2023

MUNICIPAL WASTEWATER ENERGY TRANSFER

Playbook

Version 1.0

BUILT

CleanTech Alliance™

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INTRODUCTION

Welcome to the Municipal Wastewater Energy Transfer (WET) Playbook.

The CleanTech Alliance, in collaboration with King County, Metro Vancouver, Metro Water Recovery, DC Water Authority, and the City of Toronto, proudly present the Municipal Wastewater Energy Transfer (WET) Playbook. The WET Playbook would not have been possible without the additional industry support from SHARC Energy, McKinstry, and UMC, Inc.

The WET Playbook is meant to be viewed digitally on a desktop or mobile device.

Question? please contact JP Newmann, Economic Development Coordinator, CleanTech Alliance.

The WET Playbook came together a result of the BUILT Cluster Waste Heat innovation working group. If you would like to learn more, please submit your interest here.

The BUILT Cluster is one of nine inaugural clusters within the Washington State Innovation Cluster Accelerator Program (ICAP), a multi-year innovation cluster development program supported by the Washington State Department of Commerce to help promising industry sectors assemble the ingredients they need to grow.

Wastewater Energy Transfer (WET) 101

Warm and hot wastewater flushed from homes and businesses is a significant energy source. The U.S. 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.

Through this technology, a portion of wastewater is captured in an underground holding tank where its heat energy is transferred in a heat exchanger, which allows a heat pump to extract that energy and transport it to a connected building's domestic hot water or heating or cooling system.

Repurposing this otherwise wasted heat energy resource is another way building owners can meet sustainability goals and positively contribute to climate action.

WET is a sustainable energy solution that reduces onsite fossil fuel combustion, lowers carbon emissions, and decreases a building's carbon footprint in facilities that use hydronic (circulating water) systems for heating or cooling and/or facilities with significant domestic hot water requirements, such as schools, gyms, or commercial kitchens.

350 BILLION

KILOWATT-HOURS OF HEAT ENERGY ARE FLUSHED DOWN THE DRAINS IN THE UNITED STATES EVERY YEAR

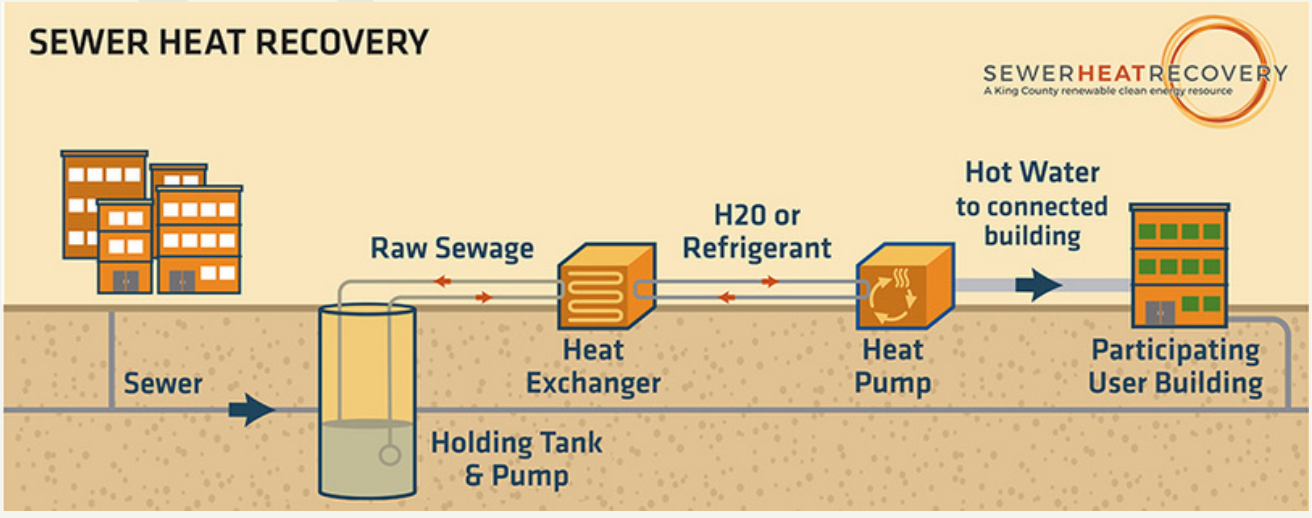

Image Courtesy of King County Wastewater Treatment Division

COMMERCIALIZED WET SYSTEMS

SHARC ENERGY

Website link: Wastewater Heat Recovery Solutions | SHARC Energy

Background: SHARC International Systems Inc. (CSE: SHRC - FRANKFURT: IWIA - OTC: INTWF), DBA SHARC Energy Systems, was founded by a team of technical and engineering professionals with over 100 years of experience in the heating, ventilating and geo-exchange industries. SHARC manufactures, develops and owns thermal energy recovery systems utilizing wastewater heat exchange technology.

Technology: Energy leaving the building is energy wasted. By being inefficient with existing resources and allowing energy leaks to go unnoticed, the world has been hemorrhaging energy unnecessarily for decades.

Thermal energy (heat, in red) can be passively or actively moved from one location to another.

As the heat is extracted from the passing wastewater, either by passive (SHARC) or active (PIRANHA) means, the wastewater temperature drops because the heat has been removed.

The captured heat is applied towards a more useful purpose, typically hot water generation or space conditioning. The SHARC system can also provide cooling if you reverse the flow direction and use the sewer as a heat sink instead of a heat source. This is what the SHARC and PIRANHA systems are meant to achieve.

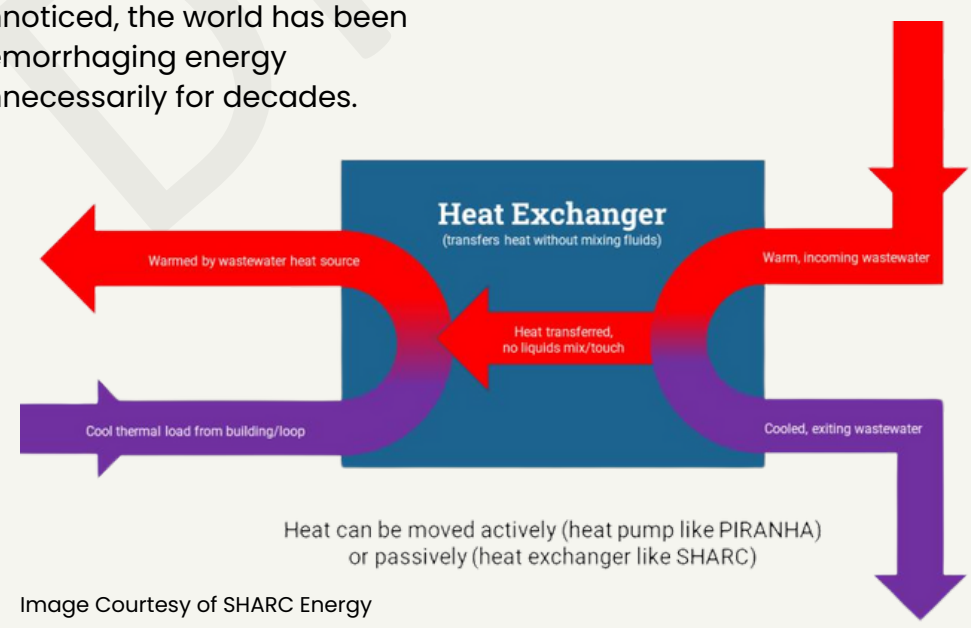

Image Courtesy of SHARC Energy

COMMERCIALIZED WET SYSTEMS

SHARC ENERGY

Below are illustrations describing SHARC's systems:

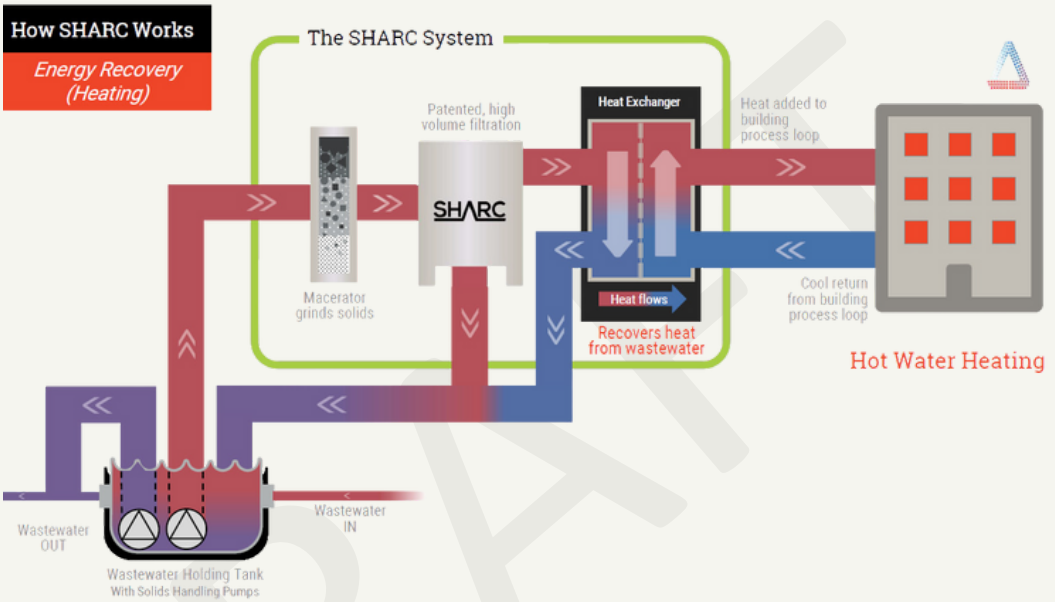

Image Courtesy of SHARC Energy

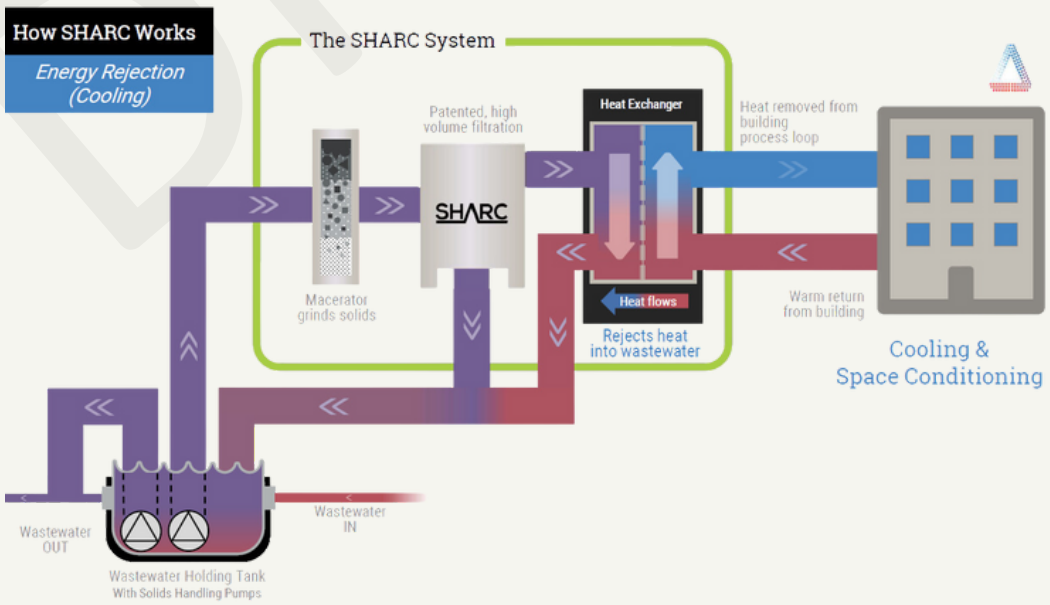

Image Courtesy of SHARC Energy

COMMERCIALIZED WET SYSTEMS

Noventa WET™ System - HUBER ThermWin®

Website link: Huber Thermwin Technology — Noventa Energy

Background: With over 150 years of operating history and 54,000 installations around the world, HUBER Technology is a recognized leader in the wastewater industry. HUBER specializes in the production of high-quality machines, plants and stainless-steel equipment for municipal and industrial water, wastewater and sludge treatment.

Technology: The HUBER ThermWin® technology combines the proven ROTAMAT RoK4® screen that separates solids and manages sludge at the sewer level with the self-cleaning RoWin® heat exchanger that facilitates the safe and reliable transfer of thermal energy to and from wastewater.

The 6mm perforated basket and auger assembly of the RoK4® ensures that only sieved brown water is pumped to the RoWin® heat exchanger. Inside this reimagined, shell-and-tube heat exchanger, an automated, internal trolley system scrapes-off any biofilm build-up on the tube bundles to ensure that the transfer of thermal energy is not impeded. Odours are contained, manual cleaning is avoided and wastewater consistency unaltered.

HUBER ThermWin® technology anchors Noventa's WET™ systems which are configured to accommodate the unique thermal energy needs and spatial limitations of each customer. We tie directly into the customer's HVAC system and provide thermal energy that improves efficiency and system performance, saving energy costs and reducing carbon emissions.

Noventa's WET™ projects are, in essence, community-scale district energy systems. They include underground distribution networks that transport thermally modified water and wastewater between the various WET™ system components. HDPE distribution pipes transport sieved brown water between the Energy Transfer Station and the Wetwell, while a separate set of distribution pipes transport hot water and chilled water to the customer.

Controls and safety measures are implemented throughout the WET™ system to protect against SO2 and other undesirable conditions. At the same time, metering and monitoring equipment is installed to measure the flows and temperature of wastewater and thermal energy supplied to the customer.

COMMERCIALIZED WET SYSTEMS

Noventa WET™ System - HUBER ThermWin®

A Wetwell is constructed perpendicular to a sanitary or combined sewer through which wastewater is accessed. The typical Wetwell is a vertical shaft, having a diameter of ~20ft and a depth of ~ 60ft or 10ft deeper than the bottom of the sewer. A manhole at grade provides access. A pipe connected to the sewer at about "5 o'clock" allows wastewater to flow via gravity to the bottom of the Wetwell that contains the patented HUBER ROTAMAT® RoK4 pumping station which screens solids larger than 6mm.

Sieved wastewater is then pumped up through the Wetwell to the HUBER RoWin® heat exchangers in the Energy Transfer Station. Any sludge that passes through the fine-screen basket of the RoK4®, is carried up through the Wetwell by a slow-moving auger to a point where spent wastewater returning from the HUBER RoWin® heat exchangers flush the sludge back into the sewer through another pipe downstream that taps into the sewer at about 2 o'clock.

An Underground Distribution Network comprised of high-density polyethylene ("HDPE") distribution pipes that circulate the screened wastewater between the Wetwell and the HUBER RoWin® heat exchangers.

Image Courtesy of HUBER

An Energy Transfer Station ("ETS") that houses the patented, self-cleaning, Huber RoWin® heat exchangers and Trane heat pumps or chillers that work together to accomplish the thermal energy transfer between the wastewater and the buildings. Noventa typically constructs the ETS above grade but, these can also be designed to sit below ground. An Energy Supply Loop ("ESL") also comprised of HDPE pipes that circulates thermally modified water between the heat pumps in the ETS and the building's HVAC system.

COMMERCIALIZED WET SYSTEMS

UHRIG

Website link: Heat from wastewater: Shaping the heat transition! » UHRIG (uhrig-bau.eu)

Background: Residual heat in the wastewater is utilized as heating energy via heat exchangers and heat pumps. An idea as simple as it is ingenious. Because wastewater heat recovery is characterised by climate friendliness, economic efficiency and enormous potential. If necessary, the same system can also be used to cool buildings in the summer - only according to the opposite principle. UHRIG sets innovative, technological standards with its patented Therm-Liner systems.

Technology: The Therm-Liner from UHRIG is a patented, modular sewer heat exchanger system for installation in sewers. It can be used in new sewers and existing sewers can also be retrofitted with it.

The modules are custom-made double-shell pressure vessels made of stainless steel, which is resistant to pitting and corrosion and is ideally suited for use in wastewater. The modules are manufactured precisely to suit the sewer situation and are inserted into the sewer via the existing shaft infrastructure and securely installed.

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The warm wastewater flows over the entire surface of the heat exchanger, which in turn has a cool working medium (usually water) flowing through it. The warm wastewater releases energy to the cooler liquid – and warms it up.

Using the principle of compression, the connected heat pump increases the temperature level of the wastewater heat obtained in this way and increases the usable energy output. Buildings can now be heated with this thermal energy. If the building is also to be air-conditioned, a reversible heat pump is used: The cycle is then simply reversed in summer and the building is cooled via the wastewater flow.

The extraction capacities in the projects we have realised range from 50 kW to 8 MW. A Therm-Liner system can also be extended or dismantled at any time without any problems. The heat exchangers are designed for a service life of up to 50 years. The actual operating time ultimately depends on the downstream system technology.

Possible heating systems and heat distribution: The Therm-Liner system is suitable for heating individual buildings, entire neighborhoods or for feeding

COMMERCIALIZED WET SYSTEMS

UHRIG

(district) heating networks. Depending on the type of use as well as local, economic and ecological aspects, the Therm-Liner system can be integrated into various heating systems.

A monovalent, bivalent or multivalent design of the heating system is possible, i.e. wastewater can serve as the sole heat source, but a combination with other forms of heating is also feasible.

There are two options for heat distribution:

- Cold heat networks: Here, each energy user has their own heat pump. The flow and return to the heat exchanger is cold and without insulation.
- Warm heat networks: This variant has a central heat pump. The primary circuit between the heat pump and the respective energy user is a warm, insulated network; the secondary circuit between the heat pump and the duct heat exchanger is a cold network.

UHRIG offers two different patented Therm-Liner systems for wastewater heat utilisation, tailored to the respective sewer. We deliver the heat exchanger elements ready for installation and install them.

Key characteristics include:

- The modules have been developed for retrofitting in sewers.
- The modules do not interfere with the actual sewer operation and fulfil all sewer construction requirements according to DWA-M 114.
- The modules are custom-made and adapted to the respective sewer situation.
- The modules can be easily mounted over the existing shaft infrastructure.
- The modules can be extended or dismantled at any time.
- The technology is patented and certified.

UHRIG Therm-Liner Form A and Form B are available for sewer cross-sections larger than DN 400, ideally DN 800 and larger.

Wastewater pressure pipes can also be used to generate heat from wastewater. However, heat exchangers can only be installed in these pressure lines if they can be taken out of service for this purpose. This is rarely the case, so a bypass, a second pipe with an integrated heat exchanger system, is built parallel to the existing pipe and the wastewater is diverted after completion.

COMMERCIALIZED WET SYSTEMS

UHRIG

The variants of the Therm-Liner at a glance: Therm-Liner Form A

- Sewer cross-sections greater than DN 800
- Sewer cross-sections larger than DN 400 as a slide-in solution in conjunction with our Quick-Lock system

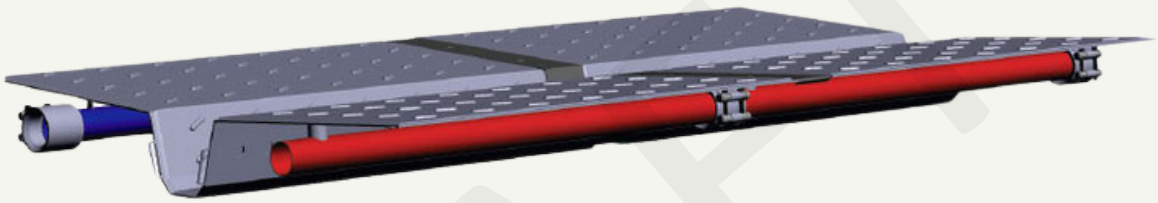

Image Courtesy of UHRIG

The variants of the Therm-Liner at a glance: Therm-Liner Form B

- Sewer cross-sections greater than DN 800
- Sewer cross-sections larger than DN 400 as a slide-in solution in conjunction with our Quick-Lock system.

Image Courtesy of UHRIG

CASE STUDY: KING COUNTY

King County

Background

The King County Wastewater Treatment Division is the first in Washington state and one of the first wastewater utilities in the nation to offer sewer heat recovery (SHR). Private commercial property owners and developers can recover heat energy from our sewer pipes for heating or cooling their buildings.

SHR technology is common in Europe and parts of Canada, but standardized SHR use agreements are pioneering in the United States. By taking a holistic approach to partnering with businesses to address the impacts of climate change, this program is just one way King County is reimagining resilient and sustainable communities.

Projects

Alexandria Real Estate Equities, Inc. - South Lake Union Campus

Public Entity: King County Wastewater Treatment Division

Building Owner: Alexandria Real Estate Equities, Inc.

Technology Provider: SHARC Energy

Engineering: McKinstry

Carbon Emissions Reduction: 99%

Business Model: Undisclosed

CASE STUDY: KING COUNTY

Image Courtesy of King County Wastewater Treatment Division

King County and Alexandria Real Estate Equities, Inc. are partnering to draw heat from a large, underground sewer pipe to heat a 1.6 million-square-foot mixed-use life science mega campus in South Lake Union. This is one of the first large commercial projects in the nation to save energy using sewer heat recovery technology, demonstrating how public-private collaborations can significantly reduce greenhouse gas emissions.

King County's Wastewater Treatment Division and Alexandria Real Estate Equities, Inc. have launched King County's first sewer heat recovery project at the Alexandria Center for Life Science – South Lake Union, a five-building, 1.6 million-square-foot mixed-use life science mega campus.

This is one of the first large commercial projects in the nation to draw heat from the sewer system as a renewable energy source for buildings and is expected to provide 70 percent of the campus' heating.

The heat recovery technology will draw heat from a county sewer pipe and send it through a heat pump system and network of pipes to heat the campus's buildings, with the first phase installed below-ground at Alexandria's 701 Dexter Avenue North development. The system is expected to come online in 2025. The temperature of wastewater in the sewer system averages 70 degrees, a consistent and reliable temperature for heat transfer.

CASE STUDY: KING COUNTY

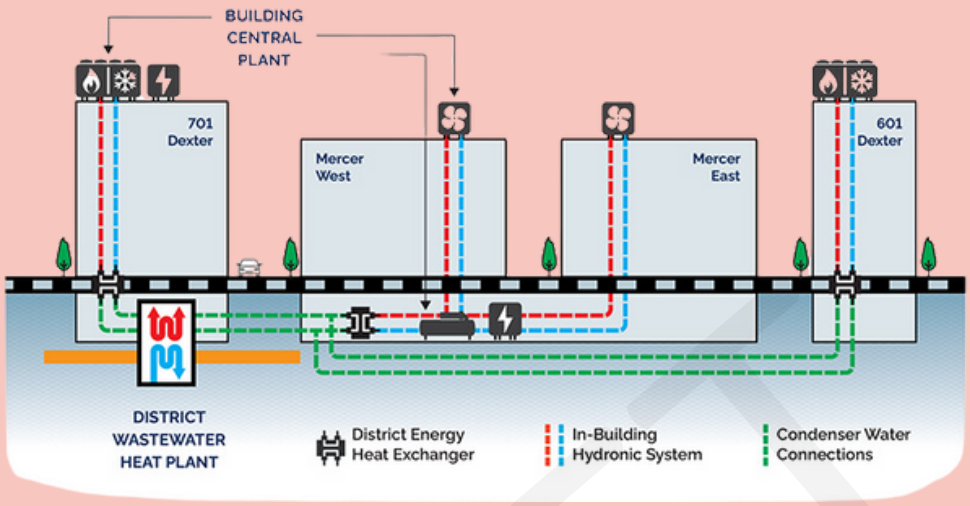

Image Courtesy of King County Wastewater Treatment Division

The system is manufactured by British Columbia-based SHARC Energy and can be used for both heating and cooling purposes. As an alternative to traditional energy sources, King County's sewer system heat is expected to reduce carbon emissions by 99 percent compared to a typical laboratory building in Seattle.

Recognizing the untapped benefits of sewer heat recovery, the King County Council authorized the Wastewater Treatment Division to launch a pilot program, and in 2020 the Division began accepting applications for three spots in the program for commercial users. Alexandria is the first project to move forward with installation. There are two spots remaining in the pilot program. The project reached a major milestone this summer when crews with contracting company McKinstry cut and connected the County's original 100-year-old brick-lined main sewer line to Alexandria's system, proving that such a system can be installed in a dense, urban landscape. Already in use in other countries such as Canada, Germany, and Japan, sewer heat recovery is an affordable, renewable energy alternative to traditional methods used to heat and cool buildings.

The benefits to commercial users are reduced energy costs; contributions to green building certification; financing supports such as King County's C-PACER Program that help developers meeting stringent energy codes; and significant reductions in potable water use. In the future, projects may be eligible to earn state renewable energy credits, making these projects even more financially attractive.

CASE STUDY: KING COUNTY

CONTACT

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Resource Recovery Project Manager
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Drew is a project manager for WTD's Sewer Heat Recovery Program, the first program of its type in Washington state. He works with private commercial property owners and developers seeking to recover heat energy from sewer pipes for heating or cooling their buildings.

Drew gathers the data they need and leads the approval process for all planning and construction of new projects. A process that ensures equity and social justice is considered as part of the approval of any sewer heat recovery project.

ADDITIONAL RESOURCES

- Sample Contract Agreement - click here
- Pilot Project Application - click here
- Sewer Heat Recovery Lookup Application - click here
- HB 1836 - 2023-24: Concerning the treatment of waste heat under the clean energy transformation act. - click here
- Erika Kinno, King County - Sewer Heat Recovery Presentation - click here

CASE STUDY:
METRO VANCOUVER & KERR WOOD LEIDAL

BACKGROUND

Metro Vancouver is working on various initiatives to make the most of the energy-rich resources in wastewater. Four of Metro Vancouver's wastewater treatment plants use wastewater to generate heat, electricity, or renewable natural gas.

There is enough excess heat in Metro Vancouver's wastewater to heat about 700 high-rise buildings. Recovering heat from sewage can provide renewable, fossil fuel-free heat to residents and businesses in the region, reducing greenhouse gas emissions. Several projects to recover heat from wastewater are currently under design or in construction:

- The new North Shore wastewater treatment plant, currently under construction, will recover 5 MW of heat and sell it to the nearby Lonsdale Energy Corporation, which is owned by the City of North Vancouver.
- In Richmond, a project is being designed to recover heat that can used by residents and businesses in the Richmond Oval area.
- Metro Vancouver is helping to fund a project with the City of New Westminster that will recover heat and use it at the Royal Columbia Hospital and in the Sapperton District.

700

HIGH-RISE BUILDINGS CAN BE HEATED USING EXCESS HEAT VIA METRO VANCOUVER'S WASTEWATER

CASE STUDY:
METRO VANCOUVER & KERR WOOD LEIDAL

PROJECTS

False Creek District Energy System & Expansion

Public Entity: False Creek Neighbourhood Energy Utility (NEU)

Building Owner: Undisclosed

Technology Provider: SHARC Energy

Engineering: Kerr Wood Leidal (contracted for expansion)

Carbon Emissions Reduction: 60%

Business Model: City-owned Utility

Image Courtesy of Metro Vancouver

CASE STUDY:
METRO VANCOUVER & KERR WOOD LEIDAL

Image Courtesy of SHARC Energy

The Southeast False Creek official development plan established a policy to minimize greenhouse gas pollution associated with new buildings in the area. After a comprehensive study on low-carbon technology options, City Council approved the development of the False Creek Neighbourhood Energy Utility (NEU) to provide heat and hot water.

In 2018, Council approved the expansion of the NEU to Mount Pleasant, Northeast False Creek, and the False Creek Flats area.

At the time of the NEU's development, only three other systems in the world recovered waste heat from untreated sewage. Since then, a number of other North American utilities locations have begun advancing plans to implement sewage heat recovery projects.

The Southeast False Creek Neighbourhood Energy Utility uses waste thermal energy captured from sewage to provide space heating and hot water to buildings in Southeast False Creek.

This recycled energy eliminates more than 60% of the greenhouse gas pollution associated with heating buildings. The utility is self-funded: it provides a return on investment to City taxpayers, while at the same time, provides affordable rates to customers.

The utility began operations in 2010 and since then has rapidly expanded to serve 395,000 m2 (4,300,000 ft2) of residential, commercial, and institutional space. Over time, the utility will be expanded to serve new developments in the neighbourhood and Great Northern Way campus lands

CASE STUDY:
METRO VANCOUVER & KERR WOOD LEIDAL

Image Courtesy of Kerr Wood Leidal

Expansion: The City of Vancouver retained Kerr Wood Leidal (KWL) to provide engineering services for the expansion of the Southeast False Creek Neighbourhood Energy Utility. KWL is the prime consultant for detailed design and construction support.

This project includes the connection of 11 new buildings to the system between 2012 and 2014. The scope of work includes buildings' HVAC system design review; detailed design of the distribution piping system; detailed design of the 11 new energy transfer stations (mechanical, electrical and controls); engineering assistance and support during construction.

To see more, please refer to the document 'Heat-Seeking Sewer Model - Kerr Wood Leidal Report' located in 'Additional Resources' - you can also **click here** to learn more.

CASE STUDY:
METRO VANCOUVER & KERR WOOD LEIDAL

PROJECTS

Leləm Development

Public Entity: University Endowment Lands

Building Owner: Musqueam Capital Corporation

Technology Provider: SHARC Energy

Engineering: Undisclosed

Carbon Emissions Reduction: ~ 99%

Business Model: Undisclosed

Image Courtesy of SHARC Energy

CASE STUDY:
METRO VANCOUVER & KERR WOOD LEIDAL

Image Courtesy of SHARC Energy

SHARC collaborated with Leləm̓, a master planned community in the University Endowment Lands developed by Musqueam Capital Corporation. The development's heating and cooling needs will be met by utilizing a SHARC low-carbon wastewater energy exchange system as part of a centralized energy facility.

A SHARC 660 was utilized for a District Energy passive energy loop that serves lelam villages' 1,250 residential units.

The project's wastewater will collect and pass through the SHARC system, allowing for the reuse of thermal energy that would otherwise be lost to the sewer lines.

By using wastewater as an energy source, the project will significantly improve energy efficiency and reduce the carbon emissions of the community for its lifetime.

Situated on the western edge of the City of Vancouver, the 22-acre leləm̓ development is bounded by the University Golf Course, Pacific Spirit Park, and the University of British Columbia. leləm̓, meaning home in həńq̓əmiń əm̓, the language of Musqueam people, reunites the north and south of Pacific Spirit Park with a new forest heart, a brand-new community centre for the University Endowment Lands, a daycare centre and a contemporary village set amidst towering trees and walking trails,

CASE STUDY:
METRO VANCOUVER & KERR WOOD LEIDAL

Image Courtesy of SHARC Energy

weaving multi-family living and a retail and gathering hub into a natural landscape.

"We are proud to be putting in a truly groundbreaking carbon neutral district energy system in some of the most pristine environment in the world, "says Lynn Mueller, CEO of SHARC Energy. "Being in harmony with nature is a key objective for SHARC Energy."

"Musqueam Capital Corporation is pleased to partner with SHARC to construct a sewage heat recovery plant to provide sustainable energy to 1,200 residential units planned at leləm̓ development. Employment of this type of technology is consistent with Musqueam's cultural values founded on stewardship of the natural world." says Babu Kadiyala, VP Real Estate of Musqueam Capital Corporation.

The development is consistent with the recommendations of the United Nations Environment Programme (UNEP) which has identified low carbon district energy systems as a best practice to addressing the global climate challenge. The report states a transition to such systems, combined with energy efficiency measures, could contribute as much as 58 per cent of the carbon dioxide (CO2) emission reductions required in the eThe system was delivered and installed in Q1 2022.

The system was delivered and installed in Q1 2022.

CASE STUDY:
METRO VANCOUVER & KERR WOOD LEIDAL

CONTACT

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Winson Cheng is a Senior Project Engineer with Metro Vancouver's Liquid Waste Services Business Development Team.

Winson coordinates and manages requests for sewer heat recovery from local member municipalities and developers across the Metro Vancouver region, to leverage the regional wastewater system as an energy source for future low carbon district energy projects.

Colin Jeffery
Project Engineer
Kerr Wood Leidal
Email: Colin.Jeffery@metrovancouver.org

Colin Jeffery is a Project Engineer at Kerr Wood Leidal who is supporting Metro Vancouver's Business Development Team.

With Metro Vancouver, Colin has helped to implement the Sewer and Waste: Heat Recovery Policy across the region on resource recovery projects. Utilizing the Policy, Metro Vancouver is currently partnering with public and private entities on a number of sewer heat recovery projects across the region.

CASE STUDY:
METRO VANCOUVER & KERR WOOD LEIDAL

ADDITIONAL RESOURCES

- Board Policy - Sewage and Waste: Heat Recovery - click here
- External Process for Requesting Access to Sewer Heat from Metro Vancouver - click here
- Heat-Seeking Sewer Model - Kerr Wood Leidal Report - click here
- Sample Executed Sewage Diversion Agreement - click here
- Case Study: Wastewater Energy Recovery at lelәm Development - click here
- Colin Jeffery, Kerr Wood Leidal, and Winson Cheng, Metro Vancouver - Metro Vancouver's Approach to Sewer Heat Recovery Presentation - click here
- Expansion of the False Creek Neighbourhood Energy Utility Presentation - click here
- Southeast False Creek Neighborhood Energy System Presentation - click here

CASE STUDY: METRO WATER RECOVERY

METRO WATER RECOVERY℠

BACKGROUND

Colorado aims to be a leader in clean, renewable energy.

According to the Colorado Energy Office, Colorado's renewable net energy generation has more than tripled since 2010. Recovering the thermal energy of wastewater diversifies Colorado's renewable energy options while also boosting the state's clean energy economy.

As the largest wastewater service provider in the state, Metro Water Recovery (Metro) is leading the charge to provide access to the clean thermal energy of wastewater within our 805 square mile service area in metro Denver.

PROJECTS

National Western Center

Public Entity: Metro Water Recovery

Developer: National Western Center

Technology Provider: Undisclosed

Engineering: EAS Energy Partners (comprised of CenTrio Energy, AECOM Technical Services Inc. and Denver-based Saunders Construction)

Carbon Emissions Reduction: Undisclosed

Business Model: Energy-as-a-service Co. (ESCO)

CASE STUDY: METRO WATER RECOVERY

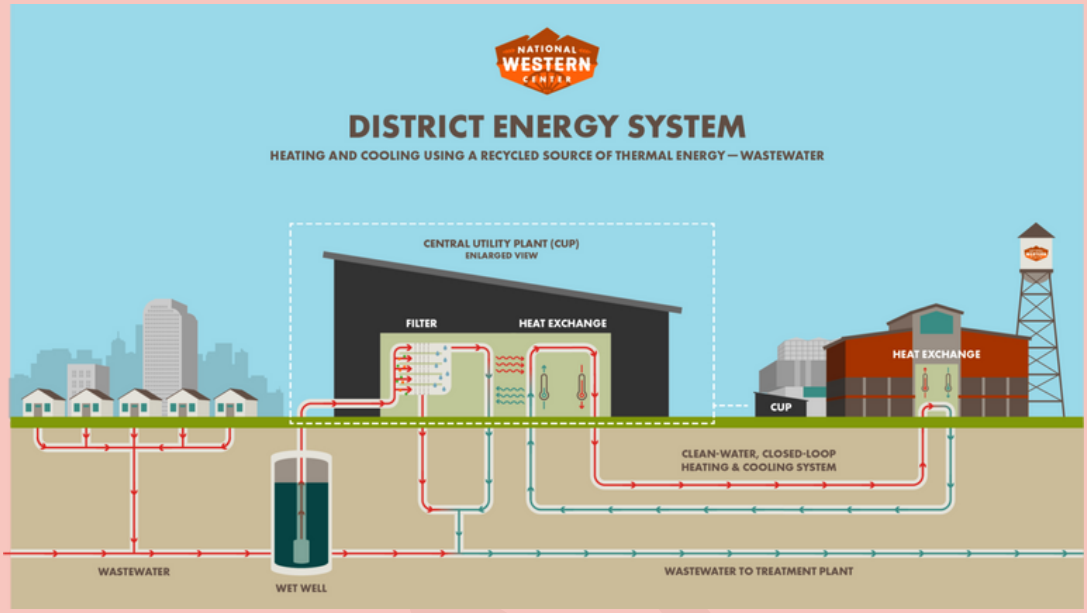

Image Courtesy of National Western Center

The 2015 National Western Center Master Plan set ambitious sustainability goals for the campus, including a principle to "embrace an ethic of regeneration" for the site itself.

As the campus redevelopment plan came together, the city of Denver project team approached Metro Water Recovery about the possibility of relocating its 7-foot-tall, aboveground pipeline that ran through the site, to allow access to the river from the campus.

At the time, Metro Water Recovery was working on regulating the temperature of the clean wastewater ("effluent") it returns to the South Platte River. Recognizing the potential environmental benefits of using thermal energy from the pipeline to heat and cool buildings, including cooling of the effluent, Metro Water Recovery conducted studies to explore the possibility. Their study prompted further studies by the City and County of Denver, Metro Water Recovery and Xcel Energy.

The results confirmed this approach was technically feasible. Faculty and students at Colorado State University – a leader in sustainability, and the first institution in the world to achieve STARS Platinum ranking – also studied the system design.

City officials worked to identify a

CASE STUDY: METRO WATER RECOVERY

Image Courtesy of National Western Center

campus energy partner with the right expertise. In 2018 EAS was selected from among seven proposers in a competitive procurement, and the National Western Center signed a long-term energy agreement with EAS in 2020.

Cost: This system is being delivered at a cost comparable to traditional natural gas systems from a total cost of ownership perspective over its lifetime. On-campus building owners will pay for the system through event fees and monthly energy bills.

A small premium for this system over 40 years over a traditional system is acceptable to campus partners because:

- This system is four times more efficient than traditional heating and cooling systems, and it helps the campus make progress toward its energy goals.
- The potential to expand the system as the campus grows could mean more cost efficiencies for all users.
- The use of recycled energy — in a system adaptable to future clean-energy technologies — stabilizes energy costs for building owners and customers, compared to fossil fuels with prices that are more volatile or potentially subject to future carbon taxes.

CASE STUDY: METRO WATER RECOVERY

- The environmental value, reliability and resiliency of the system, and quality of the provider are worth the modest premium.
- To help make the project more cost effective, the City and County of Denver Department of Public Health and Environment provided a $1 million grant toward the project from its enterprise fund that supports environmental projects.

Anticipated workforce impact: During design and construction, the system will bring new employment opportunities, including specifically for minority and women-owned businesses. EAS Energy Partners will also incorporate educational tours for school groups. The CSU Spur campus, when opened in 2022, will host ongoing research and student learning, in collaboration with EAS.

Co-Benefit Solution: Using waste heat offers a co-benefit for wastewater management in Denver. In the winter, when Metro Water Recovery returns clean effluent to the river, it's better for that effluent to be at a lower temperature — closer to the river's temperature — so that fish and other aquatic life are not exposed to significant temperature changes. The district energy system delivers lower-temperature wastewater to Metro Water Recovery's treatment facility than the pipeline alone did.

CONTACT

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Dr. Tanja Rauch-Williams serves as Metro Water Recovery's Chief Innovation Officer. She leads the Technology Innovation Department that supports the evaluation, design, and operation of new technologies that improve process efficiency, resource recovery, or future permit compliance.

ADDITIONAL RESOURCES

- Poop Power: How Sewer Gas Could Provide Clean, Renewable Energy - click here
- Metro Water Recovery - Wastewater Thermal Energy Use PowerPoint - click here
- National Western Center Webpage - click here

CASE STUDY: DC Water Authority

BACKGROUND

DC Water Authority ("DC Water") treats wastewater from the District of Columbia, Maryland and Virginia at the largest treatment plant of its kind in the world. On an average day, close to 300 million gallons of raw sewage flows into the Blue Plains Advanced Wastewater Treatment Plant to be treated.

In 2017, DC Water was awarded a US $330,000 (CAN $478,000) contract to supply its innovative SHARC thermal energy exchange system to the new headquarters of the District of Columbia Water and Sewer Authority ("DC Water") in Washington, DC.

The SHARC system allowed DC Water HQ to use its own wastewater as a source of thermal energy to condition the building. This project represents a historic HVAC first. The DC Water HQ building will be the first ever deployment of this technology used to both heat and cool a building in the USA.

PROJECTS

American Geophysical Union (AGU)

Public Entity: DC Water Authority

Building Owner: AGU

Technology Provider: Noventa WET™ System - HUBER ThermWin®

Engineering: Interface Engineering

Carbon Emissions Reduction: Undisclosed

Business Model: Undisclosed

CASE STUDY: DC WATER AUTHORITY

Image Courtesy of Interface Engineering

The American Geophysical Union (AGU) is an international non-profit scientific association with 60,000 members in 137 countries promoting discovery in Earth and space science for the benefit of humanity. In 2015, Interface Engineering was selected as part of a team to convert the existing American Geophysical Union Headquarters into a world-class, Net Zero Energy facility.

The full-building renovation transformed the 5-story, 87,780 gross square foot space into a state-of-the-art work environment that facilitates internal collaboration and showcases AGU's contributions to Earth and space sciences. The design includes a mixture of modern workspaces and cutting edge meeting/conference facilities that incorporate the most advanced technology and sustainable features.

To target its net zero energy goal, the now-complete renovation incorporated the engineering principles of reduction and absorption.

Reduction: By circulating chilled water through pipes in the building, a hydronic cooling system keeps the temperature comfortable while using less energy than a traditional HVAC system.

Cooled ceiling surface panels evenly absorb heat from people, lights and equipment. Combined with the cooling system, heat and ventilation air are provided by a dedicated outside air system.

CASE STUDY: DC WATER AUTHORITY

Image Courtesy of AGU

Absorption: The new headquarters includes a Huber system, which taps into DC's municipal wastewater systems to create a heat exchange. This system, which is the first of its kind to be installed in North America, cuts down on both the energy needed to heat and cool the building and the associated costs.

Sewer Heat Exchanger: The new headquarters uses a Huber system to cut down on the energy needed to heat and cool the building. This system, the first of its kind to be installed in North America, taps into D.C.'s municipal wastewater systems to create a heat exchange. The main purpose of a sewer heat exchanger is to transfer heat acquired inside the building during cooling season and when the conditions are right, to absorb heat from the sewer during heating season.

The Huber system diverts local wastewater to an outside settling tank before circulating it inside AGU headquarters. The wastewater is ultimately directed to an exchange system, which extracts energy (heat) from the water for heating and cooling, then returned to the sewer.

When sewer temperatures are cool, the building's radiant cooling system uses water from the sewer heat exchange system to operate in "free cooling" mode, allowing the building's water-to-water heat pump to be turned off. This capability eliminates the need for a cooling tower on the roof of AGU's headquarters and saves a substantial quantity of fresh potable water.

CASE STUDY: DC WATER AUTHORITY

PROJECTS

DC Water Headquarters

Public Entity: DC Water Authority

Building Owner: DC Water Authority

Technology Provider: SHARC Energy

Engineering: SmithGroup & Skanska

Carbon Emissions Reduction: Undisclosed

Business Model: Owned by Public Utility - in-building

Image Courtesy of SmithGroup

CASE STUDY: DC WATER AUTHORITY

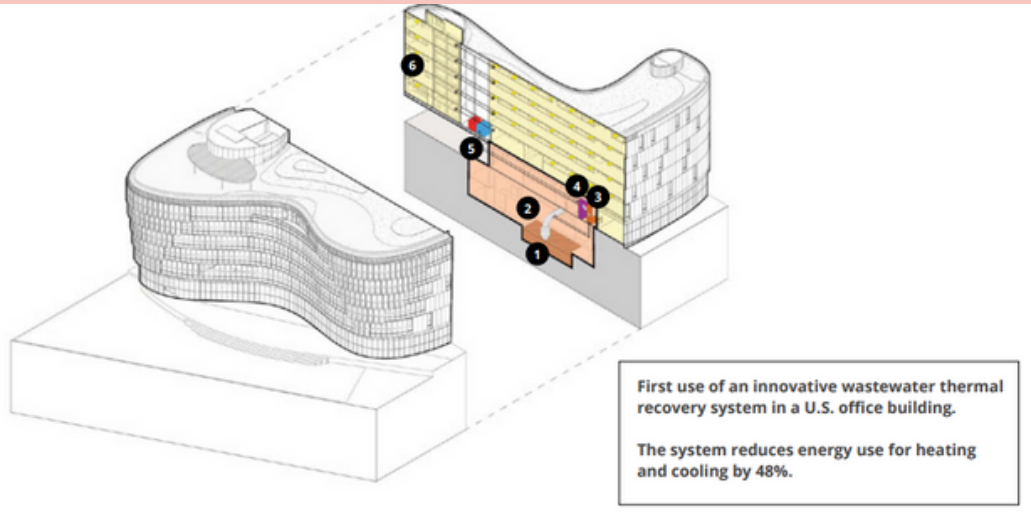

Image Courtesy of AIA Washington DC

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CASE STUDY: DC WATER AUTHORITY

CONTACT

Saul Kinter
Program Manager
Business Development & Energy Initiatives, DC Water
Email: Saul.Kinter@dcwater.com

Saul Kinter is the Program Manager for Business Development and for Energy Initiatives at DC Water. He holds a BSE degree from Princeton University, where his thesis described a new model for distributing surface water according to the Texas water rights system and has published or spoken on a wide-ranging set of topics, including climate variability, ocean-atmosphere gas transfer, the value of water conservation, and wastewater thermal energy.

At DC Water, he developed the Bloom biosolids marketing program, and is currently responsible for developing new revenue streams, including from renewable energy.

ADDITIONAL RESOURCES

- Sample Contract - click here
- D.C. Law 21-154. Renewable Portfolio Standard Expansion Amendment Act of 2016 - click here
- AIA DC - DC Water Headquarters Presentation- click here
- Saul Kinter, DC Water Authority - Wastewater Thermal Energy Presentation - click here

CASE STUDY: DC WATER AUTHORITY

ADDITIONAL RESOURCES

- SHARC Energy Customer Highlights - DC Water Administrative Building - click here
- Chris Peot, Resource Recovery at DC Water Presentation- click here
- Public Service Commission - District of Columbia: Sustainable Energy - click here
- SmithGroup - Our Work: DC Water Headquarters - click here
- SmithGroup - Putting Wastewater to Work: Tapping the Energy Flow Just Beneath Our Feet Article - click here
- Skanska - Our Projects: District of Columbia Water and Sewer Authority, New Headquarters Building - click here
- Interface Engineering - Work: American Geophysical Union Headquarters - click here

CASE STUDY: CITY OF TORONTO

BACKGROUND

The City of Toronto's Wastewater Energy Program will reduce operational greenhouse gas emissions from buildings and support the City's TransformTO climate strategy and target to reduce greenhouse gas emissions in Toronto to net zero by 2040.

Warm wastewater originating from sources such as showers, laundry machines, toilets, dishwashers, and industrial processes constantly flow through the City's sewer system. A large portion of the City's sewer system contains a high wastewater flow rate at significantly high and constant temperatures that can be used as a renewable energy source for new and existing buildings.

This is currently a largely wasted resource and the Wastewater Energy Program aims to help implement development projects that will recover this heat to use for heating or use it as a heat sink for cooling.

If you determine that there is a potentially viable sewer for your project, please contact energyreview@toronto.ca for the application and implementation next steps.

Image Courtesy of Noventa

CASE STUDY: CITY OF TORONTO

PROJECTS

Toronto Western Hospital (In-Progress)

Public Entity: City of Toronto

Building Owner: University Health Network (UHN)

Technology Provider: Noventa WET™ System - HUBER ThermWin®

Engineering: Undisclosed

Carbon Emissions Reduction: Undisclosed

Business Model: Undisclosed

Image Courtesy of Noventa

CASE STUDY: CITY OF TORONTO

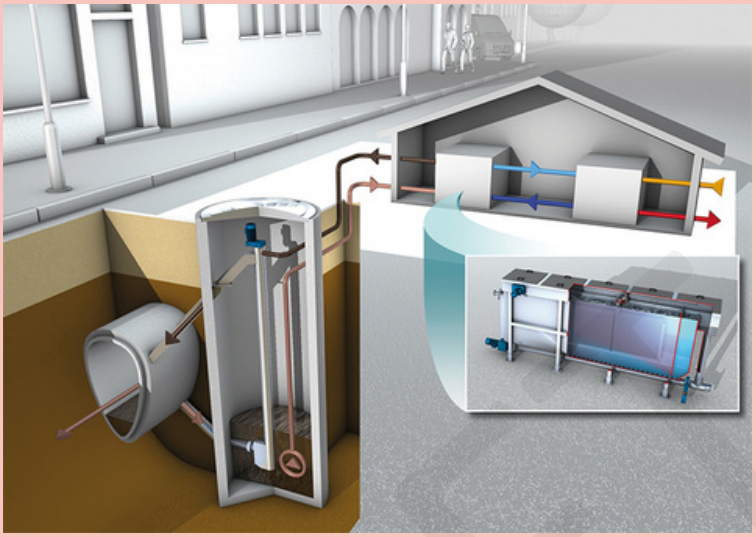

Image Courtesy of UHN

Noventa Energy Partners (Noventa) has announced the delivery of the world's largest raw wastewater energy transfer project at Toronto Western Hospital.

The $38 million project, funded in part by the Government of Canada and financed by Vancity Community Investment Bank (VCIB), will generate enough thermal energy using raw municipal wastewater from a sewer to supply 90% of the hospital's heating and cooling requirements, reducing its carbon emissions by a quarter of a million tonnes.

Noventa will use patented HUBER ThermWin® technology (for which it is the exclusive North American distributor) – and its own proprietary DFSCTM process – to harvest the energy in raw municipal wastewater flowing through a sewer, to provide the hospital with a source of clean, renewable energy.

Over the next 30 years, Noventa's wastewater energy transfer technology is expected to:

- supply 1.8 billion kilowatt-hours of energy to the hospital, or approximately 90% of the hospital's space heating and cooling requirements.
- reduce the hospital's carbon dioxide emissions by 250,000 tonnes – the equivalent of taking over 1,800 cars off the road yearly.
- save over 141 million kilowatt-hours of electricity, 130 million cubic meters of natural gas, and 1.3 billion litres of cooling water (the equivalent of 520 Olympic-sized swimming pools)

CASE STUDY: CITY OF TORONTO

Ryerson University will be working closely with Noventa and the University Health Network to conduct ongoing research, surveillance and wastewater sampling on the raw wastewater energy transfer project.

The project has secured funding from both the public and private sectors.

The Government of Canada will invest $3.3 million from its Low Carbon Economy Fund, while VCIB – a subsidiary of Vancity Group and the only Canadian bank focused on supporting emerging and built environment climate solutions under $50 million – will provide financing of $9 million. In January 2021, Vancity Group announced its climate commitments, including an ambitious target to make Vancity net-zero across all of its mortgages and loans by 2040.

CONTACT

Fernando Carou
Manager
Public Energy Initiatives, Environment & Climate Division, City of Toronto
Email: Fernando.Carou@toronto.ca

Fernando is responsible for accelerating environment and climate action in Toronto through partnerships and innovation.

He leads a multi-disciplinary team focused on creating, developing, and operating best-in-class programs, policies, and projects for net-zero development, electric vehicles, and renewable energy, such as:

- Renewable and low carbon district energy systems
- Wastewater energy program to decarbonize buildings by displacing natural gas use.

CASE STUDY: CITY OF TORONTO

ADDITIONAL RESOURCES

- Fernando Carou, City of Toronto - Leveraging City Assets for Climate Action: Sewer Energy Utilization Presentation - click here
- City of Toronto Wastewater Energy Transfer Program Report for Action - click here
- City of Toronto Proposed Wastewater Energy Transfer Pilot Projects Report for Action - click here
- Explained: Toronto Western Hospital's Wet System - click here
- City of Toronto Wastewater Energy Map - click here
- Canada Infrastructure Bank (CIB) Toronto Western Hospital Retrofit - click here

GENERAL RESOURCES

FAQs

- Energy from Wastewater with UHRIG Therm-Liner Frequently asked questions - click here
- HUBER Report - How to Heat and Cool Buildings with Wastewater Frequently Asked Questions - click here

INDUSTRY EXPERT - UMC

- UMC Project Overview - Amazon Day 1 and Doppler Buildings - click here
- UMC District Energy Development Timeline - click here
- UMC District Energy Experience - click here
- UMC Leadership in Heat Recovery Contact List - click here
- UMC Heat Recovery Ecosystem Diagram - click here

RECORDINGS

- CleanTech Alliance - Harnessing the Untapped Potential of Wastewater Energy Transfer for Your Municipality 2023 Event Recording - click here

RESEARCH

- A mathematical model to predict the effect of heat recovery on the wastewater temperature in sewers - click here