

Sep 10th, 2025

TREVI

Forward Osmosis + Data Center Waste Heat Integration

Agenda

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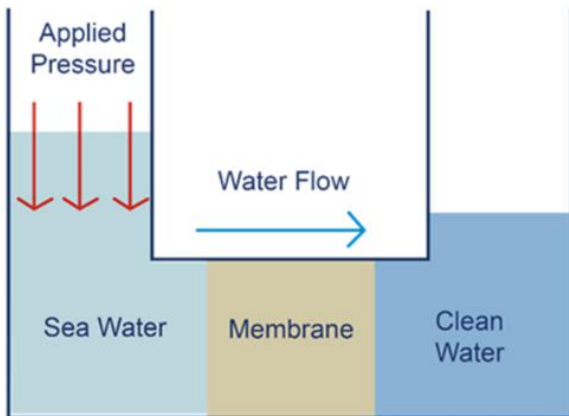
- Introduction to Trevi's FO
- Study Assumptions & Goal
- Different Sources of Water – Cases
- LCOW and TEA Assumptions
- Comparison Scenarios for LCOWs
 - Case 1: Cities
 - Case 1 LCOWs
 - Case 2: Cities
 - Case 2 LCOWs
 - Case 3a: Cities
 - Case 3b: Cities
 - Case 3a & 3b: LCOWs
- Results / Comparisons Across All Cases
- What makes an ideal FO Desalination site utilizing waste heat?
- Case 1: Water Positive Impacts & Possible Downstream Applications
- Case 2: Water Positive Impacts & Possible Downstream Applications
- Case 3: Water Positive Impacts & Possible Downstream Applications
- Permitting & Regulatory Considerations for FO Desalination (U.S.)
- Potential Operating and Revenue Models
- Scaling Up: FO + Data Center Waste Heat Integration
 - Case 1 Scaling Up: FO + Data Center Waste Heat Integration
 - Case 2 Scaling Up: FO + Data Center Waste Heat Integration
- Recommendations for Next Steps

Forward Osmosis (FO) Technology Loves Waste Heat

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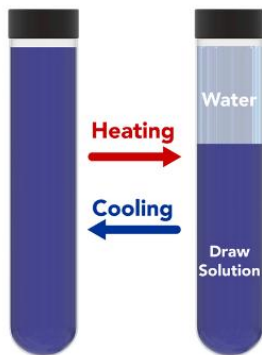
Standard Reverse Osmosis

High Pressure & Electricity Requirements



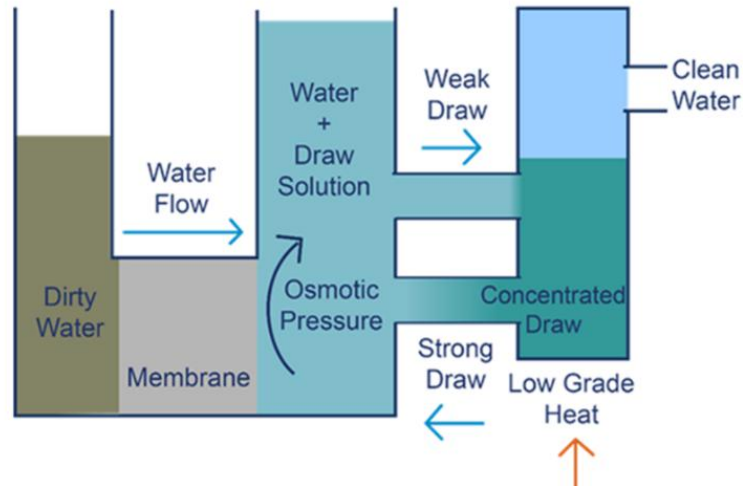
Trevi's Draw Solutions

Over 300+ Food Grade Safe



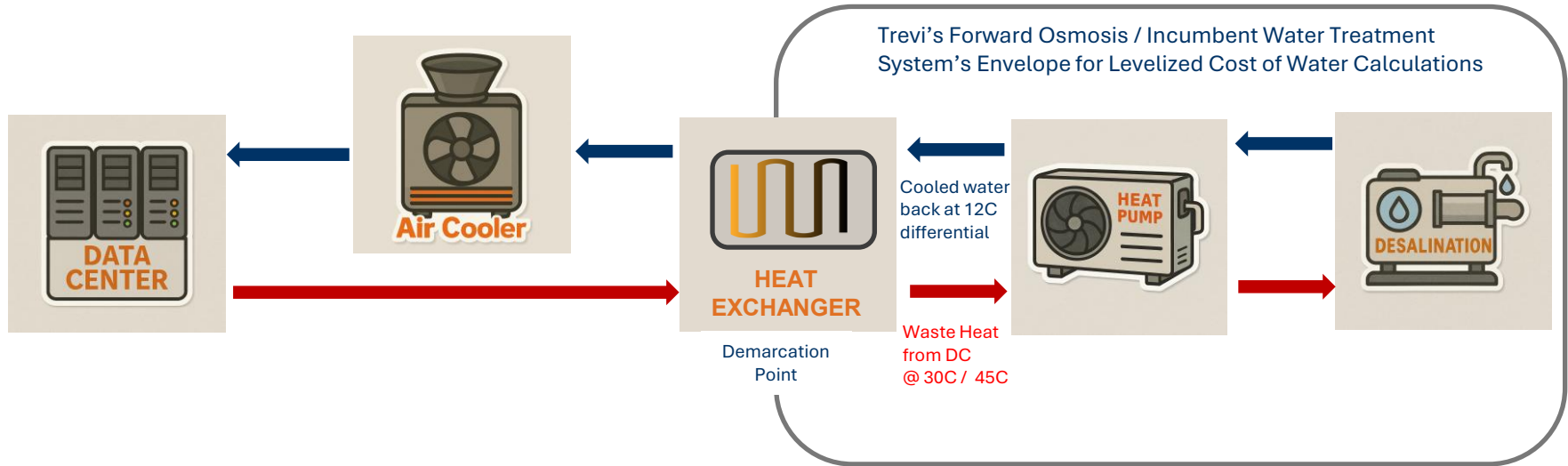
Forward Osmosis

Low Pressure & Low Grade Heat Activated



Study Assumptions & Goal

- Microsoft data centers deliver 1MW of waste heat (WH) at varying temperatures to Trevi
- To determine the cost to desalinate with FO for varying water sources with and without waste heat (at varying temperatures) as well versus incumbent technologies



Different Sources of Water - Cases

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Case 1 – Inland Brackish: ~2,000 mg/L

FO systems paired with data centers near brackish groundwater sources (<10,000 mg/L TDS), such as in Arizona, New Mexico or West Texas.

Case 2 – Coastal Seawater: ~35,000 mg/L TDS

FO systems treating ocean water near coastal data centers with access to fiber and seawater (e.g., San Diego, Corpus Christi).

Case 3a & 3b – Industrial Produced Wastewaters: ~100,000 mg/L TDS

High-salinity FO deployments

- 3a - Oil and gas basins, where data centers can be co-located with upstream or midstream operations in the US
- 3b- Industrial manufacturing facilities, where brine management and water reuse are a priority for operations in European cities



LCOW and TEA Assumptions

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| Parameter | Case 1: Inland Brackish | Case 2: Coastal Seawater | Case 3: Produced Water (Oil & Gas) / Industrial High TDS Wastewaters (Brine) |
|---|---|---|--|
| Feedwater Source | Brackish groundwater | Seawater | Produced oil & gas wastewater |
| Feedwater Salinity (TDS) | 2,000 mg/L | 35,000 mg/L | 100,000 mg/L |
| Target Brine Concentration (TDS) | 150,000 mg/L | 100,000 mg/L | 200,000 mg/L |
| Daily Production Capacity | 1,000 m ³ /day | 1,000 m ³ /day | 700 m ³ /day |
| System Recovery Rate | ~98% | ~64% | ~50% |
| FO Plant CAPEX | \$1.66 million | \$1.65 million | \$2.56 million |
| FO Plant Annual OPEX | \$115,590 | \$130,636 | \$256,476 |
| Thermal Energy Requirement | 35 kWh/m ³ | 35 kWh/m ³ | 50 kWh/m ³ |
| Electrical Energy Requirement | 1.1 kWh/m ³ | 1.1 kWh/m ³ | 4.5 kWh/m ³ |
| Waste Heat Use (Temp Lift at 30°C) | 30°C → 85°C ($\Delta T = 55^\circ\text{C}$) | 30°C → 85°C ($\Delta T = 55^\circ\text{C}$) | 30°C → 90°C ($\Delta T = 60^\circ\text{C}$) |
| Heat Pump CAPEX | \$500,000 | \$500,000 | \$500,000 |
| Heat Pump COP (with 30°C WH) | 3.5 | 3.5 | 3.3 |
| Heat Pump COP (with 45°C WH) | 4.8 | 4.8 | 4.4 |
| Heat Pump COP* (with 65°C WH) | 7.0 | 7.0 | 4.8 |
| Benchmark Comparison | UHPRO | SWRO | UHPRO + Evaporator |
| Key Challenge | Brine disposal inland | Competition with mature SWRO | Complex chemistry & salinity of produced water |

*New theoretical lift evaluated in Case 4 as a sensitivity analysis higher waste heat coming from a DC

Comparison Scenarios for LCOWs

| Various Scenarios | Description | Cooling / Heat Source | Return Temp | Description Benchmark System |
|-----------------------------------|--|---|--|--|
| FO Standalone | FO system without data center heat. | Air or seawater cooling with heat pump. | Possible cooling benefit since heat pump is used | N/A |
| FO + DC Waste Heat (30 °C) | FO system using 30 °C data center waste heat. | Waste heat + heat pump. | 18 °C cooling benefit | N/A |
| FO + DC Waste Heat (45 °C) | FO system using higher-quality 45 °C data center heat. | Waste heat + improved efficiency. | 33 °C cooling benefit | N/A |
| Benchmark System | Conventional treatment system. | None | No cooling benefit | Case 1: Ultra-high-pressure Reverse Osmosis (UHPRO) for brackish desalination Case 2: Standard Reverse Osmosis (SWRO) for seawater desalination Case 3: UHPRO + evaporator for high-TDS industrial wastewaters for brine concentration |

LCOW for FO without waste heat = Annualized (Electricity Cost + Thermal costs (with HP & ambient air cooling & no WH)+ FO CAPEX+FO OPEX+ Heat Pump CAPEX)/1000

LCOW for FO with waste heat at varying temps = Annualized (Electricity Cost + Thermal costs (with HP & WH @ 30, or 45 or 65 deg C)+ FO CAPEX+FO OPEX+ Heat Pump CAPEX)/1000



Phoenix, Arizona

- Large brackish aquifers (Gila Bend region)
- Strong fiber backbone and data center hubs (e.g., Chandler area)
- Severe drought and water scarcity issues

Alamogordo, New Mexico

- Access to significant brackish aquifers (e.g., Tularosa Basin)
- Adequate power and connectivity infrastructure
- Affordable land and proximity to data center expansions

Albuquerque, New Mexico

- Located over Albuquerque Basin brackish aquifer
- Well-developed fiber and power infrastructure
- Strategic inland site for large-scale water reuse

Midland, Texas

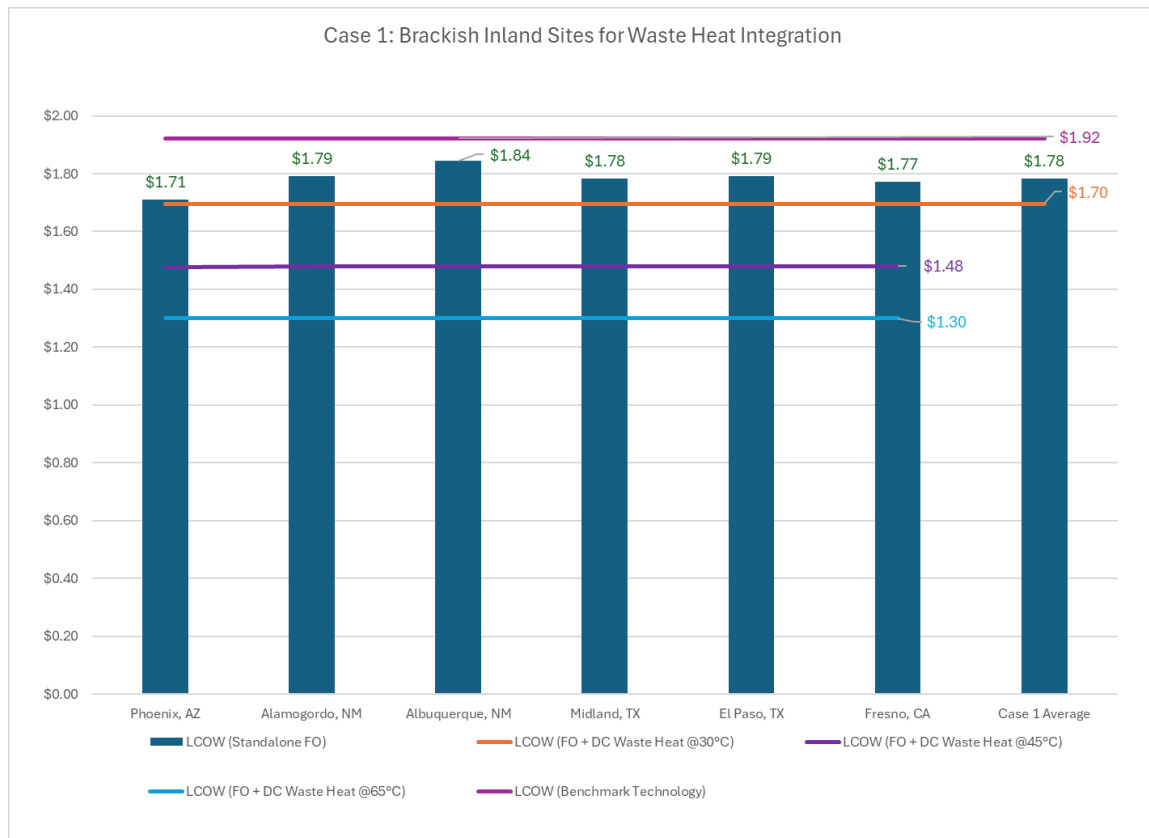
- Abundant brackish and produced water reserves
- Large land availability and strong renewable energy integration
- High water demand from local industry and urban growth

El Paso, Texas

- Existing high water costs and scarcity challenges
- Access to West Texas brackish aquifers
- Opportunity to reduce dependency on external water imports

Case 1 LCOWs: Inland Sites with Brackish Groundwater

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| City | LCOW (Standalone FO) |
|-----------------|----------------------|
| Phoenix, AZ | \$1.71 |
| Alamogordo, NM | \$1.79 |
| Albuquerque, NM | \$1.84 |
| Midland, TX | \$1.78 |
| El Paso, TX | \$1.79 |
| Fresno, CA | \$1.77 |
| Case 1 Average | \$1.78 |

| Scenarios | \$ |
|---------------------------------|--------|
| LCOW (FO + DC Waste Heat @30°C) | \$1.70 |
| LCOW (FO + DC Waste Heat @45°C) | \$1.48 |
| LCOW (FO + DC Waste Heat @65°C) | \$1.30 |
| LCOW (Benchmark Technology) | \$1.92 |

At 30°C waste heat, FO achieves ~12% lower LCOW than UHPRO. Phoenix has the best-performing standalone FO LCOW at \$1.71/m³, which improves further with waste heat integration.

Not quantified above: With FO technology utilizing waste heat from the DC, in addition to the production of 1000m³/day of fresh potable water, a cooling benefit of 1 MW is also returned to the data center in the form of cooled DC water with a 12 deg C differential.



Coastal Sites with Seawater



San Diego

Direct seawater access with established brine discharge infrastructure

Subsea cables to Pacific Rim markets

Growing edge data center market

Supportive local sustainability and water reuse policies

Favorable land and operational costs compared to other California metros

Corpus Christi

Seawater access and port infrastructure for intake/discharge

Potential future subsea cable landing site (Gulf Coast infrastructure gap)

Competitive land costs and utility rates

Data center market in early growth stage

Drought-prone, making resilient water infrastructure a priority.

Miami

High-density subsea cable hub — gateway to Latin America and the Caribbean

Seawater access for FO desalination and brine disposal

Major regional data center market

State resilience programs for hurricane/drought adaptation

Permitting pathways for desalination under emergency water supply planning

Virginia Beach

Leading East Coast subsea cable landing hub (transatlantic connectivity)

Seawater access via Atlantic coast

Fast-growing data center market serving Mid-Atlantic and European traffic

Well-developed resilience infrastructure for storms and sea-level rise

Pro-water reuse regulations and offshore wind development zone nearby

Honolulu

Transpacific subsea cable hub linking U.S., Asia, Australia, and Pacific islands

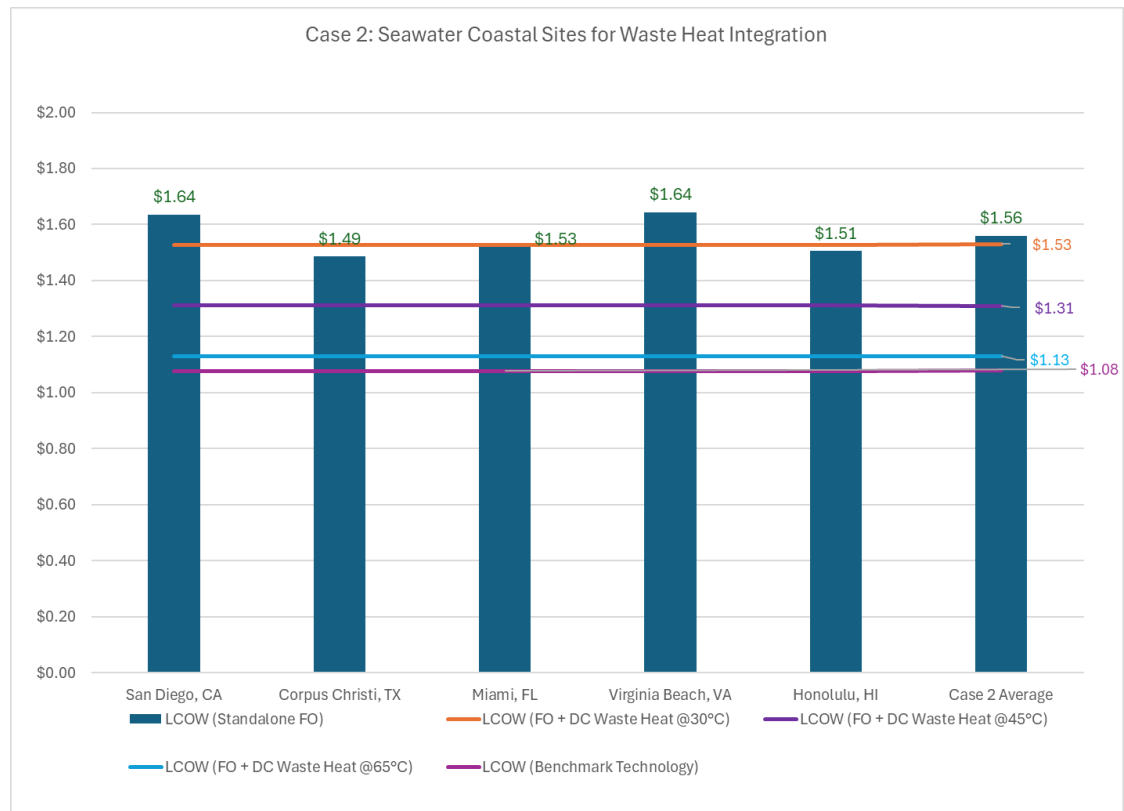
Seawater access for desalination, district cooling, and brine disposal

Data center market emerging as a Pacific edge location

State commitment to renewable energy and water-positive initiatives

Strict building and infrastructure resilience codes

Coastal Sites with Seawater



| City | LCOW (Standalone FO) |
|--------------------|----------------------|
| San Diego, CA | \$1.64 |
| Corpus Christi, TX | \$1.49 |
| Miami, FL | \$1.53 |
| Virginia Beach, VA | \$1.64 |
| Honolulu, HI | \$1.51 |
| Case 2 Average | \$1.56 |

| Scenarios | \$ |
|---------------------------------|--------|
| LCOW (Standalone FO) | \$1.64 |
| LCOW (FO + DC Waste Heat @30°C) | \$1.53 |
| LCOW (FO + DC Waste Heat @45°C) | \$1.31 |
| LCOW (FO + DC Waste Heat @65°C) | \$1.13 |
| LCOW (Benchmark Technology) | \$1.08 |

- ✓ FO is more expensive than very mature seawater RO
- ✓ FO becomes more competitive with increasing WH
- ✓ Additional value streams (e.g., cooling or water reuse credits) would be needed to justify deployment in coastal settings.

Not quantified above: With FO technology utilizing waste heat from the DC, in addition to the production of 1000m3/day of fresh potable water, a cooling benefit of 1 MW is also returned to the data center in the form of cooled DC water with a 12 deg C differential. However, seawater is also a good source of free cooling if possibly tapped



Oil and Gas Produced Wastewater Sites

| City | Region | Key Reasons for Selection |
|-------------------|---------------|---|
| Dallas-Fort Worth | Texas, USA | • Close to Barnett Shale & Permian Basin — large produced water volumes • Severe water scarcity & rapid metro growth • Major, fast-growing data center hub |
| Houston | Texas, USA | • Energy capital with extensive oil & gas infrastructure • High volumes of produced water • Rising water costs & strong data center growth • Opportunity to reuse produced water for cooling |
| Denver | Colorado, USA | • Proximity to Denver-Julesburg Basin — significant fracking activity • Increasing water scarcity (Colorado River stress) • Emerging data center market needing alternative cooling water |
| Riyadh | Saudi Arabia | • Major oil production hub (Saudi Aramco) • Rapid data center expansion under Vision 2030 • Severe water scarcity; strong focus on sustainability and reuse |
| Abu Dhabi | UAE | • Large oil production and advanced wastewater reuse frameworks • Rapidly growing data center ecosystem • High dependence on desalination; FO offers lower-cost, sustainable water reuse |
| Muscat | Oman | • Active oil production with pilot produced water reuse • Emerging data center hub with strong subsea cable links • Severe water scarcity; reliance on desalination; FO supports lower-cost industrial supply |

Industrial Wastewater EU Sites with High TDS Brine

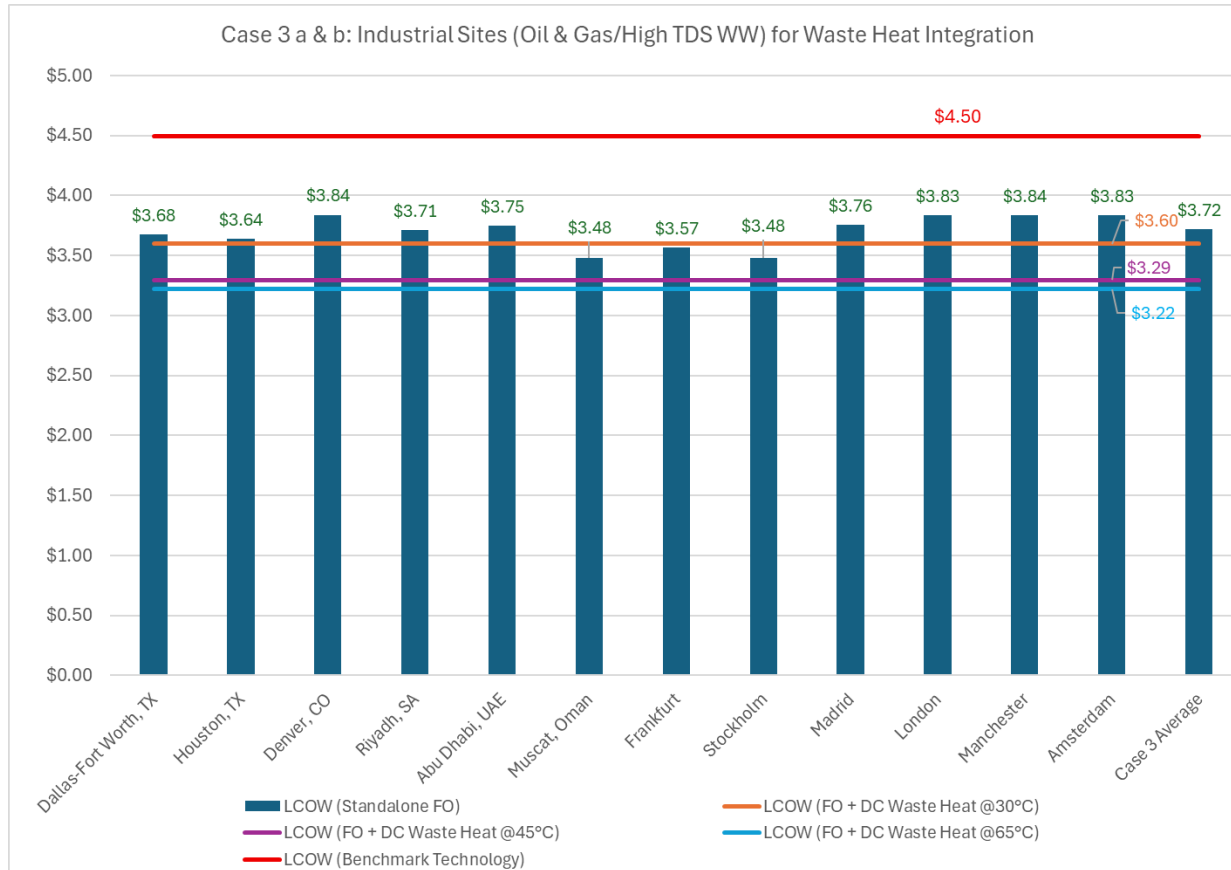
| City | Data Center Market | Industrial Wastewater Drivers | Regulatory Environment | Infrastructure & ESG Alignment |
|------------|--|--|--|---|
| Frankfurt | Largest DC market in Europe | Chemicals, pharmaceuticals, automotive | Strict brine discharge & water reuse laws (Germany) | Existing circular water & district energy systems |
| Stockholm | Rapidly growing, powered by renewables | Manufacturing, chemicals, district heating | Progressive water reuse and discharge regulations | Strong government incentives for circular economy |
| Amsterdam | Hyperscale & colocation hub | Electronics, food processing, chemicals | Very strict brine discharge & reuse enforcement | Industrial water reuse infrastructure & port proximity |
| Madrid | Expanding DC market, regional hub | Chemicals, food & beverage, pharma | Ambitious national water reuse targets | Municipal and industrial water reuse networks |
| London | Major DC market with hyperscale growth | Power generation, chemicals, pharmaceuticals | UK Water Reuse Framework & strict discharge limits | Active ESG programs and infrastructure resilience funds |
| Manchester | Emerging DC & industrial reuse cluster | Chemicals, advanced manufacturing, food processing | Regional brine reduction programs and reuse incentives | City-level ESG and water sustainability initiatives |

LCOWs

| City | LCOW (Standalone FO) | LCOW (FO + DC Waste Heat @30°C) | LCOW (FO + DC Waste Heat @45°C) | LCOW (FO + DC Waste Heat @65°C) | LCOW (Benchmark Technology) |
|-----------------------|-------------------------|---------------------------------------|---------------------------------------|---------------------------------------|-----------------------------------|
| Dallas-Fort Worth, TX | \$3.68 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| Houston, TX | \$3.64 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| Denver, CO | \$3.84 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| Riyadh, SA | \$3.71 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| Abu Dhabi, UAE | \$3.75 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| Muscat, Oman | \$3.48 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |

| City | LCOW (Standalone FO) | LCOW (FO + DC Waste Heat @30°C) | LCOW (FO + DC Waste Heat @45°C) | LCOW (FO + DC Waste Heat @65°C) | LCOW (Benchmark Technology) |
|------------|-------------------------|---------------------------------------|---------------------------------------|---------------------------------------|-----------------------------------|
| Frankfurt | \$3.57 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| Stockholm | \$3.48 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| Madrid | \$3.76 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| London | \$3.83 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| Manchester | \$3.84 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |
| Amsterdam | \$3.83 | \$3.60 | \$3.29 | \$3.22 | \$4.50 |

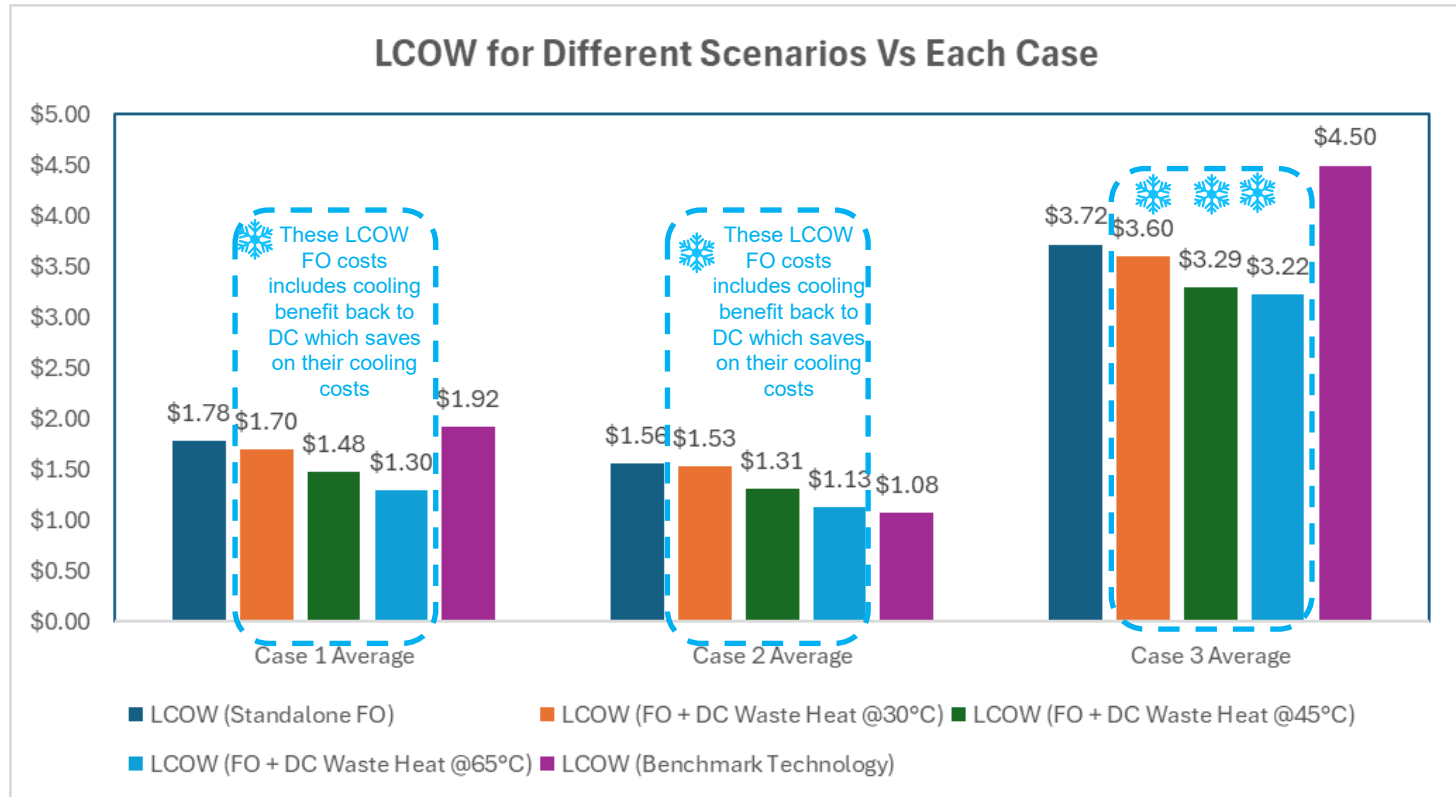
LCOWs



Takeaways

- For all 12 cities, which have high-salinity source water, FO consistently delivers a lower LCOW than the benchmark UHPRO + evaporator system, even without waste heat.
- When integrated with DC WH, FO achieves even greater cost reductions & has additional benefit of delivering cooling back to the DC, thus reducing cooling requirements of the DC ❄️ ❄️
- Strong potential for FO deployment in oil & gas regions and industrial wastewater setting where water recovery and reuse is important.

Across All Cases: LCOW Averages



Across All Cases: Percentage of LCOW Savings

| Case | Standalone FO vs Benchmark Tech | Standalone FO vs FO utilizing waste heat at 30 Deg C | FO utilizing waste heat at 30 Deg C vs Benchmark Tech | FO utilizing waste heat at 45 Deg Cvs Benchmark Tech |
|--|---------------------------------|--|---|--|
| Case 1: Inland Brackish | 7.28% | 4.81% | 11.75% | 22.96% |
| Case 2: Coastal Seawater | 44.76% | 1.68% | 41.99% | 21.62% |
| Case 3: Produced Water / Industrial Brine | 17.34% | 3.28% | 20.03% | 26.73% |

Key Takeaways:

- 30°C WH already reduces costs meaningfully (energy savings for utilizing WH is already baked into the reduced costs)
- 45°C and 65°C WH offer major savings — best for brackish, produced water, and industrial brines
- FO + WH also delivers a cooling benefit savings for the DC
- Seawater desalination remains less competitive without credits/incentives
- Waste heat valorization turns DCs into water-positive, ESG-friendly assets

Percentage of Energy Savings using Waste Heat for FO Desal

For Case 1 and Case 3 where the LCOW of FO technology utilizing waste heat from data centers is attractive compared to the incumbent technologies, utilizing the waste heat from data centers translates into the approximate percentages of energy saved when comparing the costs of desalination between FO utilizing waste heat and incumbent technologies for desalination

| Percentage of Annual Energy Savings | | |
|--|---|---|
| Case | FO utilizing waste heat at 30 Deg C vs Benchmark Tech | FO utilizing waste heat at 45 Deg C vs Benchmark Tech |
| Case 1: Inland Brackish | ~11.7% | ~33.3% |
| Case 3: Produced Water / Industrial Brine | ~31.8% | 45% |

The percentage of energy savings when it comes to utilizing waste heat for desalination does not take into account the energy savings to the data center when they get back to cooled stream of water as well.

What makes an ideal FO Desalination site utilizing waste heat?

| Category | Criteria |
|---------------------------------------|---|
| Water Source Conditions | <ul style="list-style-type: none">- High salinity or difficult-to-treat feedwaters (produced water >100,000 mg/L TDS, industrial brine, or inland brackish groundwater)- Located in areas with ZLD/MLD mandates or expensive brine disposal- Stable, year-round access to impaired water from industrial activity, aquifers, or others |
| Waste Heat Availability | <ul style="list-style-type: none">- Continuous, year-round low-grade waste heat $\geq 45^{\circ}\text{C}$ ($\geq 65^{\circ}\text{C}$ preferred for peak efficiency and LCOW savings)- Reliable thermal output from data center cooling via air-to-water or liquid cooling systems |
| Site & Infrastructure Compatibility | <ul style="list-style-type: none">- Close proximity between FO system and data center (<1000 ft) to minimize thermal losses- Available land for FO system (preferably adjacent to DC)- Electricity access and water conveyance infrastructure |
| Regulatory & Economic Environment | <ul style="list-style-type: none">- Supportive permitting for non-potable reuse (e.g., CA Title 22, TX reuse)- Permissive or favorable brine disposal regulation- Eligibility for ESG, circular economy incentives, or ZLD tax credits |
| Data Center Requirements or Synergies | <ul style="list-style-type: none">- Cooling water demand or on-site reuse opportunity (e.g., adiabatic cooling)- Need to reduce evaporative losses, trucking, or water footprint- Waste heat valorization, sustainability, or ESG reporting goals |

Water Positive Impacts & Possible Downstream Applications

Water Positive Impacts



Reduced Aquifer Drawdown

Up to 98% recovery from brackish sources reduces freshwater extraction



Lower Brine Disposal Burden

FO concentrates brine up to 150,000mg/L, cutting inland disposal volumes and costs



Waste Heat Reuse

Converts data center waste heat into a sustainable water source, replacing water-intensive cooling



Increased Water Availability

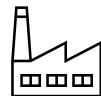
Produces potable-grade water for surrounding communities, supporting growth

Possible Downstream Applications



Agricultural Irrigation

Supports drought-resistant crops and groundwater banking



Industrial Use

Provides reliable non-potable water for cooling and processing (e.g. semiconductor manufacturing)



Emergency Resilience

Acts as decentralized water supply hubs during crises



Municipal Supply

Can be upgraded for drinking water, reducing community water stress

Water Positive Impacts & Possible Downstream Applications

Water Positive Impacts



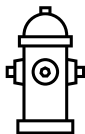
Reduced Energy & GHGs Compared to SWRO

Trevi's FO system, co-powered by data center waste heat, avoids the high pressures required of seawater RO, leading to significantly lower CO2 emissions and energy use



Minimized Marine Brine Discharge

FO technology can result in smaller volumes of concentrated brine which can be more easily managed through existing technologies to reduce ecological stress



Enhanced Water Security During Emergencies

Coastal data centers with FO units can provide resilient decentralized desalination

Possible Downstream Applications



Direct Data Center Cooling

FO-treated seawater can be recirculated within the data center for air handling or evaporative backup, reducing dependence on city water or groundwater



Urban Reuse/ Blending with Potable Supplies

Cities like Miami and San Diego with reuse policies may accept FO-treated water for blending into drinking water systems or indirect potable reuse (IPR) as regulatory frameworks mature



Industrial Zones and Port Authorities

Coastal industrial users (shipyards, refineries, commercial complexes) can use FO-treated water for process cooling, washing, or fire suppression systems.

Water Positive Impacts & Possible Downstream Applications

Water Positive Impacts



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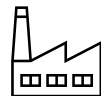
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Permitting & Regulatory Considerations for FO Desalination (U.S.)

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KEY FACTORS BY CASE

CASE 1 Brackish Groundwater (Inland)

- Groundwater withdrawal permits
- Brine disposal (deep well injection)
- State-specific environmental reviews

CASE 2 Seawater (Coastal)

- NPDES discharge & coastal permits
- Marine protection compliance (e.g. CA Ocean Plan)
- Infrastructure interconnection approvals

CASE 3 Produced Water (Oil & Gas)

- Complex ownership & reuse rights
- UIC permits for brine
- Reuse standards (e.g. fracking)
- Air permits if on-site power used

CASE 4 Industrial Brines

- NPDES & reuse permits (non potable)
- Brine disposal under RCRA
- Site construction & stormwater permits
- Potential ESG incentives & tax credits

CROSS-CUTTING THEMES

- Discharge & Reuse permits critical
- Brine handling & disposal pathways
- Ownership & beneficial use agreements
- Early agency engagement essential

Potential Operating and Revenue Models

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Direct Water Cost Offset (Owner-Operator)

Reduces water costs, improves resilience, lowers carbon footprint



Water-as-a-Service

Revenue from external water sales & circular use of waste heat



Produced Water Treatment Fee-For Service

Oil/gas operators pay-per-barrel fee, reducing ZLD costs, ESG benefits



Produced Water Treatment Fee-For Service

Oil/gas operators pay-per-barrel fee, reducing ZLD costs, ESG benefits



Embedded Infrastructure (Co-location or Lease)

FO integrated into data center campus, water for tenants, boosts green ratings



Heat & Carbon Credit Monetization

Generates carbon credits of renewable thermal certificates



Public-Private Partnership (P3)

Shared funding with municipalities, guaranteed water supply, tax incentives



ESG-Driven Supply Chain Water Credits

Generates water positive credits for corporate goals, potential credit sales

FO + Data Center Waste Heat Integration

Most promising scale-up opportunities in Phoenix (Brackish) and Houston (Produced/Industrial Brines)

Why Phoenix & Houston

- Lowest LCOW achieved within their case categories
 - Acute water stress + Microsoft Water Positive priority basins
 - Growing digital infrastructure = reliable continuous waste heat supply
 - Supportive regulatory environments for reuse and impaired water treatment
- ✓ Economic Impact of Waste Heat Integration
 - Up to 12% lower LCOW (@30C) vs RO (Brackish)
 - Up to 20% lower LCOW (@30C) vs UHPRO + Evaporator (Produced/Industrial Brine)

Scaling to 10 MW enables:

| Phoenix (Case 1 – Brackish): | Houston (Case 3 – Produced Water): |
|---|---|
| <ul style="list-style-type: none"> • Total treatment capacity of ~10,000 m³/day • Equivalent to supplying potable water to ~40,000 people per day • Provides significant municipal or industrial offset for a city experiencing recurring drought and Tier 1 Colorado River shortage declarations | <ul style="list-style-type: none"> • Total treatment capacity of ~7,000 m³/day • Creates a scalable model for oilfield reuse, eliminating the need for energy-intensive evaporators or Class II injection wells • FO product water can be reused for cooling, steam generation, or sent to third-party industrial users |

Case 1 Scaling Up: FO + Data Center Waste Heat Integration

Insights

- ✓ FO profit is significantly higher than RO in both scales (e.g., at 10 MW, FO is ~135% higher)
- ✓ Both FO and RO have the same water sales revenue, but FO benefits from:
 - Lower OPEX Ability to monetize waste heat (avoided cooling power costs)
 - Lower CAPEX (indirectly referenced)
- ✓ % of energy savings utilizing waste heat to desalinate = 32%
- ✓ Cooling water is given back to DC (\$1.88M benefit)

Confirmed Strategic Points

- ✓ At 10 MW, FO profit: ~\$2.38M/year
- ✓ FO uses waste heat effectively, offsetting cooling needs (\$1.88M benefit)
- ✓ FO remains lower in cost structure even when including thermal energy costs
- ✓ Supports ~40,000 people at 10 MW scale

| Datacenter Size – based on thermal cooling needs – Phoenix, Brackish water, 45C waste heat from DC: | 1MW | 10MW | Units / Assumptions |
|---|----------------|-----------------|---|
| Standalone Cooling Power Requirement from Waste Heat | 268.22 | 2682.22 | kW / COP of 3.7 is based on using a 20C lift above the highest ambient conditions for Phoenix (50C). A 20C lift provides for assured operation in the hottest months (to guarantee the datacenter meets reliability goals) and makes the theoretical COP then 7.457, with a discount of 50% for real world losses giving a practical COP of 3.7 |
| Annual Power Cost needed for cooling (Cooling credits) | -\$187,969.68 | -\$1,879,696.79 | \$ / Based COP of 3.7 and \$0.08 / kwh |
| Water Plant Size | 1001 | 10010 | m3/day |
| UHPRO: | | | |
| UHPRO CAPEX | 2,274,369.13 | 16,116,788.32 | |
| UHPRO Annual Electrical energy | 365,380.60 | 3,653,806.05 | \$ |
| UHPRO Annual CAPEX (20yr, 6% note) | \$195,531.44 | \$ 1,385,588 | \$ |
| UHPRO Annual OPEX | \$136,462.15 | \$ 967,007 | \$ |
| UHPRO Annual Water Sales revenue | \$701,823.07 | \$7,018,230.66 | \$ / Based on lowest tier sale price of 1.96 USD/m3 |
| RO Profit for desalination @ DC | \$4,448.87 | \$1,011,829.18 | \$ / Annual Water Sales minus Annual Costs |
| FO: | | | \$ |
| FO CAPEX | \$1,631,699.69 | \$10,911,366.01 | \$ |
| FO Annual Electrical energy | \$37,999.58 | \$379,995.83 | \$ |
| FO Thermal Energy Cost | \$210,218.98 | \$2,102,189.78 | \$ |
| FO Annual CAPEX (20yr, 6%) | \$140,280.04 | \$938,068.98 | \$ |
| FO Annual OPEX | \$117,757.41 | \$787,457.54 | \$ |
| FO Annual Heat Pump CAPEX | \$42,985.86 | \$429,858.64 | \$ |
| FO Annual Water Sales | \$701,823.07 | \$7,018,230.66 | \$ / Based on lowest tier sale price of 1.96 USD/m3 |
| FO Profit for Desalination @DC | \$152,581.19 | \$2,380,659.89 | \$ / Annual Water Sales minus Annual Costs |
| % of Annual Energy Savings utilizing waste heat for desalination = 32% = | | | \$1,171,620.44 |

Case 3 Scaling Up: FO + Data Center Waste Heat Integration

| Datacenter Size – based on thermal cooling needs – Houston, Produced Water, 45C waste heat from DC: | 1MW | 10MW | Units / Assumptions |
|---|-----------------------|------------------------|---|
| Standalone Cooling Power Requirement from Waste Heat | 232.14 | 2321.43 | kW/ is based on using a 20C lift above the highest ambient conditions for Houston (43C). A 20C lift provides for assured operation in the hottest months (to guarantee the datacenter meets reliability goals) and makes the theoretical COP then 8.6, with a discount of 50% for real world losses giving a practical COP of 4.3 |
| Annual Power Cost needed for cooling (Cooling credits) | -\$187,969.68 | -\$1,626,857.14 | \$/ Based COP of 4.3 and \$0.08 / kWh |
| Water Plant Size | 701 | 7007 | m3/day |
| UHPRO + MVR: | | | |
| UHPRO + MVR CAPEX | 2,732,846.72 | 23,124,087.59 | |
| UHPRO + MVR Annual Electrical energy | 587,239.71 | 5,872,397.08 | \$ |
| UHPRO + MVR Annual CAPEX (20yr, 6% note) | 234,947.55 | \$ 1,988,018 | \$ |
| UHPRO + MVR Annual OPEX | 232,291.97 | \$ 1,965,547 | \$ |
| UHPRO + MVR Annual Water Sales revenue | \$1,503,906.57 | \$15,039,065.69 | \$/ Based on treatment cost of \$1/bbl = \$6 USD/m3 |
| RO Profit for desalination @ DC | \$449,427.34 | \$5,213,103.42 | \$/ Annual Water Sales minus Annual Costs |
| FO: | | | \$ |
| FO CAPEX | \$2,382,481.75 | \$19,620,437.96 | \$ |
| FO Annual Electrical energy | \$92,075.91 | \$920,759.12 | \$ |
| FO Thermal Energy Cost | \$231,240.88 | \$2,312,408.76 | \$ |
| FO Annual CAPEX (20yr, 6%) | \$204,826.07 | \$1,686,802.94 | \$ |
| FO Annual OPEX | \$238,909.52 | \$1,967,490.17 | \$ |
| FO Annual Heat Pump CAPEX | \$42,985.86 | \$429,858.64 | \$ |
| FO Annual Water Sales | \$1,503,906.57 | \$15,039,065.69 | \$/ Based on treatment cost of \$1/bbl = \$6 USD/m3 |
| FO Profit for Desalination @DC | \$693,868.33 | \$7,721,746.07 | \$/ Annual Water Sales minus Annual Costs |
| % of Annual Energy Savings utilizing WH FO Desalination = 45 | | | \$2,639,229.20 |

Main Insights

✓ 10 MW Scale

FO profit: \$7.72M/year

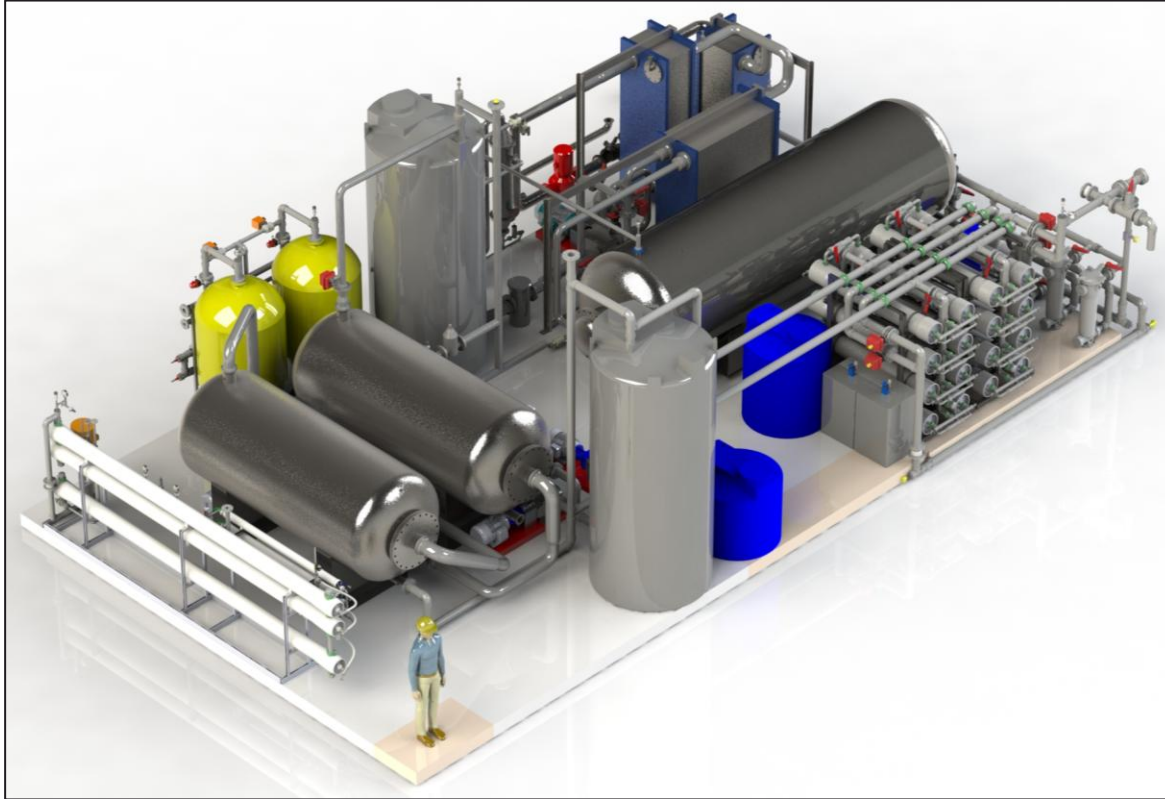
UHPRO + MVR profit: \$5.21M/year

FO profit is ~48% higher.

Confirmed Strategic Points

- ✓ FO converts waste heat into separation work, lowering electricity demand & gives back cooling
- ✓ % of energy savings utilizing waste heat to desalinate = 45%
- ✓ Cooling water is given back to DC (\$1.62M benefit)
- ✓ At 10 MW:
 - FO energy cost: \$3.2M/year
 - UHPRO + MVR energy cost: \$5.9M/year
 - ~\$2.6M/year savings.
- ✓ Similar CAPEX, but FO has lower OPEX and avoids complex mechanical vapor recompression.
- ✓ Generates ~\$1.6M/year in cooling energy offsets, leveraging data center synergy.
- ✓ FO is more resilient to corrosion and brine handling issues than RO+MVR.
- ✓ Optimal for mid-sized DCs (10–20 MW scale), aligning with oilfield water consolidation realities.

1000 m3/day FO Desalination Plant



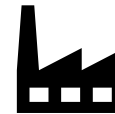
Possible sources of water to desalinate with forward osmosis systems utilizing waste heat could be:



City water which is being desalinated for use by the data centers currently with reverse osmosis technology



Cooling blowdown water which data centers typically have to discard after a certain number of utilization cycles



Reverse osmosis brine from data center RO treatment systems which is typically discarded can be further treated with FO to squeeze out more water

Recommendations for Next Steps



Pilot Deployment

- ✓ Deploy 1 MW FO pilot co-located with a data center in Phoenix, AZ or Houston, TX
- ✓ Conduct site-specific feasibility & integration study



Next Steps

- ✓ Engage Microsoft CO+I and relevant teams /stakeholders (site, logistics, permitting)
- ✓ Develop scope, budget & timeline
- ✓ Collaborate with Water Positive team to quantify regional benefits



Pilot Objectives

- ✓ Demonstrate technical reliability & thermal integration
- ✓ Validate economic advantage over current solutions
- ✓ Lay foundation for scalable rollout (5–10 MW) & regional water hubs

Replenishment priority locations *

As of July 2024, we have invested more than \$34 million in 76 replenishment projects around the world, estimated to provide >100 million m³ in volumetric water benefit over the project lifetime.



In Europe, countries like Germany now *mandate* data centers to reuse 10–20% of their waste heat, and even in Sweden where it's not compulsory, strong district-heating networks mean operators are expected to plan for heat recovery.



Why Phoenix?

- ✓ Access to brackish groundwater
- ✓ Severe freshwater scarcity pressures
- ✓ High energy costs make FO more competitive



Why Houston?

- ✓ Access to high-salinity produced water (oil & gas)
- ✓ Strong industrial reuse potential
- ✓ Presence of large-scale data centers



Strategic Alignment

- ✓ Both cities are Microsoft Water Positive priority basins, supporting 2030 water goals:
 - Reduce freshwater withdrawals
 - Convert waste heat into reusable water
 - Generate replenishment credits

Global Trends in Data Center Waste Heat Utilization

Europe leads with binding mandates — e.g., Germany requires data centers to reuse 10–20% of waste heat, while countries like Sweden rely on strong district-heating networks to integrate it

With no mandates but extreme climate pressures, the Middle East is pushing advanced cooling and green-data-center design, setting the stage for future waste heat utilization



The U.S. has no federal mandate yet, but states like New York and California are piloting thermal energy networks and efficiency standards that open the door for heat reuse

Asia's approach is mixed — Singapore and Japan encourage integration into district cooling/heating, while China is piloting waste-heat recovery in industrial clusters

Rest of World: “Elsewhere, waste heat reuse is still emerging, with most regions relying on voluntary initiatives, pilot projects, or alignment with broader decarbonization goals.

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