Waste Water Energy Transfer and Geothermal
“The Perfect Pairing”

Geothermal: The Genius Renewable

Live at Groundwater Week in partnership with NGWA

Las Vegas, NV
December 5-7, 2023

Annual Conference, December 6-8, 2022 – Las Vegas, NV
CEUs for this workshop

Be sure to scan the QR for Tuesday, Wednesday, and Thursday workshops to get points towards your IGSHPA certification CEUs.
We Turn Wastewater Into Opportunity
Pinch Points for GeoThermal / GHEX:

- Available space at project site:
  - Tight site
  - Urban area
  - Future expansion plans

- Budget/ Timing constraints:
  - Limited Funding
  - Extended time needed for 100% GHEX

- GHEX Contractor Capacity
SOLUTIONS for GeoThermal / GHEX Pinch Points:

• Available space at project site:
  • Hybrid GeoThermal with WET

• Budget/ Timing constraints:
  • 3rd Party Financing
  • Energy Services Contract
  • Install WET before or during GHEX install

• GHEX Contractor Capacity
  • WET reduces required GHEX capacity
  • WET utilizes existing ATL/TEN’s
  • WET manages GHEX “CREEP”
The Average Person Uses **24 Gallons** of **Hot Water** per Day at 130°F/60°C*

- Average Residential Wastewater Temperature is 70°F/ 20°C
- Commercial & Industrial Wastewater Temperature can reach 140°F/60°C or Higher

**Wastewater sources:**
- Black and Grey Water Within Buildings
- Sanitary Sewers
- Lift Stations/Treatment Centres

*estimated 60 gallons/day of wastewater
Wastewater as a Heat Pump Source
How Reliable is Wastewater?

Waste Water Vs Geothermal Vs Ambient Temperatures

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Our solutions, to whom

**Industrial**
- Commercial Food Production
- District Energy
- Pulp and Paper
- Textiles

**Commercial**
- Hospitals
- Micro-Breweries
- Hospitality
- Commercial Laundry
- Mixed-use, 500+ units

**Residential Building**
- Multi-unit housing, 50—500 units
- Student Housing
- Senior Living
- Community Housing
The PIRANHA is a self-contained heat pump that uses a specifically designed direct expansion heat exchanger to recover thermal energy from a building’s wastewater for domestic hot water heating.

- **Models:** T5/T10/T15
  - Design heat output
    - **60/120/180 MBH**
    - Increase output scalable with multiple units
  - Modular
  - Designed to fit through standard double door access
- **Average COP of 3.5**
- **DHW and/or Space Heating**
- **NSF-372 rated BPHE**
  - Double-wall, leak detection
- **R-513a**
  - 56% Lower GWP than R-134a (573 vs. 1,430)
  - Same performance

*Average COP across a range of source temperatures, output temperatures and application types.*
PIRANHA paired with Geothermal
Simultaneous Heating + Cooling

Geo-Field
• Balance
• Load Shed
• Optimize

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• SHARC Filter Unit
• Support Frames/Skids
• Control Panel
• Macerator/Grinder
• Piping/Valve Assembly
• Plate & Frame Heat Exchanger
  ➢ Wide Gap

• Wastewater Holding Tank
• Solids Handling Lift Pumps
• Heat Pump(s)
The SHARC is a wastewater separator/filter that allows access to thermal energy by temporarily removing solids from wastewater.

The filtered wastewater is then passed through a Heat Exchanger where the thermal energy is transferred to/from the building.

<table>
<thead>
<tr>
<th>SHARC Model</th>
<th>Max Flow</th>
<th>Typical Energy Transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td>660</td>
<td>550 GPM</td>
<td>2,474 MBH/ 0.725 MW</td>
</tr>
<tr>
<td>880</td>
<td>1,200 GPM</td>
<td>5,399 MBH/ 1.6 MW</td>
</tr>
<tr>
<td>1212</td>
<td>2,500 GPM</td>
<td>11,248 MBH/ 3.33 MW</td>
</tr>
</tbody>
</table>

• Energy Recovery or Rejection

• Variable Use Source Energy
  - Hot Water Heating
  - Hydronic Heating/Cooling
  - Wastewater Cooling
  - Cooling Tower Offset

• Exponential efficiency for ‘low-temp’ condenser loops
  - Up to MW of energy transferred for low kW energy input

• Load side condenser loops and water source heat pumps/chillers
  - Average COP 3.5-4

• Designed to allow for high flow rates and ease of service.
• Completely Sealed at Installation Site, odor free

Higher flow rates achieved with parallel modules
Unmatched Cleaning Characteristics

• SHARC’s patented design allows for unmatched cleaning characteristics.

• Superior continual cleaning of the filter screen ensures high flow rates to meet demand.

• Minimal wear on internal parts for longer lasting components.

• Low pressure drop across the SHARC filter.

• Little or no fresh-water usage.
Controls & Integration

* Standard across all SHARC Energy Equipment

- SHARC developed Controls program
- Touch screen interface
  - Default Settings / User Configurable
- Remote Monitoring capabilities
  - Emailed warnings & alarms
  - Data Trending
- DDC & BMS integration through BACnet or Modbus
- BTU Meter / Power Meter Options
- Factory Support

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**SOURCE Side:**
- Sewage/Municipal Water
- De-watering
- Subway Tunnels
- Rivers / Surface Water
- Geothermal Production
  - Low/Medium Temp

**LOAD Side:**
- HVAC
- Ventilation
- Potable Hot Water (DHW)
- Snow Melt
- Aquaculture/Agriculture

**How SHARC Works**

**Thermal Energy Network**

**Ambient Thermal Loop**

**Heat Pump(s)**

**Geo-Exchange – Balance/LoadShed/Optimize**

**Ground Loops**

**SHARC**

**Heat Exchanger**

**Wastewater Holding Tank**

**City Wastewater IN**

**City Wastewater OUT**

**Incoming DCW**

**Pre-Heated DHW**

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How SHARC Works

Multiple applications within an individual building loop

Load Side:
- Water Source Heat Pumps
- Geo Heat Pumps
- Water Cooled Refrigeration
- Fan Coils
- Water Cooled Chillers
- Boilers
- Any Hydronic based HVACR
Passive Ambient Loops for Districts

- Provides net energy to all buildings, heat cool and hot water
- Reduces solar and wind requirements makes NZE possible on district scale

District Energy Plant

Heating OR Cooling for Entire District
Low-Temp/Ambient loop (i.e. 70°F)
Each building has heat pumps/chillers etc.
District Energy

National Western Center

- (2) SHARC 880 provide 3.8MW of thermal transfer
- 90% of total heating & cooling load for 1M sq ft of indoor space
- ~2600 mt CO₂e/yr offset
- Plans to expand plant to 10MW
False Creek Neighbourhood Utility – Community owned utility

- Designed as a clean energy solution for 2010 Olympic Village
- With the retrofit of SHARC Energy filtration units 2017, became highly successful system
- 2022 Announce expansion to 10 MW and that they are a fully viable utility with competitive rates, free from local or federal subsidies
- By 2025 will be 70% renewable energy between WET & Renewable Natural Gas

Denver National Western – ESCO (energy service company) Centrio

- Private entity, being served by district loop, owned by ESCO
- Commissioned – April 2022, 3.8MW
- Potential expansion to 6.0+MW for future

Lelem – Private - Musqueam First Nations, at University of British Columbia

- Small 0.5MW district system for 1st phase of 3 phase development. Initial phase serves 22 acre development of residential, community center, commercial
- Potential expansion, based on densification, increasing wastewater flowrate

District system Seattle, WA – Public/Private

- Expected to commission 2024
- Utilizing King County Sewer municipal line connection – 50-50 share of any REC’s earned + transfer fee paid to KC
- Initial sizing 1.0MW to serve entire city block, potential expansion to surrounding buildings in future
- Private developer will own and operate system
The Why and The How…

Lynn Mueller:

• Why WET Systems for:
  • Building Owners
  • Municipalities
  • Developers

• Case Study Reviews
Construction of Ambient Energy Loop
The new REC economy

DC Water Income from RECs - >$4M since 2018

- Completely new source of revenue
- DC Water has earned >$4M in RECs since 2018
- Returns trending higher each year
- WA Legislation will vote to recognize WW as renewable energy in 2024

*Screenshot from DC Water’s presentation at City of Denver event
Chris Peot – PE, BCEE, WEF Fellow
Director, Dept of Resource Recovery | DC Water
Outcomes

- Carbon free District Energy System over 500 tons CO2 offset per year
- Energy sharing between buildings and users
- Energy Storage within the Passive Energy Loop
- Meets the needs and values of the Musqueam Capital Corporation
- Sets an example for all communities

Ileləm’
Passive Energy Loop

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District Energy

• 1.3M sq ft indoor space
• 30,000 sq ft retail, including grocery
• 1,300 residences
• 15,000 sq ft community center

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- June 9, 2022 - SHARC Energy Welcomes Washington State’s Building Electrification Mandate
- May 31, 2022 - PIRANHA and PIRANHA HC WET Systems Selected by Sustainable Living Innovations for Six New Projects
- May 3, 2022 - SHARC Wastewater Energy Transfer ("WET") System to be installed in Seattle
- Feb 2, 2022 - King County WET Project to Showcase SHARC Technology
- June 16, 2022 - SHARC Energy and HTS to install 2 PIRANHA T15 to the Ontario market

Increased activity & adoption of sustainability is clear

- 3.8MW North America’s largest wastewater district energy system (as at Apr 2022)
- Reduction of 2,600 t CO$_2$e/year by avoiding fossil fuels

National Western Center
2x SHARC 880 District Energy

2022

Increased activity & adoption of sustainability is clear
Southeast False Creek Neighborhood Energy Utility (NEU)

Vancouver, BC

- NEU currently serves 5 Million ft² of residential, commercial, and institutional space, planned expansion to 20 Million ft²

- 3.2 MW plant capacity output, planned expansion to 10MW.

- Qty-2 SHARC 880
Tripling the Sewage Heat Recovery Capacity in Vancouver’s False Creek Energy Centre

ALEX CHARPENTIER, SENIOR ENERGY ENGINEER – CITY OF VANCOUVER
ABBY DACHO, PROJECT ENGINEER – KERR WOOD LEIDAL

System Growth

- 2010: 1.5 million ft² (140,000 m²)
- 2022: 6.4 million ft² (600,000 m²)
- Build-out: 23 million ft² (2 million m²)
- Outgrew existing Sewage Heat Recovery (SHR) capacity
- Relying on Renewable Natural Gas (RNG)
- Increasingly stringent building-level GHG intensity limit requirements
- Commitment to explore transition to 100% Renewable Energy by 2030

False Creek Neighbourhood Energy Utility

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--- | --- | --- | ---
New Capacity (MW) | 3-6 | 3 | 0-3
COP | 3 | 2.3 | N/A
Availability of Resource | Good | Seasonal | Diminishes as demand grows
Maintenance/Reliability | Medium | Medium | Good
Capital Cost ($/kW) | $750-2,000 (HP) | $840 (ASHP + WSHP) | N/A
Ease of Connection | Medium | Medium | Medium

Modelling using Toronto Water flow and temperature data indicates that the City’s trunk sewer network has the potential to support a heat demand of approximately 300 MW (Table 1). This would be equivalent to nearly 20 projects of a size similar to the Noventa-TWTH project without affecting influent temperatures at wastewater treatment plants. However, not all subsections of the network can support projects this size, and not all projects would demand such heat, so it is likely there will be many more projects ranging in size from 300 kW to 20 MW.

Table 1. Summary of Available Heat (Winter Dry Weather Flow Scenario)

<table>
<thead>
<tr>
<th>Network sub-section</th>
<th>Max Flow (L/s)</th>
<th>WWTP Temp (°C)</th>
<th>Max Heat (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Etobicoke</td>
<td>376</td>
<td>18.1</td>
<td>9.6</td>
</tr>
<tr>
<td>Humber</td>
<td>3,548</td>
<td>18.1</td>
<td>60.5</td>
</tr>
<tr>
<td>Don-Coxwell</td>
<td>1,989</td>
<td>19.6</td>
<td>62.7</td>
</tr>
<tr>
<td>Don-North Toronto</td>
<td>688</td>
<td>18.9</td>
<td>19.8</td>
</tr>
<tr>
<td>Interceptors</td>
<td>5,728</td>
<td>17.4</td>
<td>131</td>
</tr>
<tr>
<td>Highland</td>
<td>2,005</td>
<td>16.7</td>
<td>40.8</td>
</tr>
<tr>
<td>Total</td>
<td>12,344</td>
<td>17.9</td>
<td>261</td>
</tr>
</tbody>
</table>

With wastewater as the heat source/sink, energy cost dropped an additional 29%.

And the building could be fully electrified even where a geothermal field was impossible.

In total, the trunk sewer network could eventually support WET projects that would avoid approximately 200,000 tonnes of CO2 annually. For context, this would represent over 2% of emissions from buildings city-wide (2018). Refer to Attachment 1 for a map of the sanitary trunk sewers network and estimated heat recovery potential.
Your interest in sewer heat recovery is a great step toward confronting climate change and becoming a regional pioneer in the use of sewer heat energy—an untapped renewable, carbon-free energy resource.

Governor “WA” – Jay Inslee
Warm and hot wastewater flushed from homes and businesses is a significant source of energy. The US Department of Energy estimates that 350 billion kilowatt-hours of heat energy are flushed down the drains in the United States every year—roughly enough to power 30 million homes.
Summary Steps:
• Capture Thermal Energy
• Enhance Temperature as Needed
• Deliver This Renewable Energy Where Needed
• REPEAT Process

Thank you

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