




WASTEWATER ENERGY RECOVERY SYSTEMS: Technology Overview

	HUBER Technology	SHARC Energy	UHRIG Group
Website	<p>HUBER Technology: www.huber-technology.com</p>  <p>Noventa Energy: www.noventaenergy.com</p>	<p>SHARC Energy: https://www.sharcenergy.com/</p> 	<p>UHRIG Group: https://www.uhrig-bau.eu/en/company/</p> 
Company Location	Headquartered in Denver, NC, USA	Headquartered in Port Coquitlam, BC, Canada – Offices in NY	Headquartered in Geisingen, Germany – offices in NY
Company Contacts	<p>Henk-Jan van Ettehoven, President - HUBER Nate Madding Sales - HUBER: nate.madding@hhusa.net Dennis Fotinos, CEO - Noventa Ed Rubinstein, Vice President - Noventa: erubinstein@noventaenergy.com</p>	<p>Aaron Miller, Eastern Regional Manager: aaron.miller@sharcenergy.com c 646-303-1204 Brock Trimble, Director, Technical Sales: Brock.trimble@sharcenergy.com c 604-862-0872</p>	<p>Frank Urro, Renewable Energy Strategist, Head of North America Business Unit: urro@uhrig-bau.com c 978-528-4478 Stephan von Bothmer, Head of Global Business Unit Energy from Wastewater: bothmer@uhrig-bau.com c +49 171 8432 856</p>
Summary	<p>HUBER Technology, with over 175-years of wastewater management experience, has partnered with Noventa Energy, to bring a wide range of energy from wastewater opportunities to North America ranging from smaller, single building behind-the-meter installations to large district energy systems financed, designed, built and operated by Noventa.</p> <p>Anchoring these opportunities is the ThermWin system for wastewater heat recovery from raw sewage, which accesses the sewer via a wet well, screens the raw wastewater using HUBER’s ROTAMAT® RoK4 screens and then extracts thermal energy, for heating and/or cooling, using HUBER’s RoWin heat exchangers, returning the wastewater back to the sewer. The ThermWin system allows for a flexible and modular design that can be tailored to suit specific site requirements for a wide range of</p>	<p>Completely sealed, odor-free systems that use wastewater for space heating and cooling and/or the production of domestic hot water. The PIRANHA™ and SHARC™ systems are scalable to meet a wide range of load profiles. They provide energy savings, drastically reduce carbon emissions, pair beautifully with geothermal loops and can serve as the primary energy source for a Thermal Energy Network (TEN) or district heating and cooling.</p> <p>PIRANHA and SHARC turn the sanitary line into Urban Geo.</p>	<p>The Therm-Liner system is a modular sewer heat exchanger system that can be installed in new sewers and existing sewers to provide energy savings and reduce carbon emissions from individual buildings, entire neighborhoods or district heating and cooling networks.</p> <p>UHRIG has implemented 120+ projects in Europe.</p>

WASTEWATER ENERGY RECOVERY SYSTEMS: Technology Overview

	HUBER Technology	SHARC Energy	UHRIG Group
	<p>heating and cooling requirements ranging from single buildings, to multi building campuses or developments. In combination with heat pumps, several hundred kilowatts of thermal output can be generated, depending on the size of equipment selected, with a variety of hot water temperatures, or even steam, possible. The flexibility to design ThermWin systems to meet specific energy requirements combined with the ability of Noventa Energy (HUBER's exclusive North American distributor and energy partner for the ThermWin series of equipment) to finance projects makes it possible for municipalities, hospitals, universities, housing developments, small business, and industrial complexes to cover 100% of their heating and cooling requirements using wastewater as low-carbon energy source without having to assume capital or operational risk.</p>		
<p>Product Components</p>	<p>The ThermWin system is comprised of several main pieces of equipment, listed below, that can be installed in parallel, allowing for modular design that can be easily scaled-up to meet customer needs:</p> <ul style="list-style-type: none"> • The ROTAMAT® RoK4 screen is available in a range of sizes (models BG300, 500, 700, 700XL) in lengths up to 40 feet. • The RoWin heat-exchanger is also available in a range of capacities (models BG 4, 4S, 6, 6S, 8, 8S, 14, 14S), which can be installed in parallel to meet the desired flow and capacity, with each size is available in a stainless-steel tank or frame version for an installation in concrete basin. 	<p>PIRANHA™ Wastewater source heat pump (DHW up to 140°F)</p> <p>SHARC™ Wastewater energy transfer system (heat source & sink)</p>	<p>The Therm-Liner: Our trademark for generating heat from wastewater » UHRIG (uhrig-bau.eu)</p>

WASTEWATER ENERGY RECOVERY SYSTEMS: Technology Overview

	HUBER Technology		SHARC Energy		UHRIG Group	
	<ul style="list-style-type: none"> The Ro9 integrated screen is ideal for single-building, behind the meter ThermWin installations. The ThermWin-Mini, which combines a RoWin heat-exchanger with an integrated screen for small applications. <p>As well, because HUBER is a leader in wastewater management technology, a wide range of other equipment is available for special circumstances.</p>					
Application	<p>Individual Building Scale <i>Small – Medium:</i></p> <ul style="list-style-type: none"> multi-family residential (e.g., 50-350 unit apartments / condos; student housing, community housing) commercial (hotels, laundries, etc.) institutional schools, recreational centres, etc.) light industrial (breweries, distilleries, food processing, etc.) specialized applications (sterilization condensate heat reclaim, hot springs heat recovery) 	<p>Multiple Building Scale: <i>Medium – Large:</i></p> <p>District and Campus Energy</p> <ul style="list-style-type: none"> multi-family residential commercial heavy industrial (petrochemical, pulp & paper, auto manufacturing) university campuses hospital and health network campuses <p>District energy systems (new and retrofit to decarbonize)</p>	<p>Individual Building Scale <i>Small – Medium:</i></p> <ul style="list-style-type: none"> Multi-family Residential (e.g., 50-350 units) – apartments / condos; dormitories, assisted living, community housing) Commercial – hospitality, hospitals, commercial laundry, community activity center Industrial – manufacturing, food production, micro-breweries, and distilleries, wastewater treatment 	<p>Multiple Building Scale / District and Campus Energy:</p> <ul style="list-style-type: none"> Medium to large multi-family residential buildings (350+ units) Medium-large commercial Medium-large Industrial Geothermal bore field offset and loop optimization. Wastewater treatment plant Hot/cold/ambient water loop offset for large campuses 	<p>Individual Building Scale: <i>Small – Medium:</i></p> <ul style="list-style-type: none"> Heating and cooling with energy from wastewater are possible in any building with a power requirement of around 50 kW or more (around 15 residential units, apartments, condos, student housing, senior assisted living community housing) commercial buildings: (hospitals, micro-breweries and distilleries, hospitality, commercial laundry, community activity center and industrial). 	<p>Multiple Building Scale: District and Campus Energy: <i>Medium – Large:</i></p> <ul style="list-style-type: none"> multi-family residential, commercial, and industrial use up to 8 MW.

WASTEWATER ENERGY RECOVERY SYSTEMS: Technology Overview

	HUBER Technology	SHARC Energy	UHRIG Group	
Useful Links to Projects	<p>Three smaller scale sample projects in Switzerland</p> <p>The Toronto Western Hospital WET™ Project</p>	<ul style="list-style-type: none"> Building Seven35, North Vancouver, BC Lake Louise Inn, Banff, AB 3200 Bluff, Boulder, CO Amalgamated Housing Corporation, Bronx, NY EPRI & Incubatenergy® Labs Challenge <p>Additional projects implemented by SHARC Energy</p>	<ul style="list-style-type: none"> District of Columbia Water Headquarters Ielərñ Village Vancouver, BC National Western Center, Denver, CA Alafia Development, Vital Brooklyn, NY False Creek Neighborhood Energy Utility, Vancouver, BC <p>Completed Therm-Liner projects:</p> <ul style="list-style-type: none"> 112 projects completed from 2007 to 2022 	
Source of Wastewater Flow (min / avg. GPM or GPH)	Minimum of 10 gpm up to 900 gpm <i>per</i> RoWin heat exchanger, with the ability to run multiple heat exchangers in parallel (e.g. projects with 60 RoWin14 heat exchangers handling flows of up to 77.8 MGD).	Variable based on application. Wastewater holding tank acts as thermal battery and buffer.	Variable based on application, 100 GPM minimum flow rate. Wastewater holding tank acts as thermal battery and buffer.	Minimum quantity required: 160 GPM = 10 l/s
Depth to Sewer (feet)	HUBER's ThermWin system can be used to access waste water at all depths, from surface access, as found in wastewater treatment plants or in a building's basement, to 100 feet below the surface or lower, as is the case with the Toronto Western Hospital installation .	PIRANHA equipment is sited inside building – completely sealed system.	SHARC equipment is sited inside building – completely sealed system.	No limitation

WASTEWATER ENERGY RECOVERY SYSTEMS: Technology Overview

	HUBER Technology	SHARC Energy		UHRIG Group
Sewer Diameter (inches)	Due to the straightforward design and installation process, the ThermWin system is able to access wastewater from all sizes of sewer; there are no minimum or maximum diameter requirements.	PIRANHA connects to any building sanitary system and/or hydronic loop.	SHARC scales from building level to municipal level sanitary systems. Can accommodate any sewer pipe diameter.	32 inches and larger
Distance from Sewer to Building(s) (feet)	With the installation of appropriately sized pumps, there is no limit on the distance from the sewer to buildings serviced by a ThermWin system. If space is constrained, the RoWin in-channel heat exchanger, which sits directly in the wastewater flow, can be used.	PIRANHA equipment is sited inside building – completely sealed system	SHARC equipment is sited inside building – completely sealed system	The greater the amount of energy that is brought from the duct to the building or district heating network, the less important the distance is as a cost factor: We have implemented projects where the ducts were a few meters to 500 meters (1,640 ft) away.
Energy Recovery: (min & max ranges: kW for heating and cooling)	<p>Minimum energy recovery of 100 kW is possible with maximum energy recovery only limited by the availability and flow of wastewater.</p> <p>60–180 MBH heating and 48–144 MBH cooling, depending on model. Multiple units can be run in parallel.</p>	Each unit offers .45–3.3 MW _{th} typical design thermal transfer based on SHARC model and flow rate range with a 10° F ΔT. Multiple units can be run in parallel.	Each unit offers .45–3.3 MW _{th} typical design thermal transfer based on SHARC model and flow rate range with a 10° F ΔT. Multiple units can be run in parallel.	<p>Min: 50 kW</p> <p>Max: 10-20 MW</p>

WASTEWATER ENERGY RECOVERY SYSTEMS: Technology Overview

	HUBER Technology	SHARC Energy		UHRIG Group
Preliminary Assessment (for customers)	Starting with a few high level questions (e.g. building type and location to get a sense of heating and cooling requirements) Noventa Energy, HUBER's ThermWin energy partner and representative in North America, then analyzes project specific information collected through a short questionnaire, such as building thermal loads, utility rates, existing heating & cooling equipment, and wastewater characteristics (e.g. temperature, flow, etc.) to create a feasibility report and wastewater energy recovery business case for interested customers.	No charge for preliminary project analysis and report. Includes on-site visit by SHARC to validate opportunity and design. Our rep partner HTS covers all New England states. We have developed an acronym for assessing retrofit opportunities: W.A.S.H.		Based on sewer data (dimensions, wastewater flow and temperatures), we determine the sewer potential and specify the costs for tapping this potential. The scope refers to the wastewater heat recovery system. We then advise the customer on how to proceed if the cost analysis is convincing. We offer this initial assessment free of charge.
Energy Solution Options (for customers)	<p>HUBER is the equipment manufacturer and supplier for the ThermWin equipment including the ROTAMAT® RoK4 screening system and RoWin, heat exchanger.</p> <p>In partnership with Noventa Energy a wide range of energy solutions are available, from engineered equipment sales, to the design and construction of customer owned & operated systems (supported by service contracts) to wastewater heat recovery systems financed, built, owned and operated by Noventa Energy where customers enter into a thermal energy service agreement for heating and cooling. Noventa also has the flexibility to</p>	<p>SHARC Energy is an OEM.</p> <p>Given that the PIRANHA system is a highly engineered solution, our team works closely with engineers, architects, and end-users to properly size and design the WET system, including the ancillary hardware and tanks.</p> <p>Our no-charge preliminary analysis</p>	<p>SHARC Energy is an OEM.</p> <p>Given that the SHARC systems is a highly engineered solution, our team works closely with engineers, architects, and end-users to properly size and design the WET system, including the ancillary hardware and tanks.</p> <p>Our no-charge preliminary analysis</p>	<p>A) We plan, build, and install our systems - turnkey, all from a single source. The plants are then usually taken over by third parties who own or operate the system. In addition, we offer online monitoring of the systems and regular inspections of the system.</p> <p>B) We take over the financing and/or operation of the system and supply heat to the customer.</p>

WASTEWATER ENERGY RECOVERY SYSTEMS: Technology Overview

	HUBER Technology	SHARC Energy	SHARC Energy	UHRIG Group
	<p>incorporate ThermWin technology into third party owned energy systems.</p>	<p>details the anticipated Coefficient of Performance (COP), fossil fuel and GHG emissions offsets, and electrical load increase in kWh.</p> <p>SHARC Energy includes factory start-up for all installations, and can include additional training required for O&M.</p> <p>The PIRANHA controls package captures flow, temperature differential and BTU data.</p>	<p>details the anticipated thermal transfer, flowrate & ΔT. The data sets in the controls provide the full SHARC specific BTU metering, including the power consumption of all motors connected directly to the SHARC control panel.</p> <p>SHARC Energy includes factory start-up for all installations, and can include additional training required for O&M.</p> <p>The SHARC controls package captures flow, temperature differential and BTU data.</p>	

WASTEWATER ENERGY RECOVERY SYSTEMS: Technology Overview

	HUBER Technology	SHARC Energy	SHARC Energy	UHRIG Group
<p>Estimated Energy Results (based on size of product option installed: estimated energy / cost savings, MMBtu of energy transferred / day etc.).</p>	<p>The Toronto Western Hospital Wastewater Energy Transfer™ (WET™) system is currently on track to be the world's largest raw wastewater energy project. With a combined total of over 19MW of thermal capacity, including over 33,000 MBTU of heating capacity and over 2,400 of cooling capacity), the project will supply 90% of the campus's heating and cooling needs, reduce annual greenhouse gas emissions by around 8,400 metric tonnes, and save the hospital over \$500,000 per year in utility and operating costs.</p>	<p>Depending on wastewater source flow/temp and project load profile, PIRNAHA can cover up to 100% of Domestic Hot Water (DHW) production. Multiple PIRANHA can be operated in parallel to provide up to ~15 MMBTU output per day.</p> <p>PIRANHA can also provide supplementary heating, cooling, and geothermal field optimization.</p>	<p>Depending on wastewater source flow/temp and project load profile, SHARC can cover up to 100% heating, cooling, and DHW production when paired with downstream heat pumps.</p> <p>Based on typical design parameters, each SHARC 880 can provide ~130 MMBTU thermal transfer per day. These units can be operated in parallel to scale up to support projects of any size.</p> <p>Current project: Geothermal field optimization and/or bore field offset. Using the sewer as an additional heat source/heat sink, SHARC can reduce the required size of a bore field by up to ~47%. This represents large up-front cost reductions to geothermal projects.</p>	<p>Depends on the variables of the project.</p>