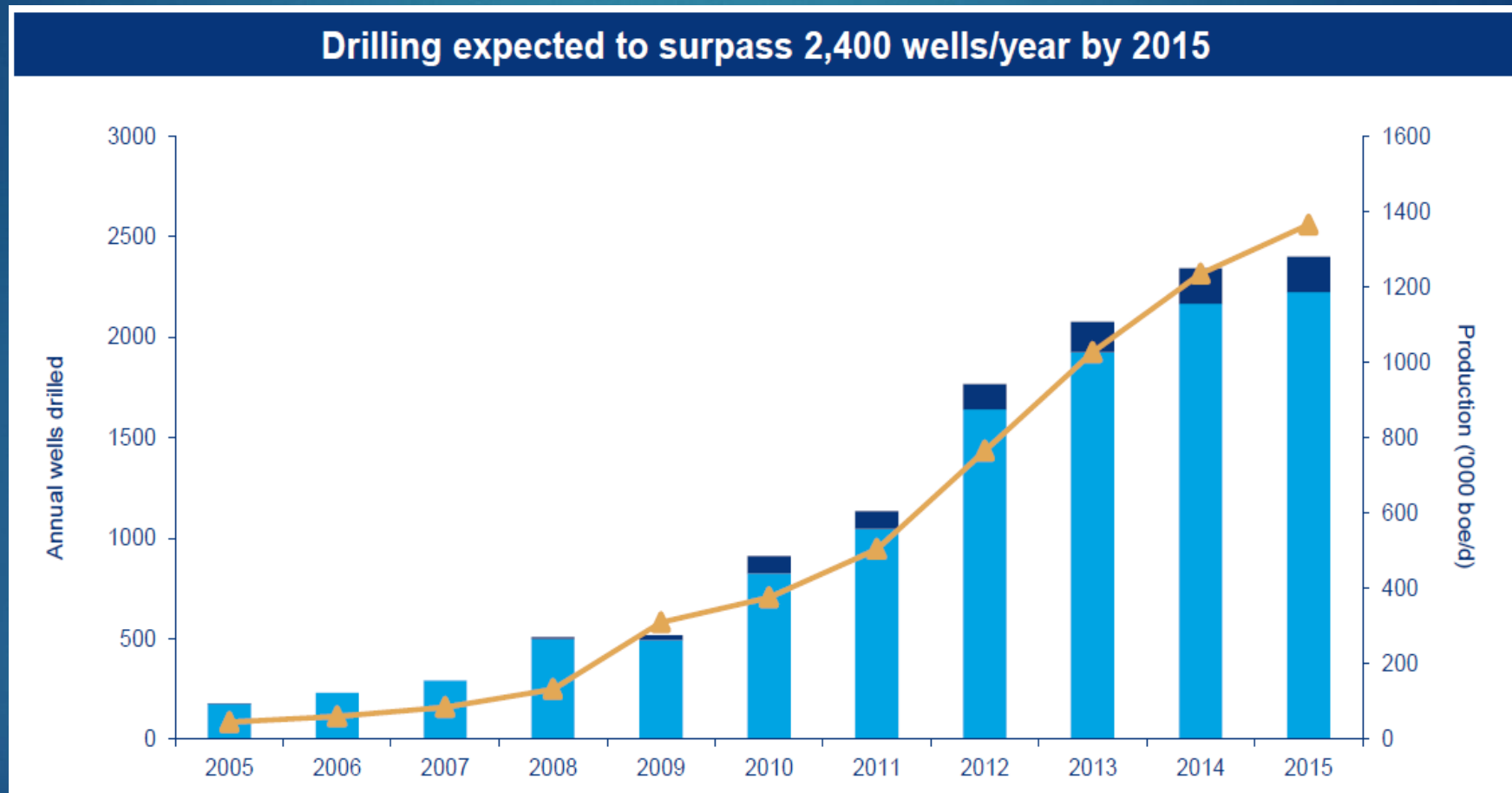
**Mail & Guardian online**

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

**THE  
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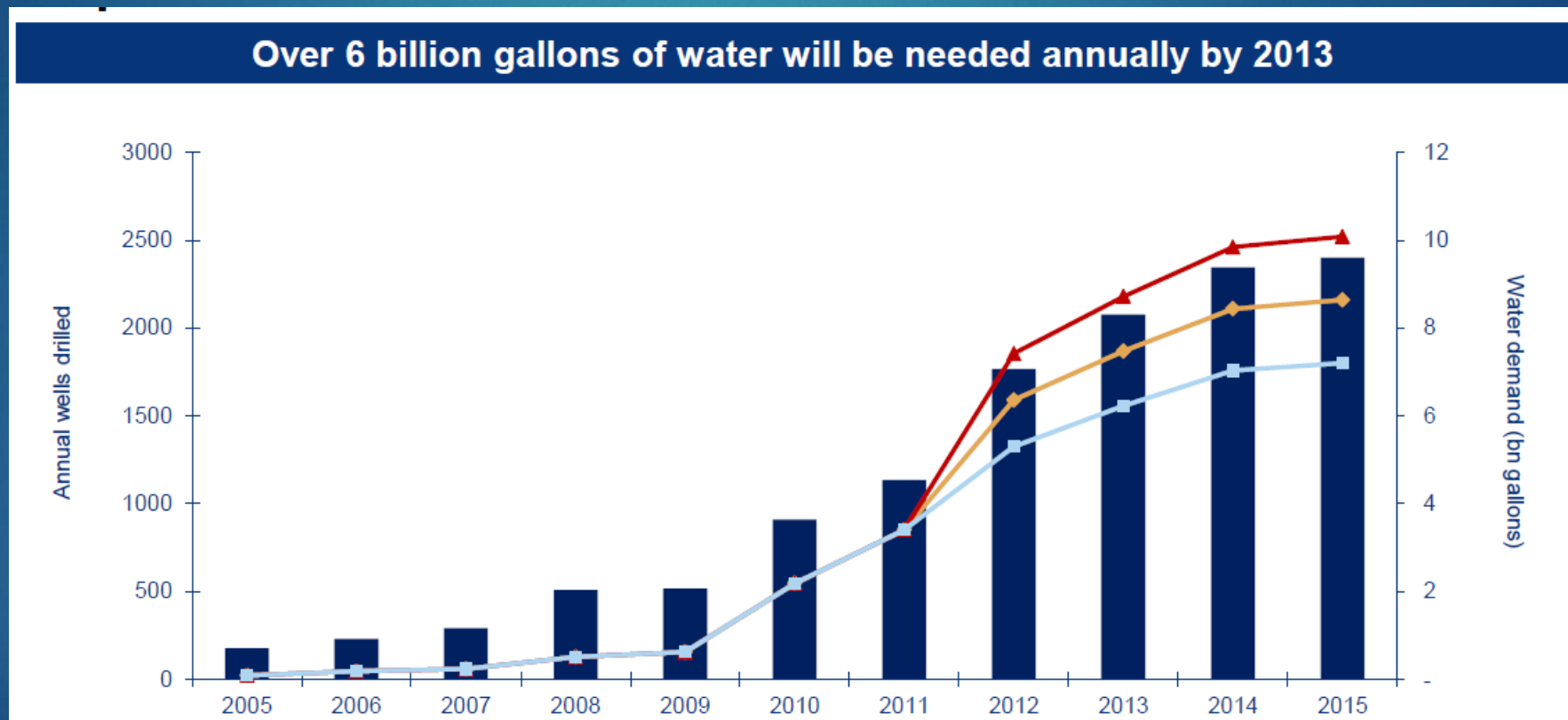


# Marcellus drilling has grown dramatically in the last few years





# Marcellus 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

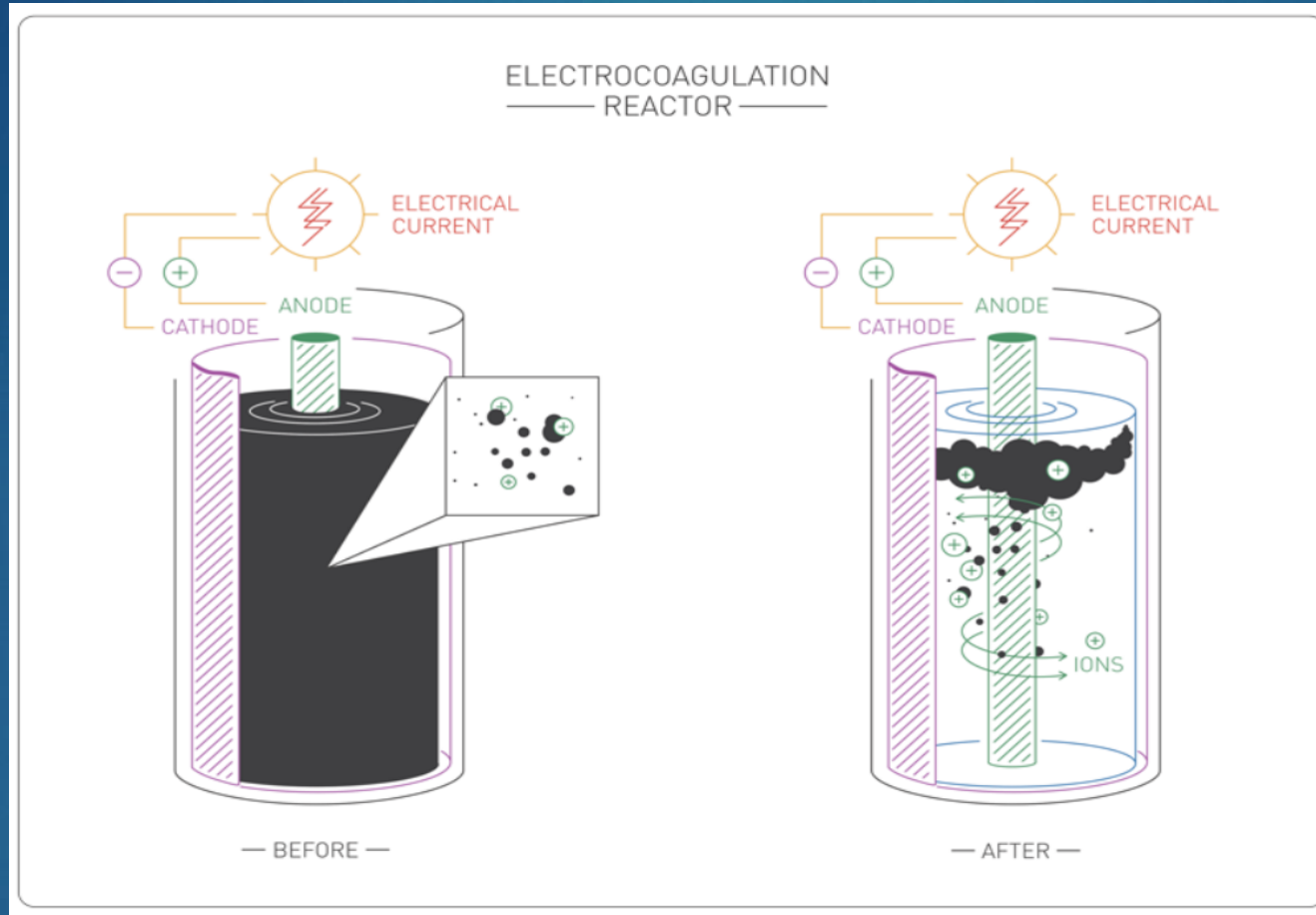
## Electrocoagulation



## Solar Distillation System



# How does Electrocoagulation work?



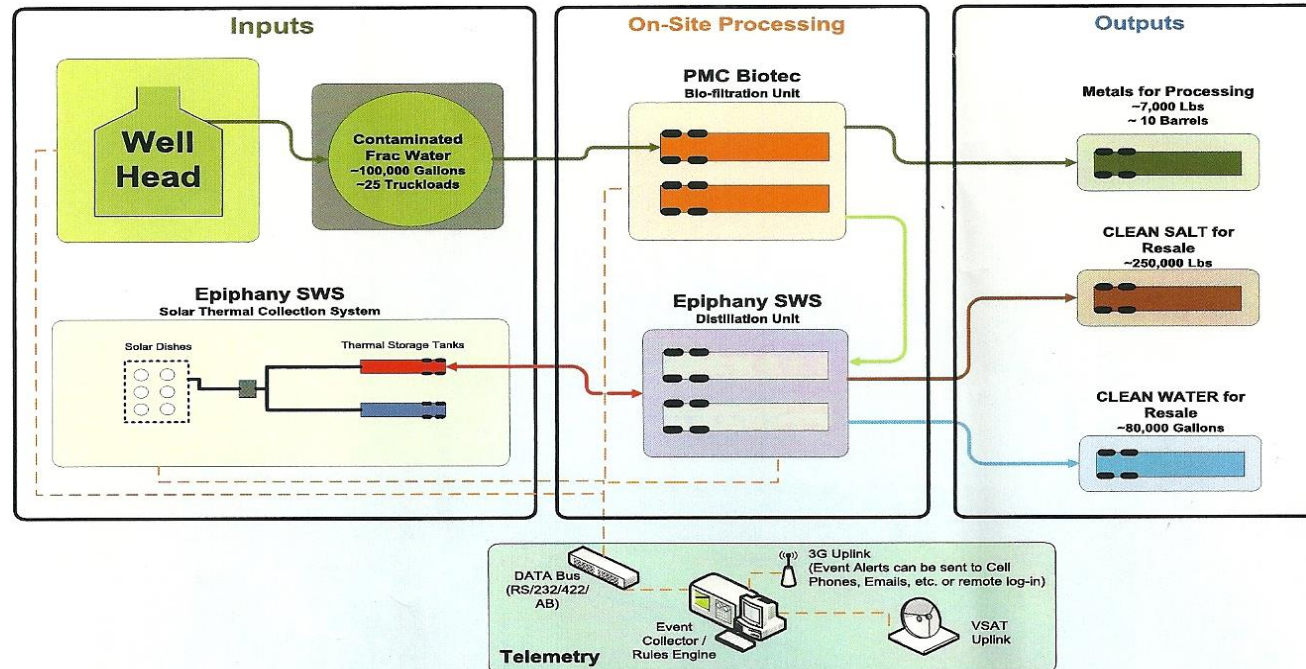
Electric current applied to the reaction plate causes contaminant separation.



# 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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