

# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**



**Presentation for;**  
**ASHRAE - NB/PEI Chapter**  
**October 8 2013**

# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**

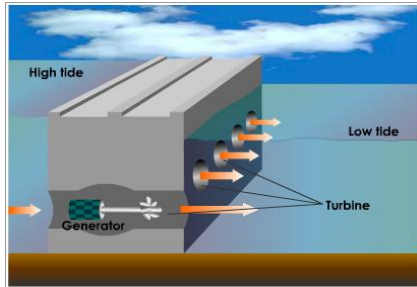
**“We are like tenant farmers chopping down the fence around our house for fuel when we should be using Nature’s inexhaustible sources of energy – sun, wind, and tide. I’d put my money on the sun and solar energy. What a source of power ! I hope we don’t have to wait until oil and coal run out before we tackle that “**

***Thomas Alva Edison - 1931***



# SEWAGE-WASTEWATER

## A Renewable Energy Source



**The world continues to research and implement new and sustainable ENERGY sources.**





# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**

**In recent years this research has discovered something**



# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**

**Society injects Billions of Btus / Joules  
/Kw-Hrs into water.....**

**.....that is ultimately discarded.**



# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**

**“350 billion Kw-Hrs worth of hot water  
are discarded annually through drains  
in North America”...**

Reference: US Department of Energy.



# SEWAGE-WASTEWATER

## A Renewable Energy Source



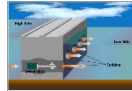
**Meet the newest player on the Alternate Energy landscape**





# SEWAGE-WASTEWATER

## A Renewable Energy Source



### THE ALTERNATE ENERGY BOX





# SEWAGE-WASTEWATER

## A Renewable Energy Source



**Exiting from Buildings**  
**Beneath sidewalks**  
**Beneath roadways**  
**Flows ENERGY**

**ABUNDANT**  
**ACCESSIBLE**  
**RENEWABLE**

**SEWAGE**



# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**

**Reliable source – People**

**Essentially 95% + liquid, with some solids**

**Is a Low Carbon Energy Source**

**Temperatures support energy exploitation;**

- Summer 12 C – 25 C ( 54 F – 77 F)**
- Winter 10 C – 16 C ( 50 F – 61 F )**

**Typically Energy exchange (demand) takes place near source (supply)**



# SEWAGE-WASTEWATER

## A Renewable Energy Source



**ENERGY = Flow (m) x Cp (constant) x  $\Delta T$  (temperature change)**





# SEWAGE-WASTEWATER A RENEWABLE ENERGY SOURCE

**“350 billion Kw-Hrs worth of hot water are discarded annually through drains in North America”...**

Reference: US Department of Energy.

## **Typical Sources :**

- Laundry
  - Dishwasher
    - Shower / Bath
      - Cooking
        - Process



**...DOWN THE DRAIN**

# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**

### **350 Billion Kw-Hrs - Energy Context**



**Point Lepreau Generating Station**

**Built in phases 1975 thru 1981  
Refurbished 2008 -2012**

**635 MW Capacity via 1 CANDU**

**Delivers 4 Billion Kw-Hrs annually**



# SEWAGE-WASTEWATER

## A Renewable Energy Source



# 88 Point Lepreaus



# SEWAGE-WASTEWATER

## A Renewable Energy Source

### Value of ENERGY in sewage water

♻️ USDOE 350,000,000,000 Kw-Hrs Annually

♻️ Equals ~ 12,000,000,000 Therms

♻️ @ \$ 1.35 / Therm ~ \$ 16,200,000,000

♻️ @ \$ 0.10 / Kw-Hr ~ \$ 35,000,000,000



# SEWAGE-WASTEWATER

## A Renewable Energy Source

### OPINIONS SUSTAINABILITY

STEVE MODDEMEYER

#### Energy Underfoot

U.S. utilities begin working to exploit the thermal energy flowing through wastewater pipes each day.

MILLIONS OF DOLLARS' WORTH of thermal energy is flowing beneath the streets. Around the globe, a few utilities are tapping into that energy as a smart sustainability strategy. With more than 30 such projects already operating in northern Europe, China, and Canada, the United States is finally entering the market.

This new renewable energy market is sewer heat recovery. In the United States, the King County Wastewater Treatment Division in Seattle is leading the way. The utility is seeking "deep-green real estate developers" and district energy companies to help determine the best way to develop renewable thermal energy resources by tapping into the network of regional sewer lines. In

mid-July, county officials sent out a formal request seeking interest and information that included a regional map of the area's large piping system to test the potential interest and to better understand what might be necessary to encourage real estate developers to use the thermal energy in wastewater.

"We think that this can be a win/win where we are tapping a waste stream and putting it to work for our ratepayers, our communities, and the planet," says Jessie Israel, manager of the King County Resource Recovery Section. "It requires us to think out of the box as a government and consider technologies that we haven't previously considered."

Says Dow Constantine, King County executive, "We have a

hidden supply of energy that flows right under our streets—energy that can reduce our reliance on fossil fuels. We want to hear from the private sector about how we might capture this thermal energy to heat and cool and power our buildings."

To understand how sewer heat recovery works, think of the large network of wastewater pipes lying under the city as a constantly flowing source of millions of British thermal units (Btu) of energy each day. These Btu are constantly replenished as people take baths and showers, do dishes, and wash laundry. Industrial, commercial, and institutional users such as hospitals and schools contribute as well by sending heated water down their drains. That thermal energy is



STEVE MODDEMEYER is a principal at Gullis Weisman, a Seattle-based architecture, planning, and sustainable development firm. He has worked globally with the International Water Association to help launch the Cities of the Future program, which seeks to help cities build infrastructure appropriate for the rapidly escalating challenges they face in the 21st century.



# SEWAGE-WASTEWATER

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### Facts About Waste Water...

- ♻️ Waste water has an average temperature of over 21°C (or 70°F) when exiting buildings.
- ♻️ The average person in North America uses ~ 375 liters (or ~ 100 gallons) of water daily.
- ♻️ 40-50% of a buildings energy requirements go out via the sewer everyday.





# **SEWAGE-WASTEWATER** **A Renewable Energy Source**

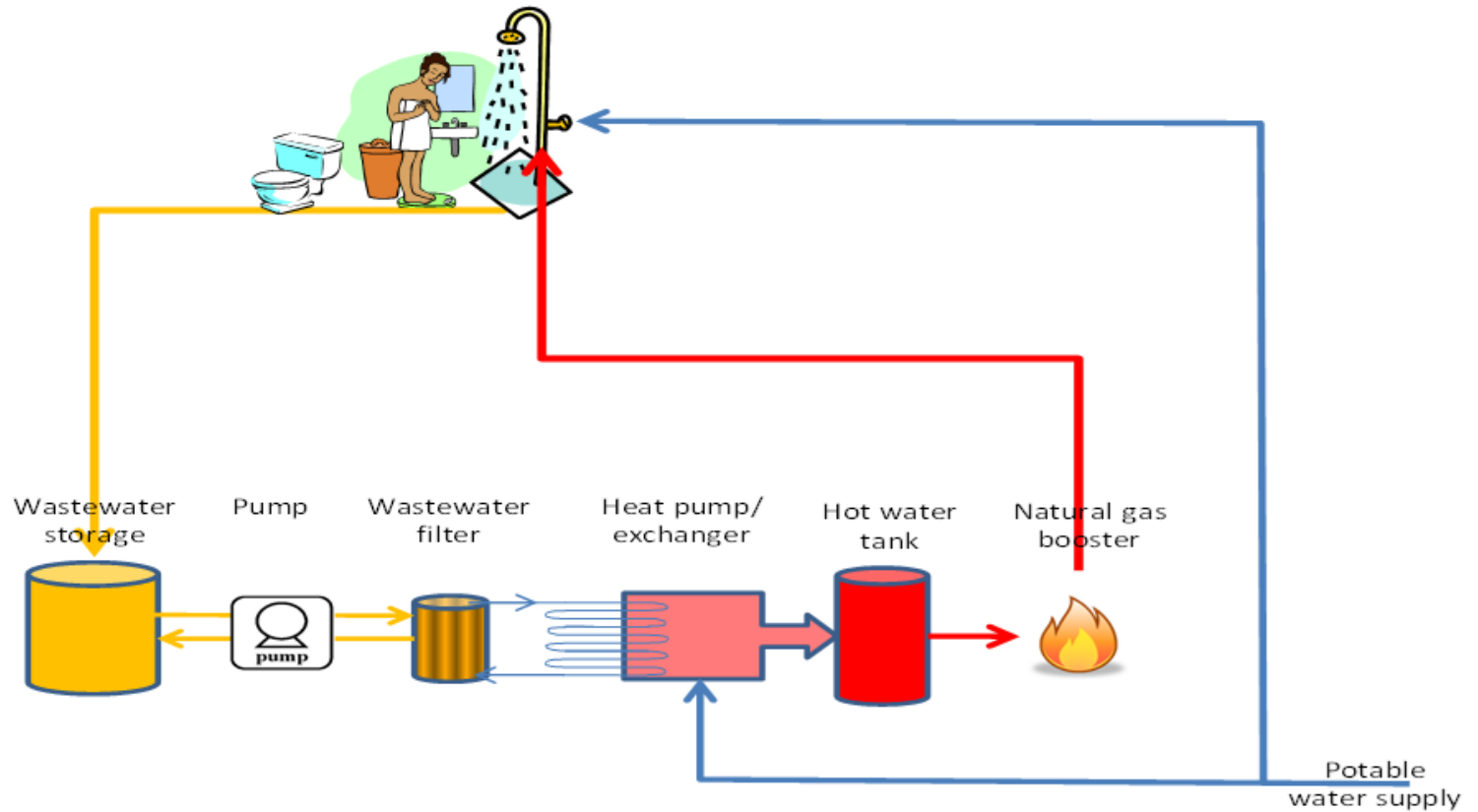
## **Facts About Mechanical Refrigeration equipment ;**

- ♻ Can operate at COP's of up to 6.0 in heating mode.**
- ♻ Can operate at EER's in excess of 20 in air conditioning mode.**
- ♻ Can offer competitive and often shorter paybacks compared to alternate energy systems**

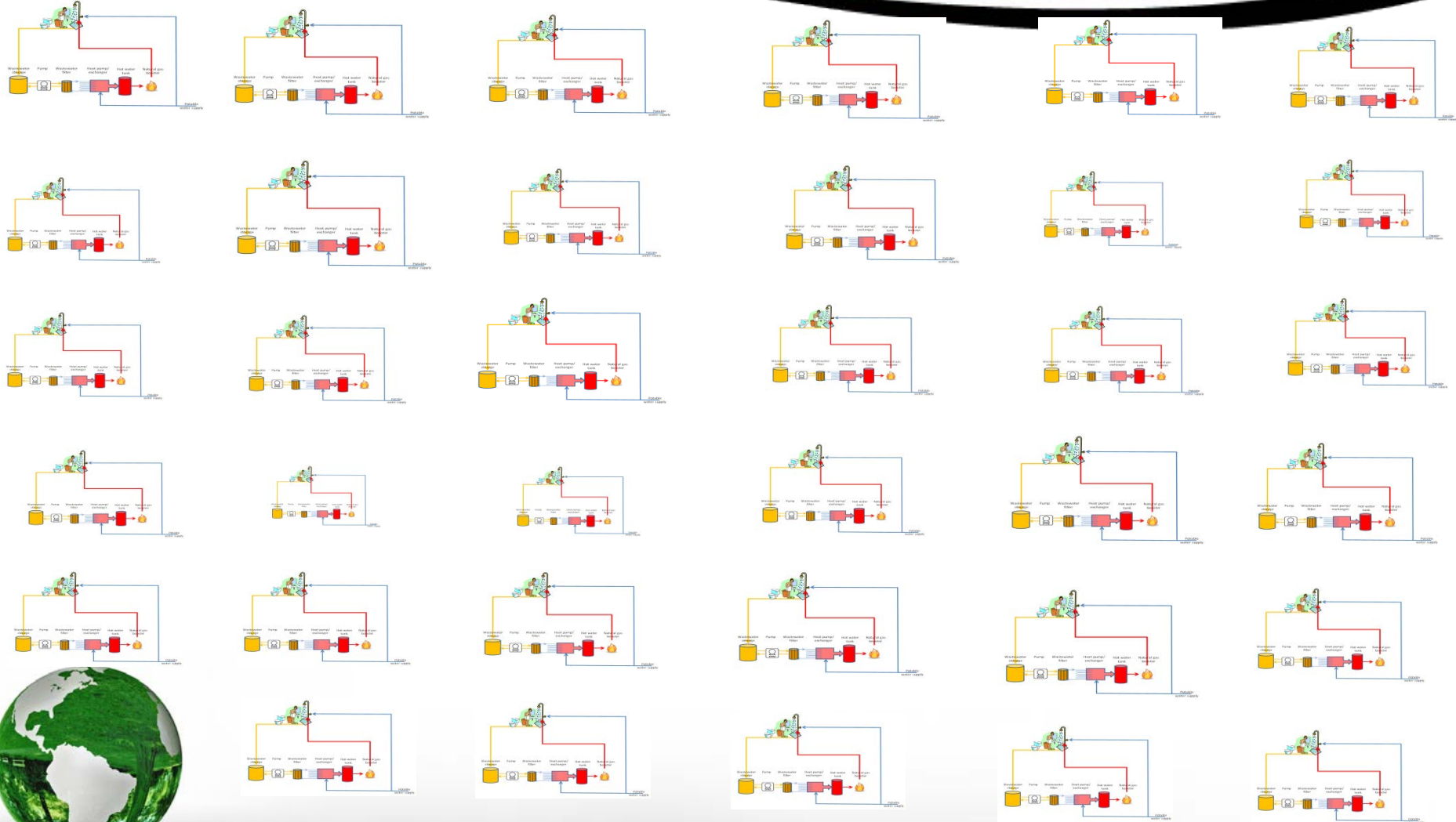


# SEWAGE-WASTEWATER

## A Renewable Energy Source



# How Sewage SHARC Systems Work...





# SEWAGE-WASTEWATER A Renewable Energy Source

## False Creek Energy Centre in Vancouver

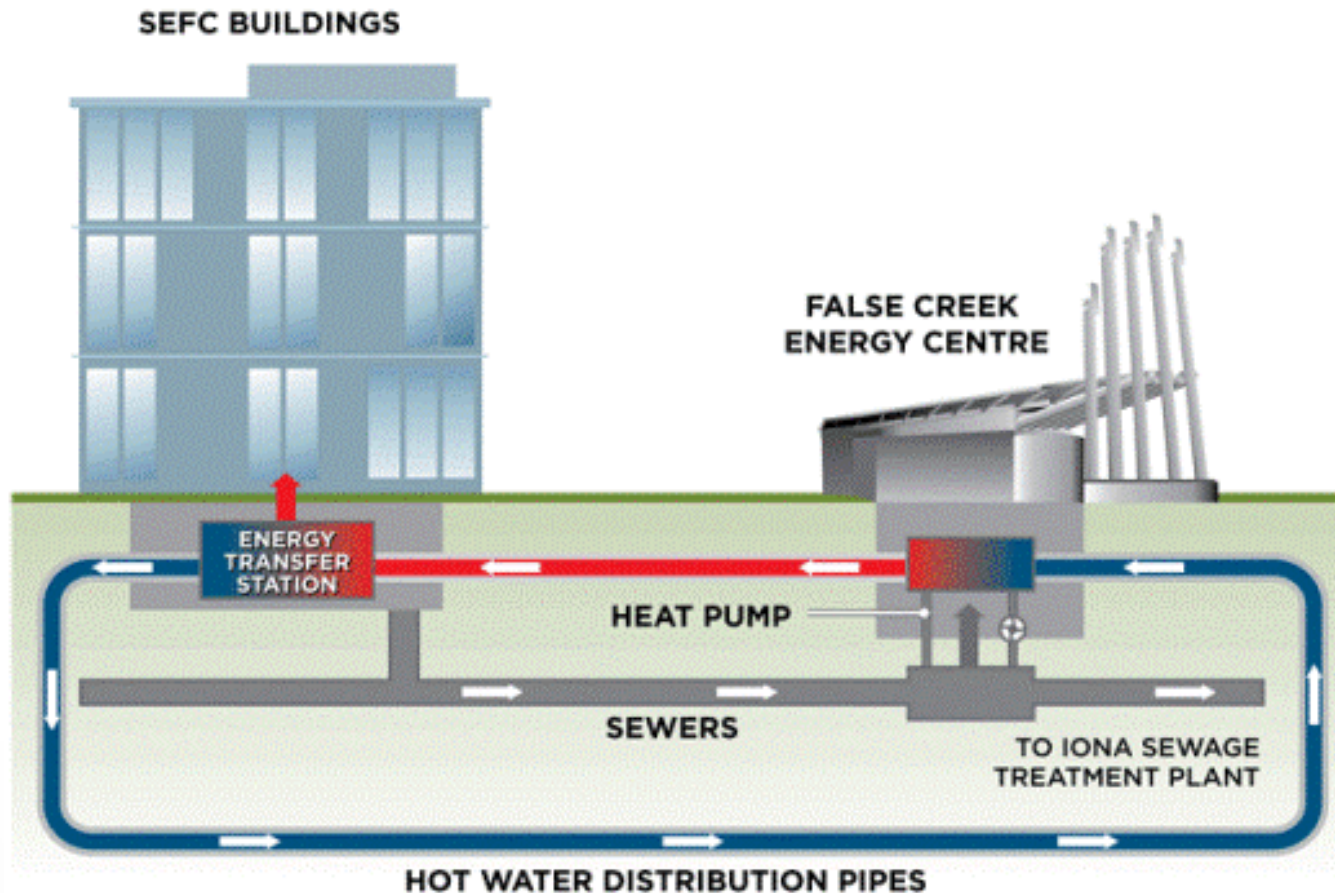
♻️ 1<sup>st</sup> large-scale wastewater heat recovery system in North America

♻️ \$ 45M publically funded project completed 2010.



# SEWAGE-WASTEWATER

## A Renewable Energy Source



**FALSE CREEK ENERGY CENTRE - How it works**





# SEWAGE-WASTEWATER

## A Renewable Energy Source

### False Creek Energy Center



# SEWAGE-WASTEWATER

## A Renewable Energy Source

### False Creek Energy Center





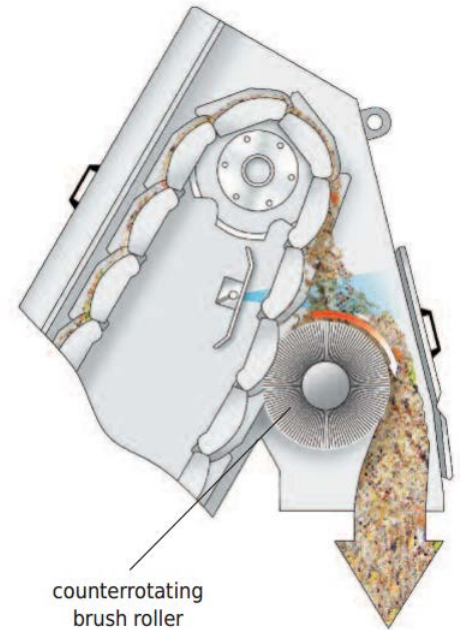
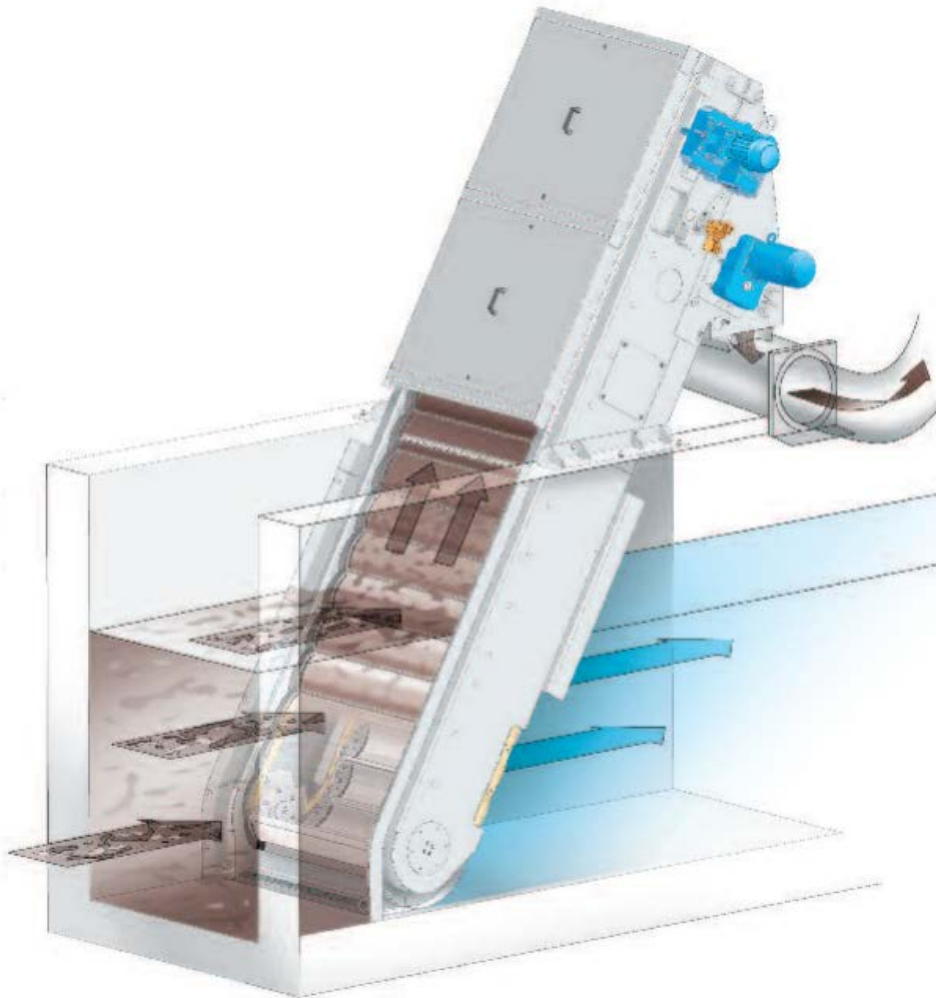
# SEWAGE-WASTEWATER A Renewable Energy Source

## False Creek Energy Center



# SEWAGE-WASTEWATER

## A Renewable Energy Source





# SEWAGE-WASTEWATER

## A Renewable Energy Source

### Beijing South Railway Station

Total area: 2.5 million square feet

Project completion date: August 1, 2008



# SEWAGE-WASTEWATER A Renewable Energy Source





# SEWAGE-WASTEWATER

## A Renewable Energy Source

### **Hotel Kunlun** --5-star hotel in Beijing

Building height: 102 meters with 29 floors

Total construction area: 865,000 square feet

Sewage wells dimension:  $R=3\text{m}$ ,  $H=8\text{m}$

System provides hot water, heating and cooling



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# SEWAGE-WASTEWATER

## A Renewable Energy Source

- The 60-unit Seven35 in North Vancouver developed by Adera Capital Corp. is Canada's first multi-family project designed to LEED **Platinum** and **Green** Building Gold. One of its sustainable features is IWS' Sewage SHARC for its residents' hot water supply.
- Per Adera Development president Norm Couttie, Seven35 is the first waste-water heat-recovery project among private multi-unit developments in North America.

*(BIV Magazine)*



# SEWAGE-WASTEWATER A Renewable Energy Source

**Inside Mechanical  
Room at Adera's  
Seven35 project in  
North Vancouver.**





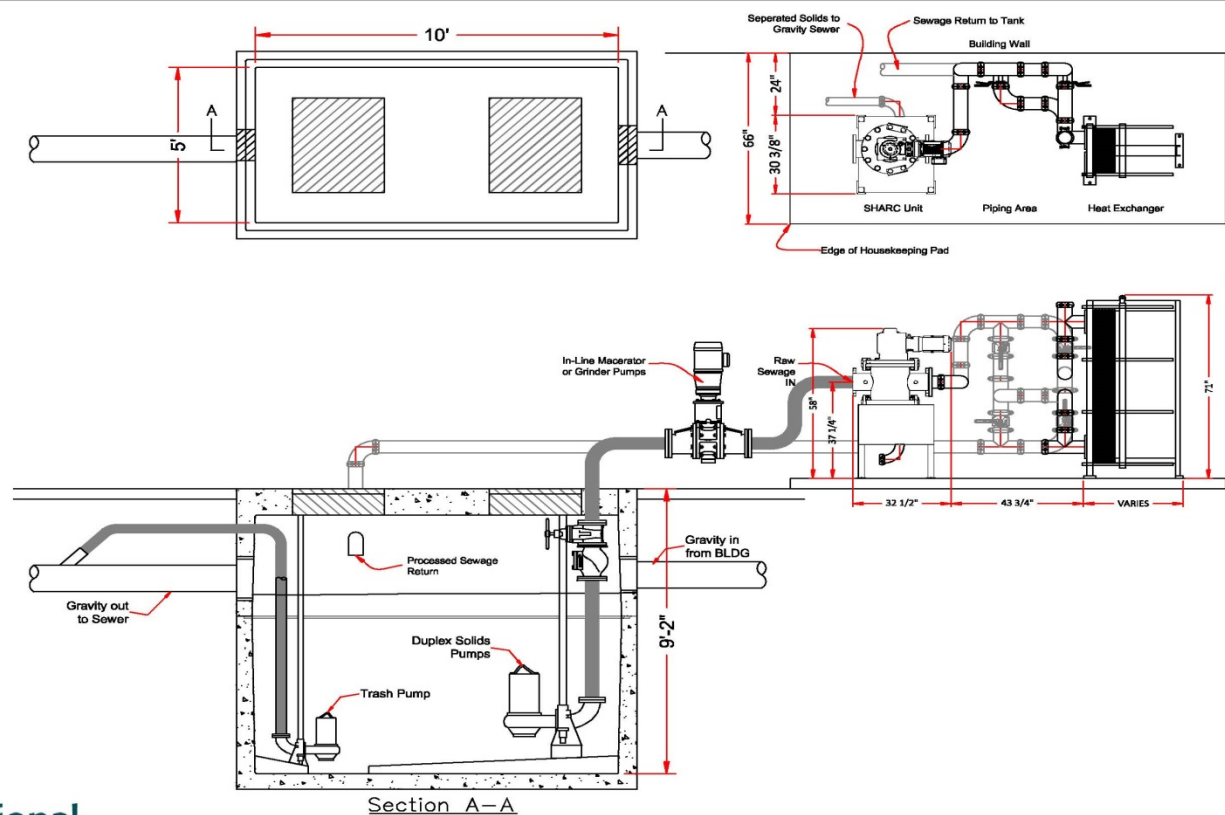
# SEWAGE-WASTEWATER

## A Renewable Energy Source



# SEWAGE-WASTEWATER

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4638 Hastings Sreet, Burnaby, BC, Canada V5C 2K5 | T:604-569-0313 | F: 604-294-0042 | [info@sewageheatrecovery.com](mailto:info@sewageheatrecovery.com)

**DRAWING NAME:** Typical Equipment Layout

**PROJECT:** Typical

**DRAWN BY:** MJW

**DATE:** 19Mar13

**SCALE:** NTS

**REV**

**SHEET 1 OF 1**

**DO NOT SCALE DRAWING**

**THIRD ANGLE PROJECTION**



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# SEWAGE-WASTEWATER A Renewable Energy Source

**Outside Mechanical Room in Parking level  
Adera's Seven35 project in North Vancouver.**





# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**

### **In-line Gravity Sewer HX**



**Requires energy upgrade (Heat-Pump)**

**Minimum sewer diameters required**

**Higher frequency Maintenance / cleaning**

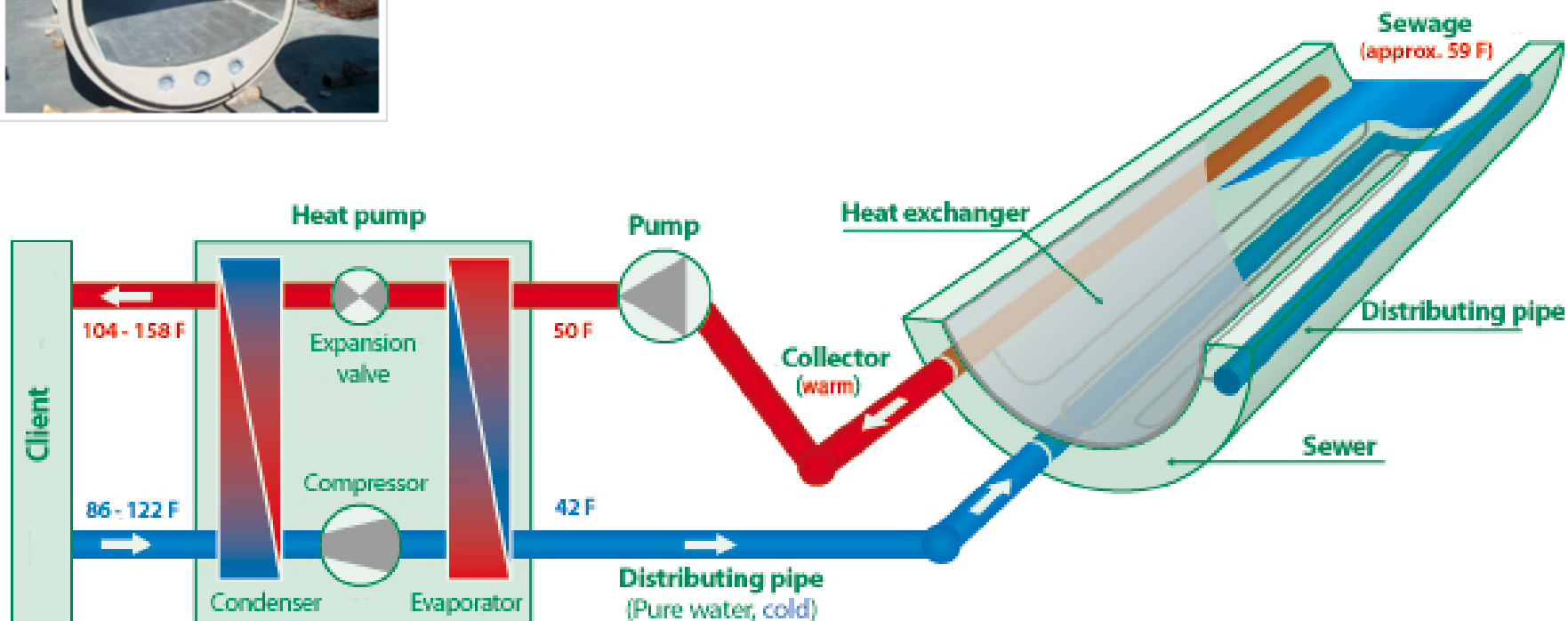
**New construction/replacement optimal**





# SEWAGE-WASTEWATER

## A Renewable Energy Source



# SEWAGE-WASTEWATER

## A Renewable Energy Source

### APPLICATIONS

- ♻️ District Energy Systems
- ♻️ Condominiums & Apartments
- ♻️ Public / Government Facilities
- ♻️ Geothermal
- ♻️ Aquatic Centers
- ♻️ Commercial & Retail Buildings
- ♻️ Industrial Complexes
- ♻️ Hospitals & Long-term Care
- ♻️ Universities & Colleges
- ♻️ Schools & Sport Facilities



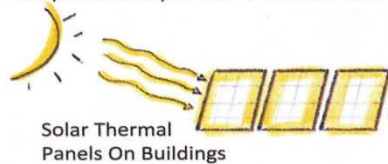
# SEWAGE-WASTEWATER

## A Renewable Energy Source

### Impact on District Energy Systems

#### Ambient Loop District Energy System

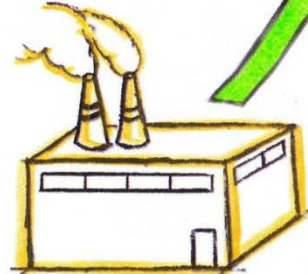
- Simpler, more flexible, more reliable and robust than conventional dual-temperature district energy systems.
- Less capital cost than conventional DES
- Provides flexibility for DES growth; ideal for phased developments
- Ideally suited for multiple sources of renewable low grade heat sources that can also be added incrementally
- Complements capture of waste heat from sewage.



Solar Thermal Panels On Buildings



- Sewage Heat Recovery
- Heat Rejection to Storm & Sewer System



Back-Up Boilers



Residential Buildings



Future Residential Buildings



Commercial Buildings



Closed Loop Ground Heat Exchanger (Adds/Rejects/Stores Heat)

Single Pipe Low Temperature Ambient Loop

#### New Buildings Designed With:

- High performance envelope
- Water-to-water heat pumps connected to ambient loop for heating & cooling & DHW
- Energy & water metering
- Solar thermal on roof tied into building heating & ambient loop.





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## A Renewable Energy Source

### Impact on Geo-exchange Systems;

- ♻️ Can reduces drilling requirements 30-50%
- ♻️ Will Reduce land mass requirements
- ♻️ Will Reduce project payback periods
- ♻️ Will improve loop temperatures: higher in heating  
& lower in cooling
- ♻️ Will Yield Higher heating COP's
- ♻️ Will Yield Higher cooling EER's



# SEWAGE-WASTEWATER

## A Renewable Energy Source

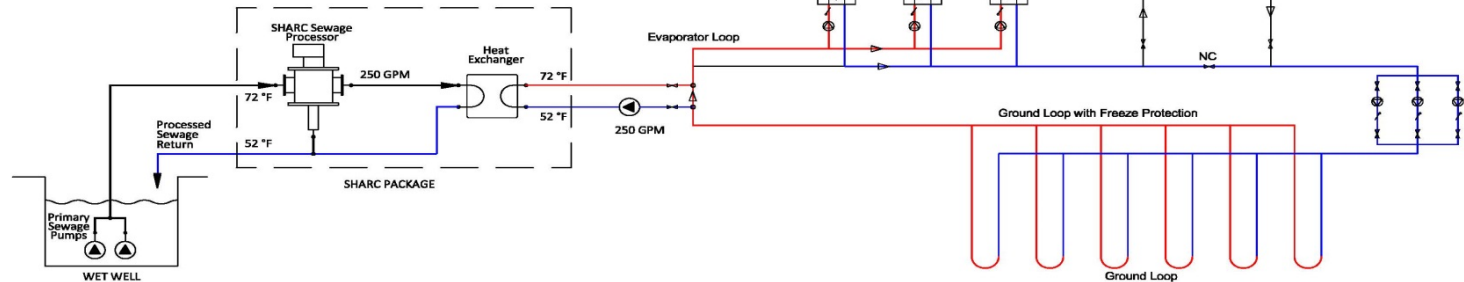
### Heat Mode

■ CGC units in heating mode (Fan coils-compressor OFF)

■ CGC units in cooling mode (Compressor operating)

#### NOTES:

Based on Occupancy of 2.5 per Suite  
200-250,000 Gal/day sewage flow



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DRAWING NAME: Preliminary Layout - Heat Mode

PROJECT: Sewage Heat Recovery

DRAWN BY: MJW

DATE:

SCALE: NTS

REV

SHEET 1 OF 2

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THIRD ANGLE PROJECTION

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## A Renewable Energy Source

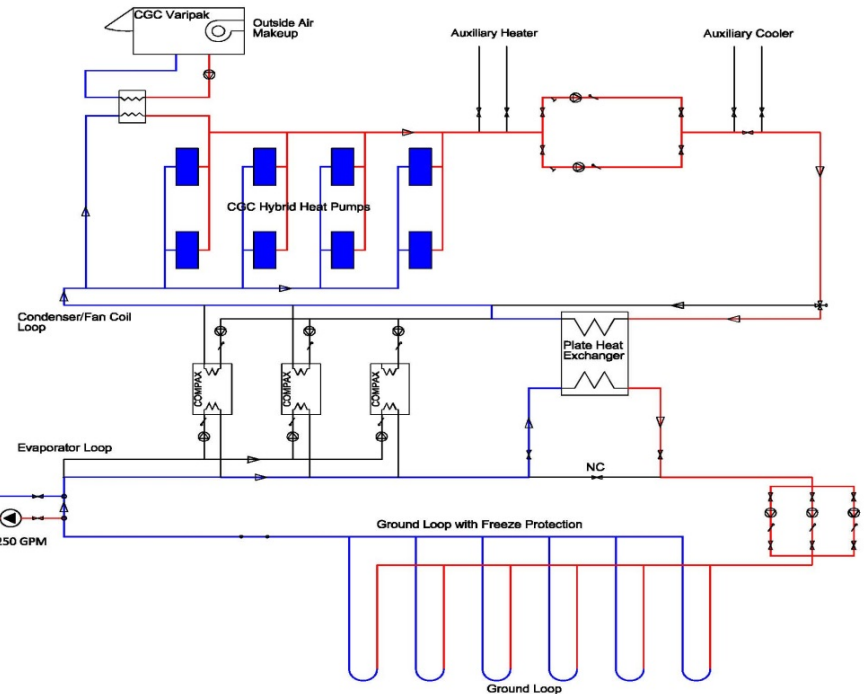
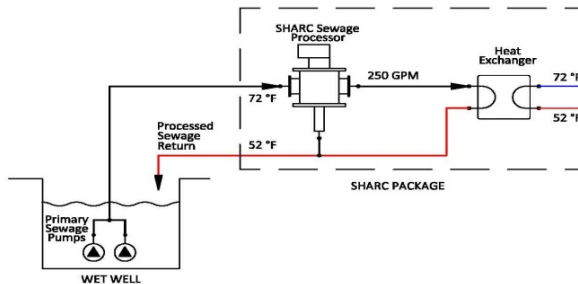
### Cool Mode

■ CGC units in heating mode (Fan coils - compressor OFF)

■ CGC units in cooling mode (Compressor operating)

#### NOTES:

Based on Occupancy of 2.5 per Suite  
200-250,000 Gal/day sewage flow



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DRAWING NAME: Preliminary Layout - Cool Mode

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REV

SHEET 2 OF 2



# SEWAGE-WASTEWATER A Renewable Energy Source

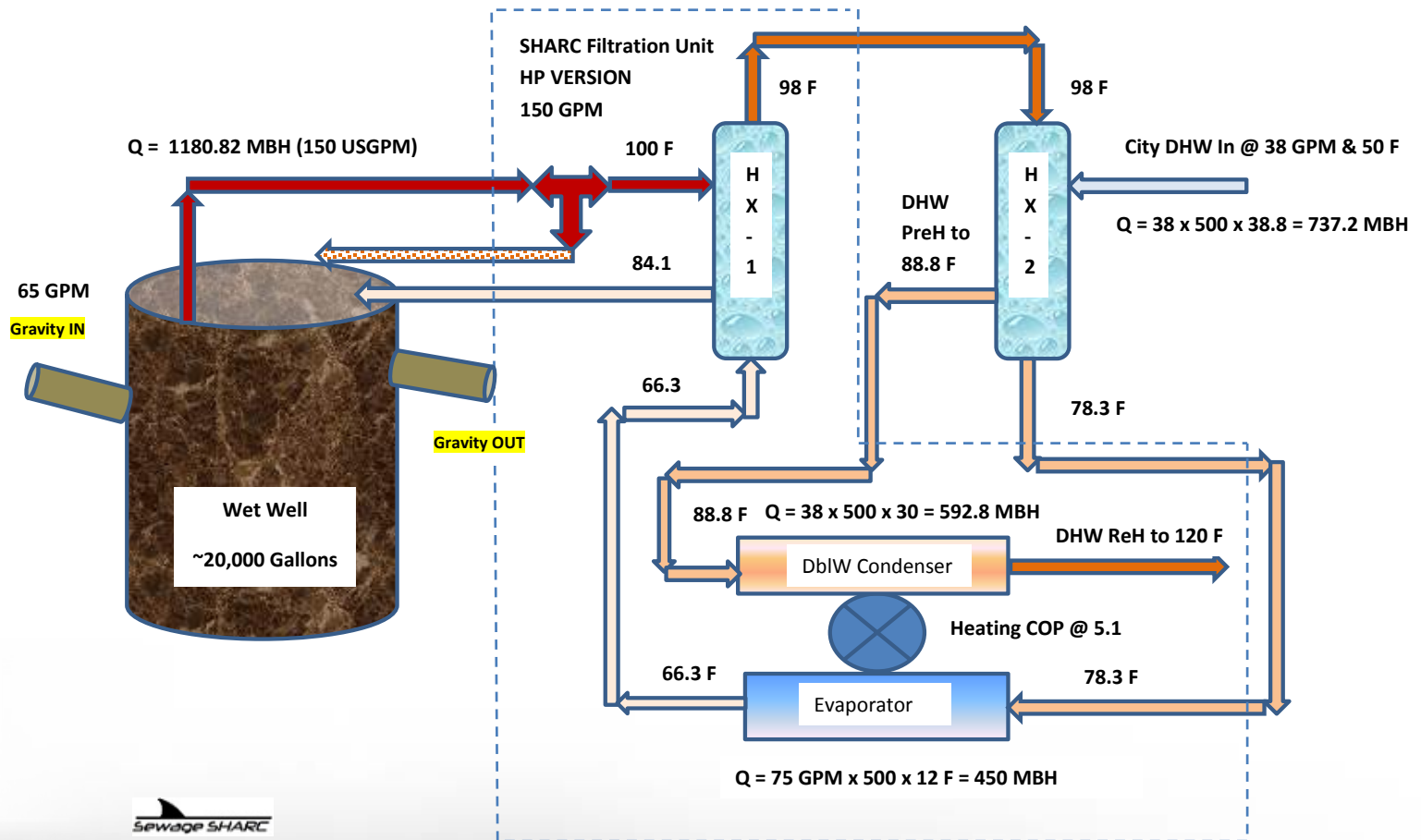
## Austin Texas Civic Center Cooling Rejection System

- ♻️ 30 million gallons / year cooling tower make-up water
- ♻️ 18,900 lbs/day of CO<sub>2</sub> produced by A/C unit = 7 million lbs/year CO<sub>2</sub>
- ♻️ GHG emissions reduced by 30 – 50%
- ♻️ 100% of the make-up water usage saved
- ♻️ Energy savings of 30 – 50%



# SEWAGE-WASTEWATER A Renewable Energy Source

## HOSPITAL Application - Toronto



# SEWAGE-WASTEWATER A Renewable Energy Source

## Regional Pumping Station – Southern Ontario





# SEWAGE-WASTEWATER A Renewable Energy Source

## Regional Pumping Station – Southern Ontario

### **Energy Review Parameters;**

Average In-flow sewage volume to Pumping Station : 1.02 cu m / sec (16200 USGPM)

Temperature range of available sewage 13 C to 15 C (55 F to 59 F)

Cost of Natural Gas; \$ 0.25 / cu m (\$ 0.71 / Therm)

Cost of Electricity; \$ 0.12 / Kw-Hr

Design Energy-Recovery Temperature Differential ; 5.6 C (10 F)



# SEWAGE-WASTEWATER A Renewable Energy Source

## Regional Pumping Station – Southern Ontario

Estimated conditioned-space area served by recovered energy: 250,838 sq m  
(2,700,000 sq ft)

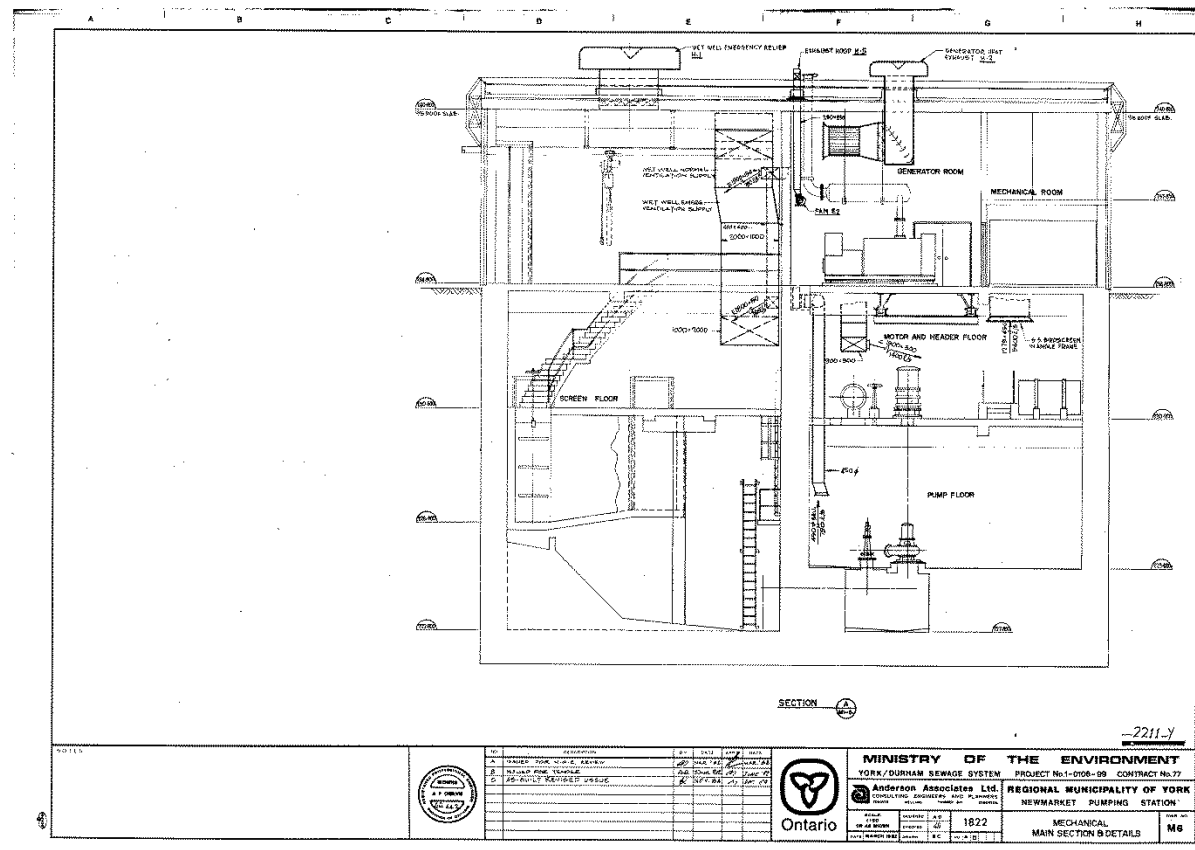
Estimated Cooling Plant rejection - Equivalent Displacement Capacity : 23,739 Kw  
(6750 Cooling Tons).

Estimated Heating Plant Equivalent Displacement Capacity ; 7,485,858,000 MJoules  
(7,095,600 Therms = 207,900,000 Kw-Hrs = 0.06% DOE Estimate)

Equivalent Market Value of energy - Ngas @ \$ 0.71 / Therm = \$ 5,447,640.00



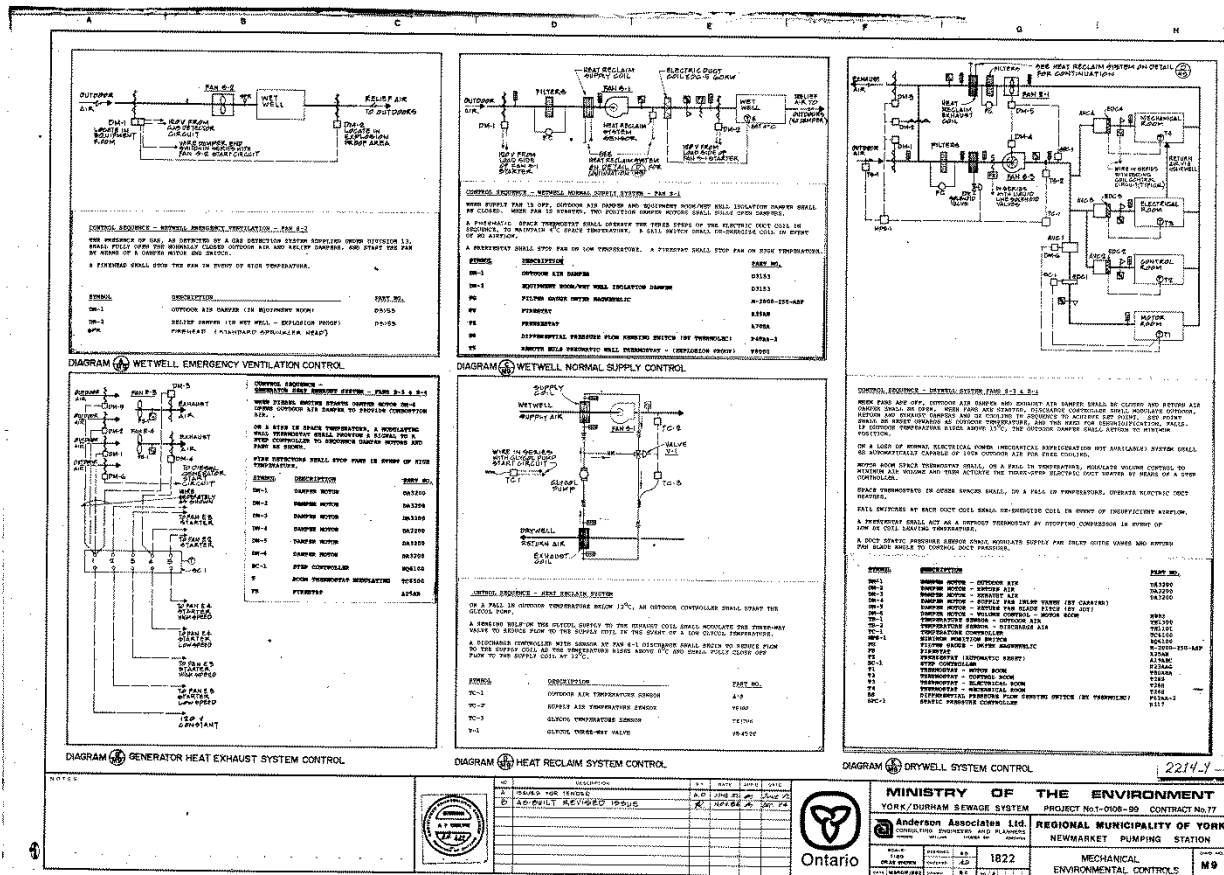
# Regional Pumping Station – Southern Ontario





# SEWAGE-WASTEWATER A Renewable Energy Source

## Regional Pumping Station – Southern Ontario



# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**

### **Regional Pumping Station – Southern Ontario**

#### **HVAC Renovation Proposal;**

- Air-cooled to water-cooled AC**
- Heat-pump based hydronic re-heat in lieu of Electric**

 **25,000 lbs/yr CO2 GHG reduction**

 **\$ 22,000 yr Electrical Energy savings**

 **Electrical Energy savings of ~ 60%**




 **Kw Demand Reduction ~ 100 Kw**



# **SEWAGE-WASTEWATER**

## **A Renewable Energy Source**

### **SUMMARY:**




-  **Sewage is a reliable and ever-increasing “free” energy resource**
-  **Sewage energy-exchange technology is available to leverage the energy opportunity offered with sewage-wastewater**
-  **Sewage energy-exchange technology can provide a cost-effective and environmentally-friendly means to augment building heating, cooling, and domestic hot water systems.**





# **SEWAGE-WASTEWATER** **A Renewable Energy Source**

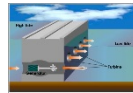
## **The Engineering Proposition**

-  **70 F discarded water is a viable energy transfer medium**
-  **Mechanical technologies can facilitate reliable, significant and cost-effective energy transfer**
-  **Engineering imagination will benefit the Industry and the Environment**



# SEWAGE-WASTEWATER

## A Renewable Energy Source



**THE ALTERNATE**



**ENERGY BOX**



# SEWAGE-WASTEWATER

## A Renewable Energy Source





# SEWAGE-WASTEWATER

## A Renewable Energy Source

**Thank you !**

