

# Athena Global Energy Solutions

SOLAR WATER TREATMENT

2014



# Commercial Equipment

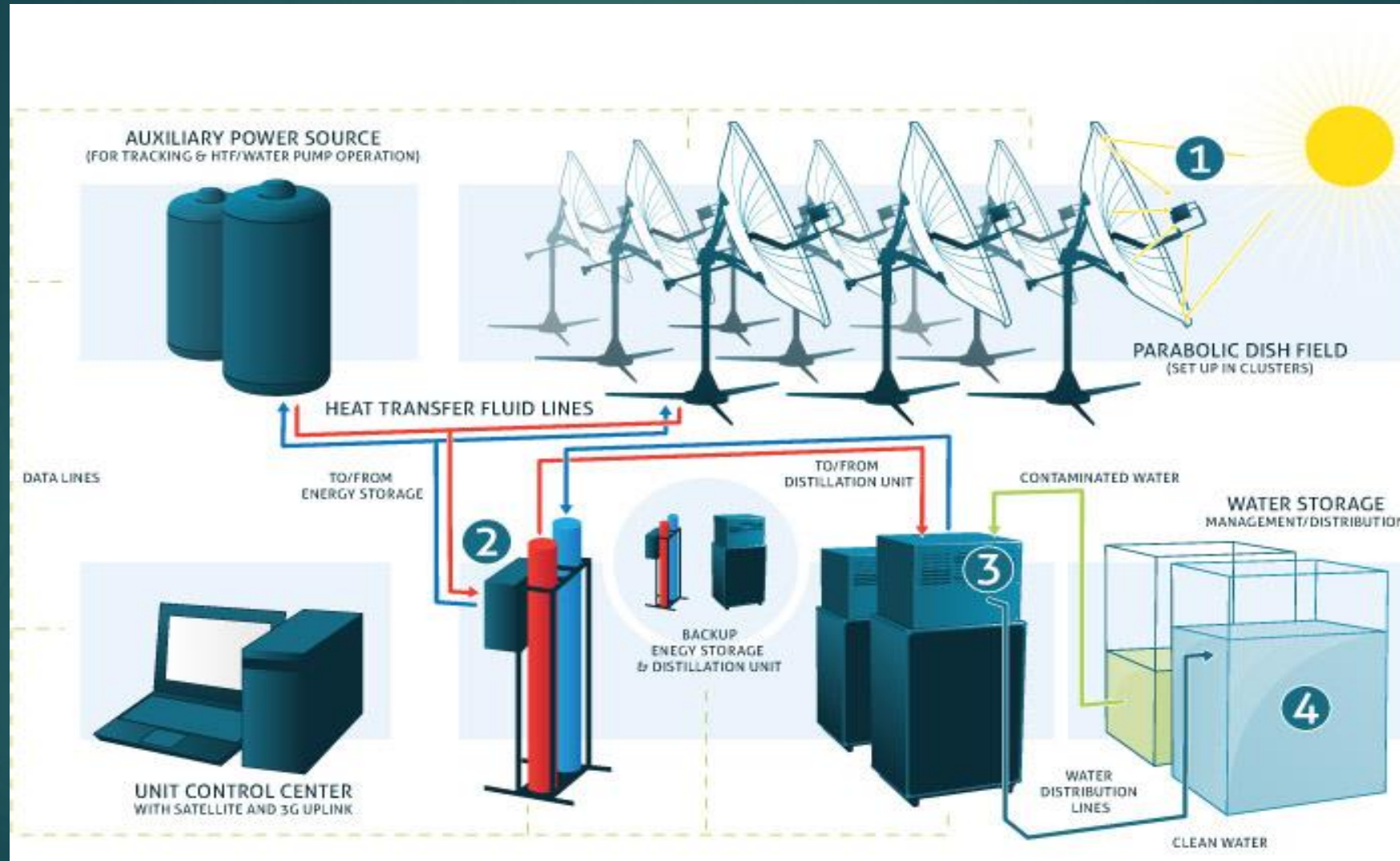
Outside View



Solar Concentrators



# Flow chart (configuration)



# System Specifications

<b>300-500 gallons/day</b>	- Using solar energy
<b>900-1500 gallon/day</b>	- Solar energy + propane/natural gas generator
<b>13mm (1/2")</b>	- Water input feed
<b>Input</b>	- Frac Production Water (250,000 PPM TDS)
<b>Output</b>	- Less than 250 PPM total impurities
<b>Shipping Size</b>	- 20' x 8' x 8'.8"
<b>Installation Footprint</b>	- 20' x 8' x 17'
<b>Dry Weight</b>	- 7000 lbs *(3200kg)

Note: **System can be cascaded to increase daily output capacity !**

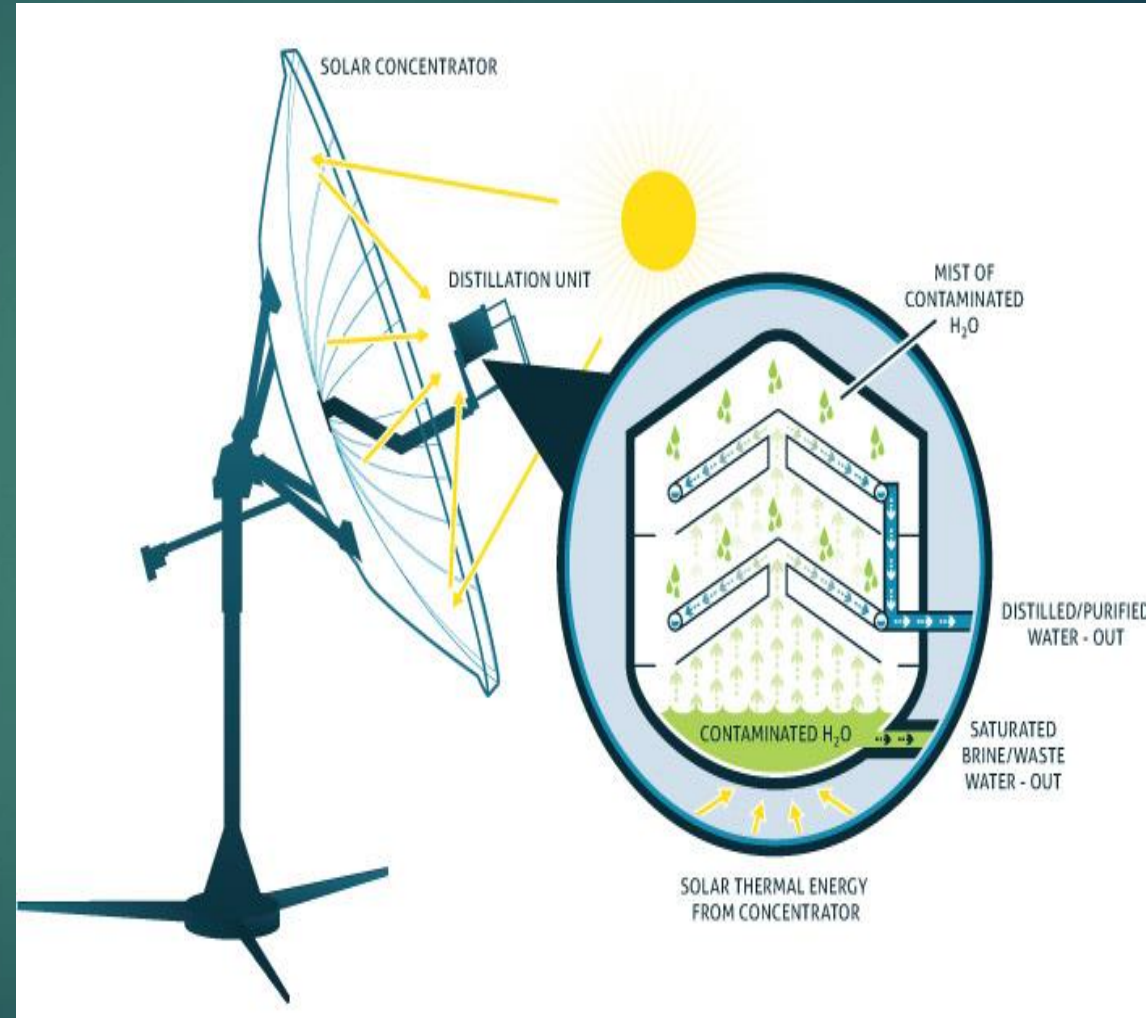


# DIRECT SOLAR DISTILLATION

Epiphany's flagship product utilizes a parabolic concentrating dish to focus sunlight on a proprietary, high-throughput distillation unit mounted at the dish's focal point.

The operation of the system is simple: Dirty water passes into the distillation unit and instantly vaporizes due to the intense heat focused on the distillation unit. During the vaporization process, any dissolved solids (e.g. heavy metals) separate, and living organisms (e.g. bacteria) are killed due to the intense heat.

The water vapor (now void of any impurities) continues to pass through the distillation unit. As the steam reaches colder stages it begins to condense back down into distilled water. From the output of the distillation unit then comes freshly distilled water, safe for consumption. The figure below pictorially illustrates the distillation process occurring at the focal point of Epiphany's concentrating solar power (CSP) dishes.

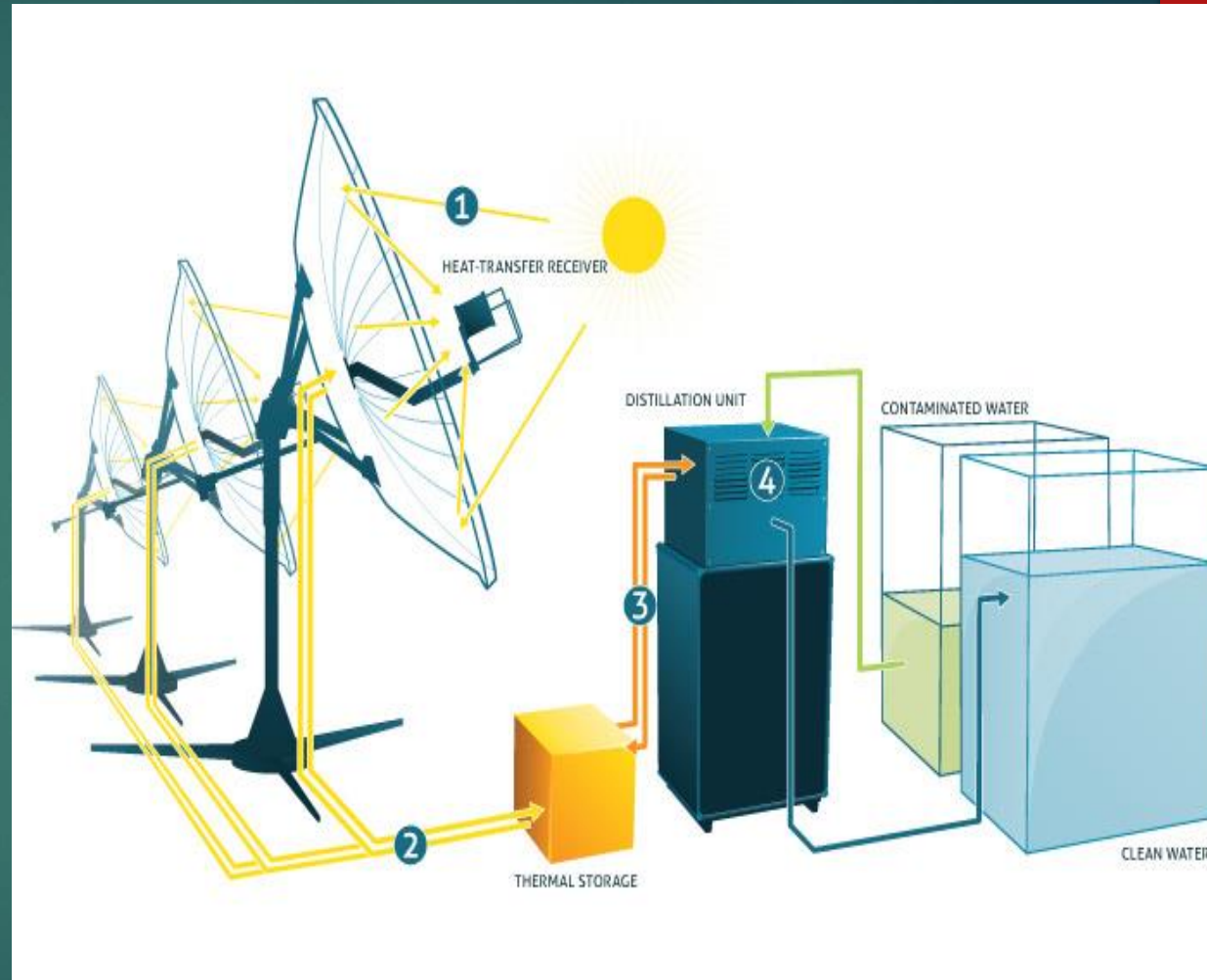


# SOLAR/ELECTRIC HYBRID DISTILLATION

The E3H system utilizes a heat transfer fluid and heat storage system to guarantee continuous operation when the sun is intermittent or during the night. This hybrid system consists of several Epiphany solar collector dishes, but instead of there being distillation units mounted at the focal points, the dishes are fitted with solar receiver units.

Cold heat transfer fluid is pumped through the receivers, which convert the concentrated sunlight to heat and then transfer the heat to the heat transfer fluid. As the fluid absorbs the sun's heat, its temperature is increased several hundred degrees and is then stored in a "Hot" storage tank (thermal battery). The fluid in the hot tank is then used to power the distillation unit as a replacement for the distiller's conventional heat source (e.g. electrical resistance heat, natural gas, etc.).

To power the distillation unit, the fluid is pumped through a heat exchanger in the distiller, where the heat is transferred to the water causing it to boil. Once the heat from the fluid has been exhausted (e.g. to create steam) it is transferred into a "Cold" storage tank, where it waits to be cycled through the dish receiver again to absorb more solar energy. The output of fresh water from these hybrid systems can be scaled up from several hundred gallons per day to tens of thousands of gallons per day. The figure below shows a diagram of a small hybrid system setup

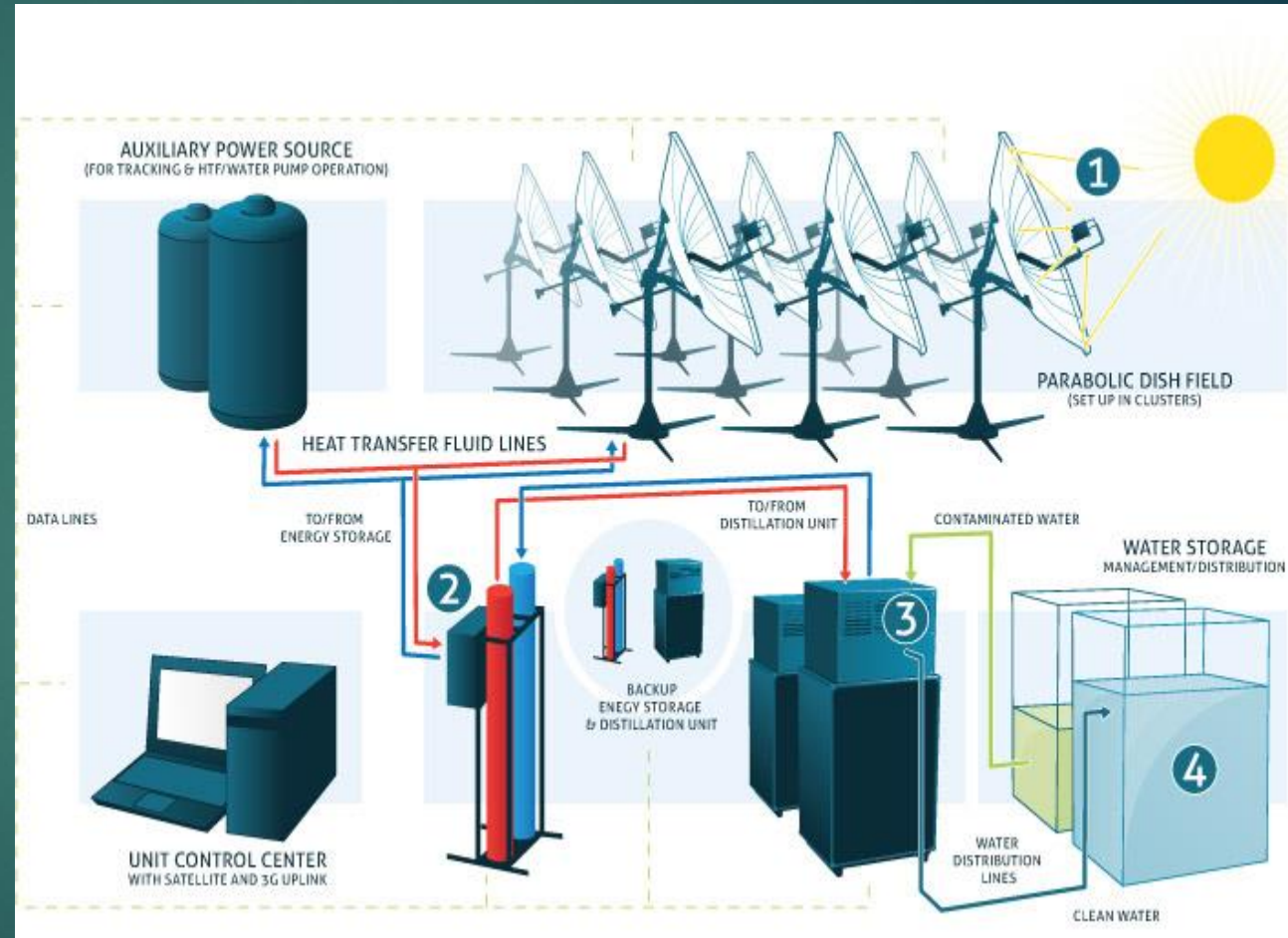


# MICRO SCALE DISTILLATION PLANT

Epiphany's solar water systems are modular in nature, making them easily scalable to serve the needs of entire municipalities. One primary application for larger systems consisting of several Epiphany water purification units is for entire rural communities that have water needs ranging from 10,000 to 50,000 gallons per day. The example below illustrates a system capable of distilling up to 50,000 gallons per day, using energy gathered by 300 solar concentrating dishes and stored in a 10,000 gallon thermal reservoir. Epiphany has partnered with Chester Engineers, a leading infrastructure firm specializing in water and waste water treatment, to help implement such a system.

The solar concentrating dishes heat the large reservoir of heat transfer fluid, which is designed to contain enough heat to keep the distillation unit running 24/7. That is, the heat stored in the reservoir during the day can be used at night to continue to distill water. In the unlikely event that there should be limited sun for a sustained period of time (e.g. monsoon season), the water purification system can make use of an auxiliary heat source, such as compressed natural gas (CNG) or Propane (LPG).

As the complexity increases over individual units, Epiphany has also designed a custom monitoring system which alerts operators in real time on the operational status of the system. This system will make use of regionally available 3G cellular communication networks and/or satellite uplinks. A schematic of what such a system might entail is shown above.



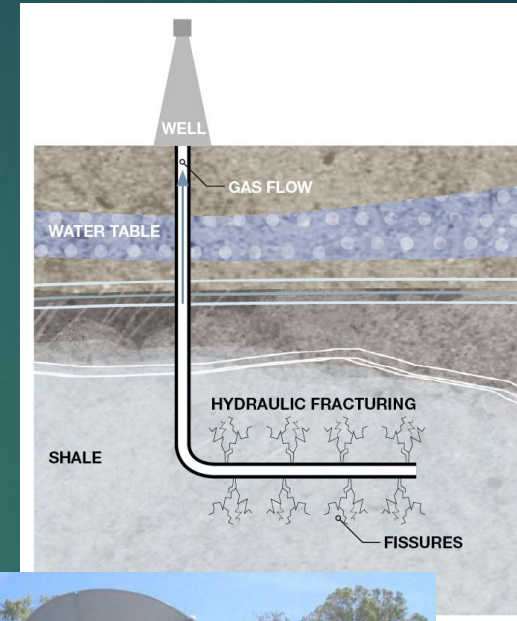


# Shale Gas Well Pad

## MICRO SCALE DISTILLATION PLANT

Epiphany Solar Water Systems E3H unit is a well-pad based Production Water treatment solution. The E3H uses a combination of concentrated solar energy and generator power to drive our distillation process. Epiphany's crystallizing distiller technology purifies Production Water to as clean as rain, while allowing for easy removal of salts and metal solids. With Epiphany's patent pending technology, shale gas operators can:

- Utilize a sustainable solution to treat Production Water on each well-pad
- Better forecast the lower cost of treating produced water
- Never need to shut down production due to inability to transport produced water
- Reduce the water transportation cost by over 80%
- Reduce carbon emissions as a result of lowering truck traffic
- Reduce impacts on roads and neighboring communities





# Oil & Gas Growing Water Problem

## Frac Drilling

- Thousands of Wells will be drilled each year for decades, 4000 Wells active now
- **\$2 Trillion** in anticipated Capital spend
- **Production** water use is approximately 200~400 bbls per day/well for next **20 years**
- Water with very high metal and salt content, treatment and/or disposal required
- Tightening State and Federal Regulations
- Growing Costs for Transport and Disposal
- Currently Epiphany is the only Cost Effective, Well Pad Treatment Solution

# Test Lab Results

PPM (Parts per million)													
	TSS	TDS	Al	Ca	Fe	Mg	Mn	K	Na	ICP SO4	Chloride	Ba	Sr
Pre-treatment	317	185896	4.62	22780	325	2577	14.61	378	59720	18.6	129000	1852	2507
Post-treatment	0	5	0	0	0	0	0	0	0	5	0	0	0

**This chart shows that the raw produced water contains approximately 18.5% total impurities, including harmful levels of highly toxic metals such as Barium and Strontium. After it is processed by Epiphany's system, the discharge water is 99.9995% pure, far exceeding every water safety standard, including purity requirements for pharmaceutical uses.**

# Applications

- Frac (Produced Water) Treatment
- Ground Water Cleanup
- Surface Water Cleanup
- Process Rinse Water & Wash Water
- Potable Water
- Influent Quality Water Control



# Applications

Processing Produced Water – Frac Site - Arkansas



# 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 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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