


SHARC ENERGY SYSTEMS

"Doing our part to Change the Climate"

Presenting to: ASHRAE®

Wastewater Energy Exchange Opportunities

Leveraging Building & Municipal Wastewater

ASHRAE London ON Chapter

Sept 24 - 2018

- **Presentation by:** Rick Lawlor P. Eng. LEED® AP Eastern Regional Sales Manager




Sanitary Water Energy Exchange

Welcome all !

Tonight’s discussion is intended to introduce you to the fundamentals and opportunities with SWEE

Why SWEE ?

- **Background / Drivers behind SWEE**
- **How SWEE works**
- **SWEE Technologies Available**
- **Real World Stuff: Where is SWEE in use ?**
- **Advancing the concept; What technical parameters to consider ?**
- **???**

Why SWEE ?

1) Potential for Energy Savings

- 15% to 30% of energy that goes into a building will leave down the drain

How much energy is available?

"350 billion Kw-Hrs worth of hot water are discarded annually through drains in North America"

– US Department of Energy

350,000,000,000 Kw-Hrs annually

Therm equivalent ~ 12,000,000,000

Natural Gas @ $0.80 / Therm

= $9.6 Billion Annually

Why SWEE ?

1) Potential for Energy Savings

- 15% to 30% of energy that goes into a building will leave down the drain

2) Supports Low-Carbon, High-Performance Green Building Culture

- Buildings account for 18% of global emissions today, equivalent of 9 billion tonnes of CO2 annually.

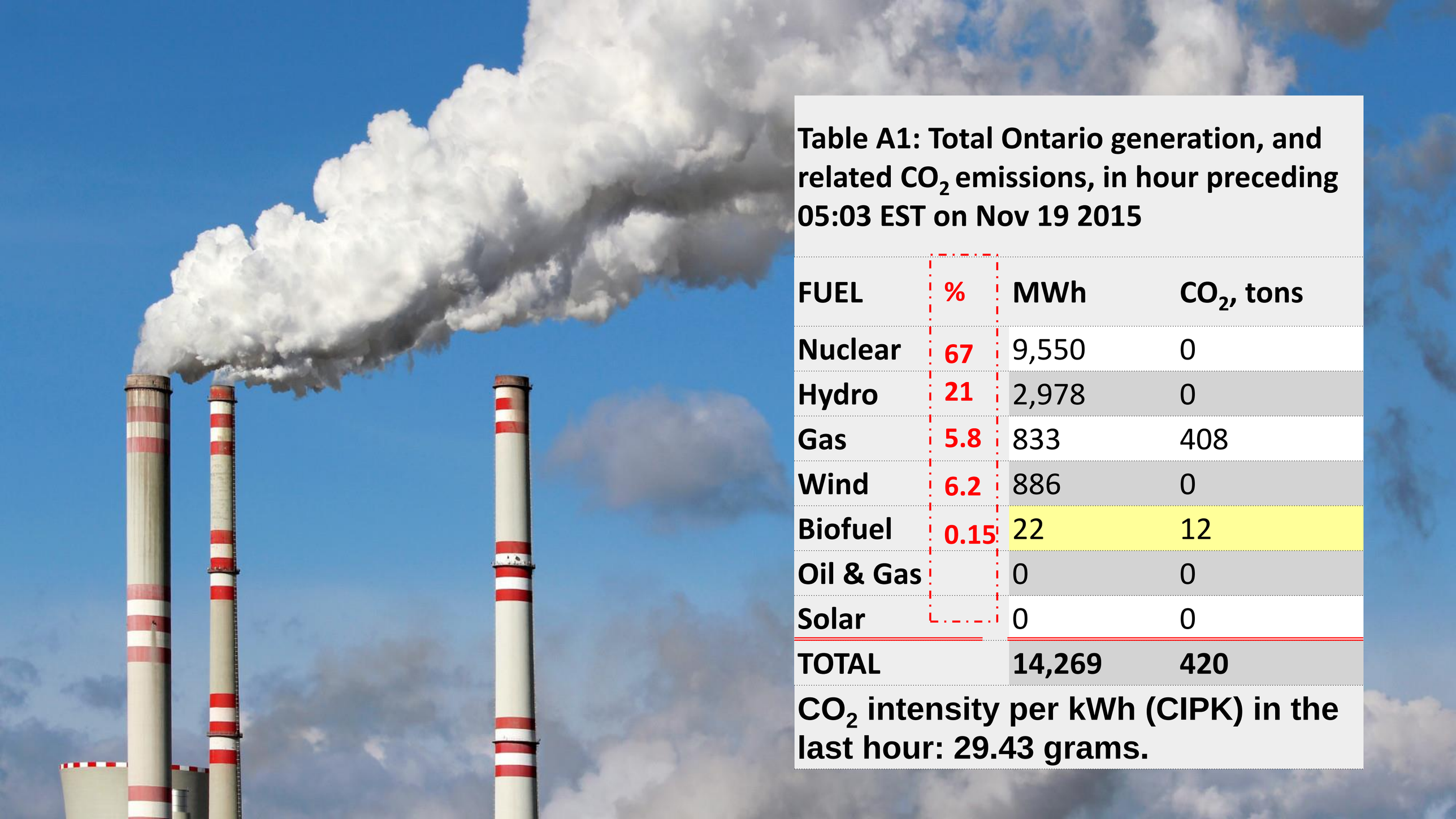
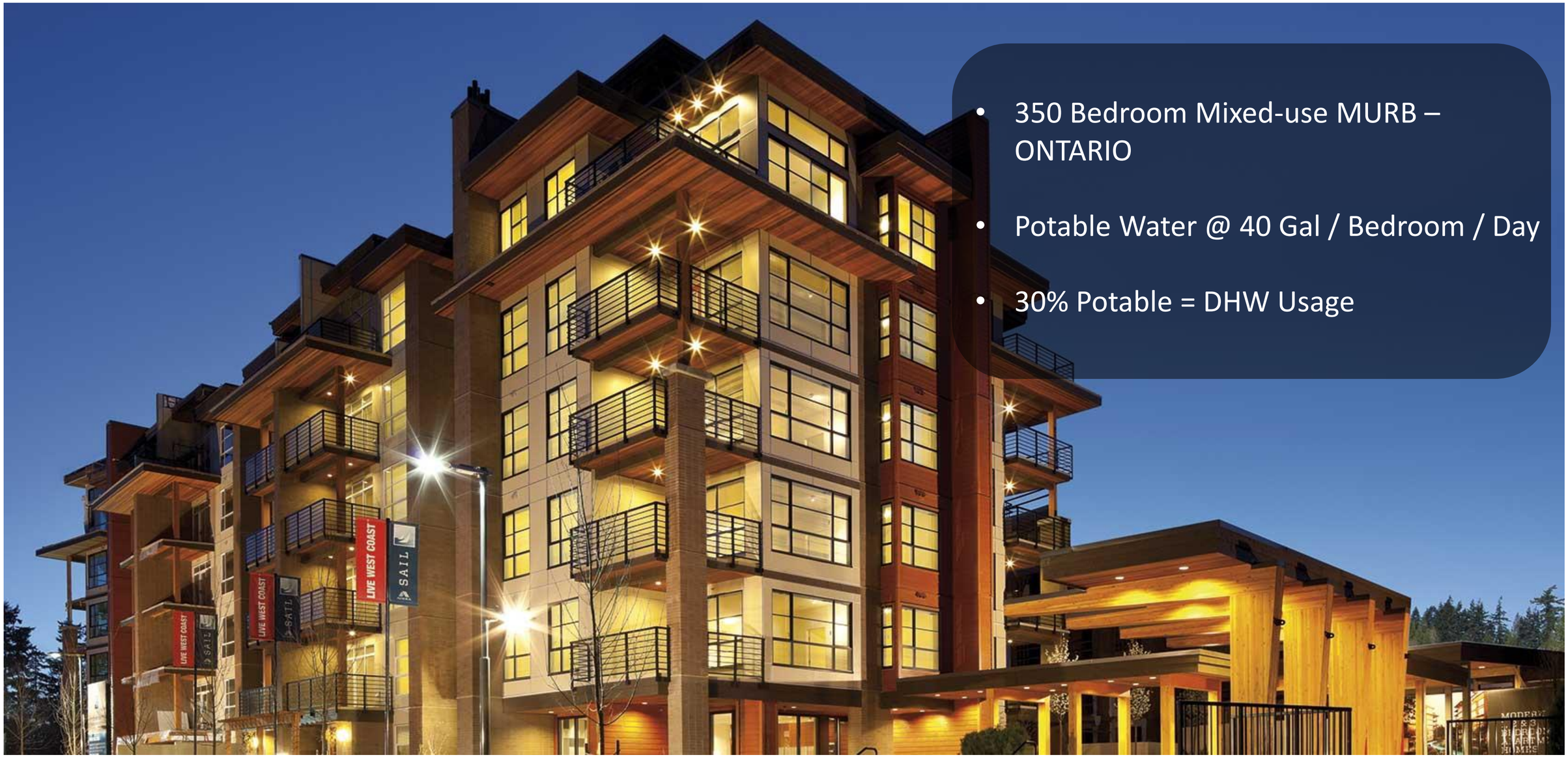


Table A1: Total Ontario generation, and related CO_2 emissions, in hour preceding 05:03 EST on Nov 19 2015

FUEL	%	MWh	CO_2, tons
Nuclear	67	9,550	0
Hydro	21	2,978	0
Gas	5.8	833	408
Wind	6.2	886	0
Biofuel	0.15	22	12
Oil & Gas		0	0
Solar		0	0
TOTAL		14,269	420

CO_2 intensity per kWh (CIPK) in the last hour: 29.43 grams.



- 350 Bedroom Mixed-use MURB – ONTARIO
- Potable Water @ 40 Gal / Bedroom / Day
- 30% Potable = DHW Usage

SCENARIO A

90% Eff Ngas DHW Plant

148,000 Lbs CO_2 = 100% Annual Load

SCENARIO B

Built-up SWEE

Hybrid 4.0 HCOP / 90% Eff Ngas DHW

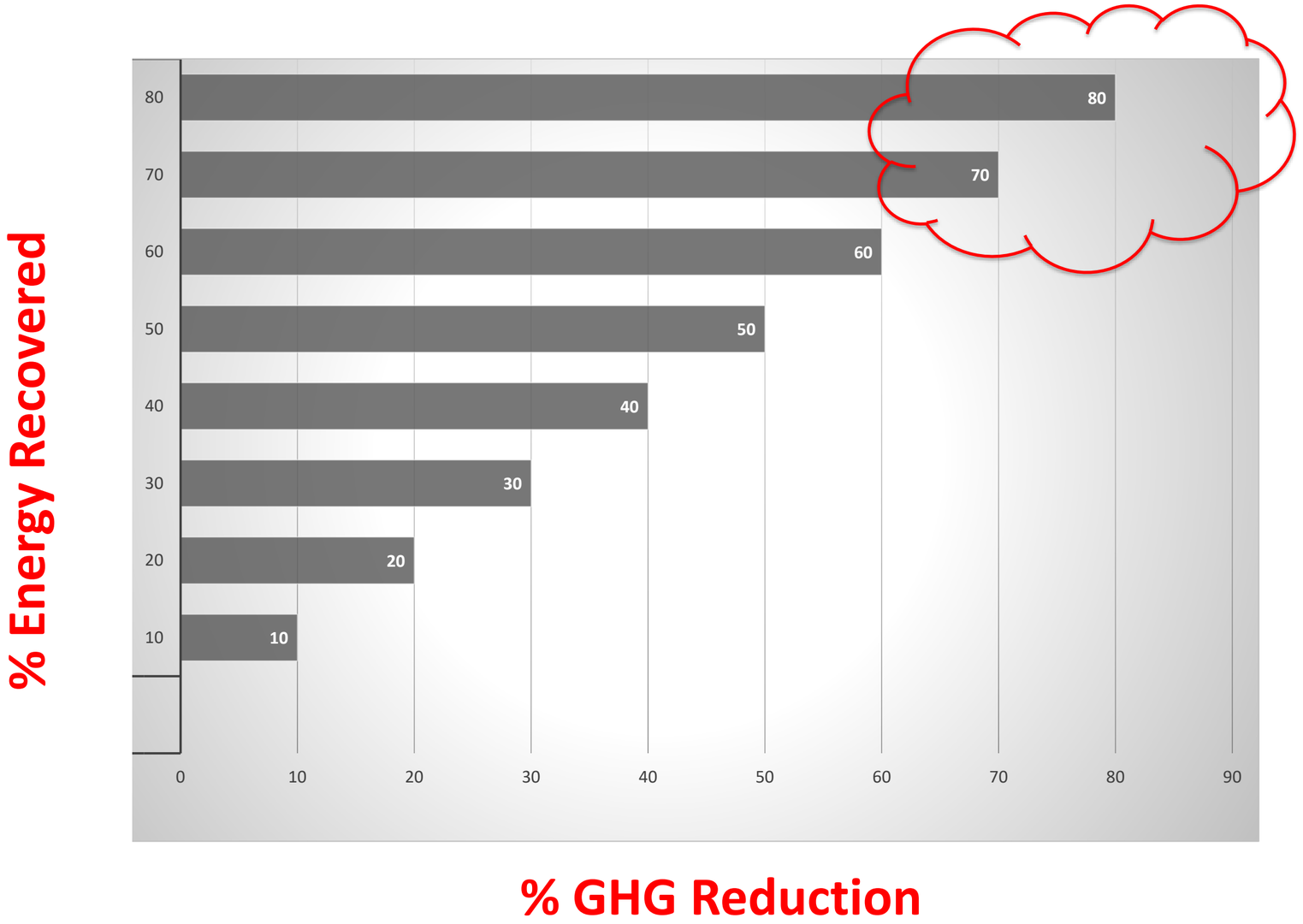
80 / 20 Load-share (HP / NGas)

34,000 Lbs CO2 = 100% Annual Load

B versus A

> 75% Reduction Lbs CO_2 Emissions

Why SWEE ?


% Energy Recovered
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80
90
% GHG Reduction

Why SWEE ?

Why SWEE ?

1) Potential for Energy Savings

- 15% to 30% of energy that goes into a building will leave down the drain

2) Solution to Green Building Culture & Carbon Reduction Initiatives

- Buildings account for 18% of global emissions today, equivalent of 9 billion tonnes of CO2 annually.

3) Water Savings

- Alternative to cooling towers

150,000,000,000 gallons /day

Water @ $1.50 / 1000 gallons

= $82 Billion Annually

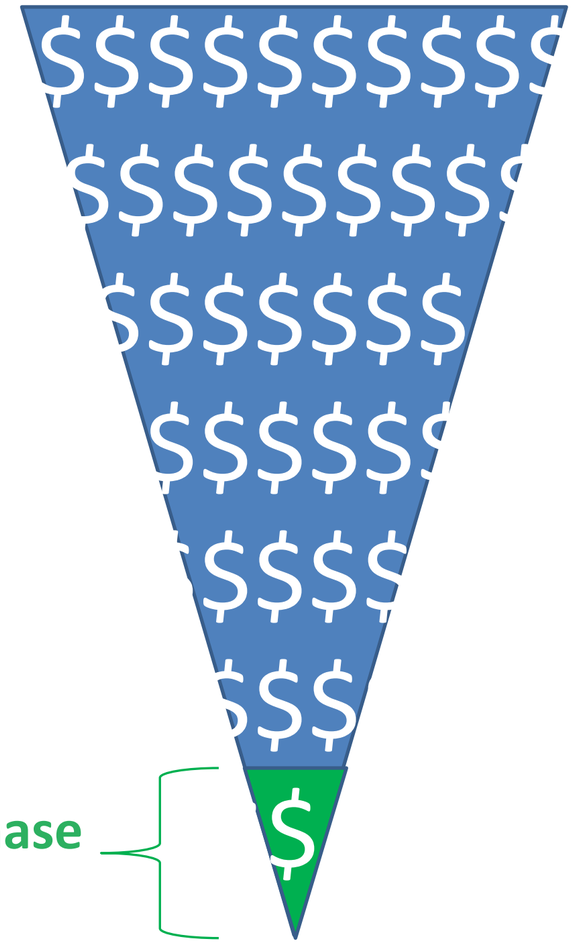
MUNICIPAL SEWAGE

AC Heat-Rejection

Eliminates Cooling Towers;

- ✓ Leverages previously used water
- ✓ Eliminates primary make-up water
- ✓ Eliminates evaporation plume
- ✓ Eliminates chemicals for water-treatment
- ✓ Eliminates mechanical fan energy
- ✓ Eliminates airborne radiated sound
- ✓ Reduces AC Energy Operating Costs
- ✓ Disease Mitigation - Legionella

Life-cycle Cost - Owning & Operating a Cooling Tower



Initial Purchase

Electricity

Make-up Water

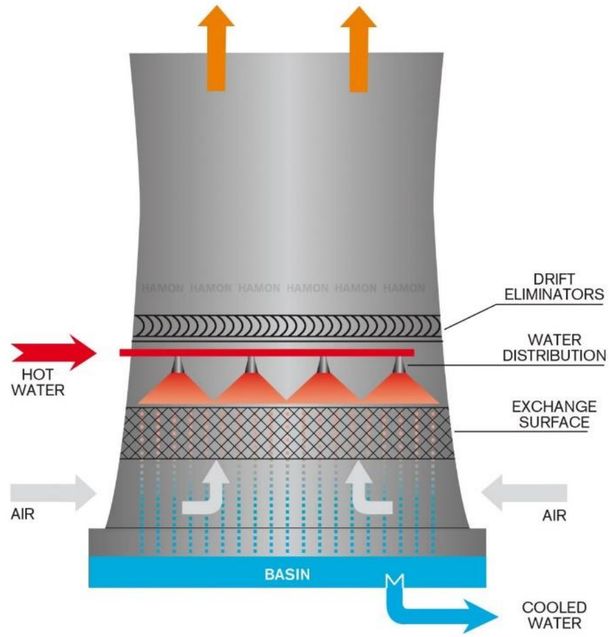
Chemicals

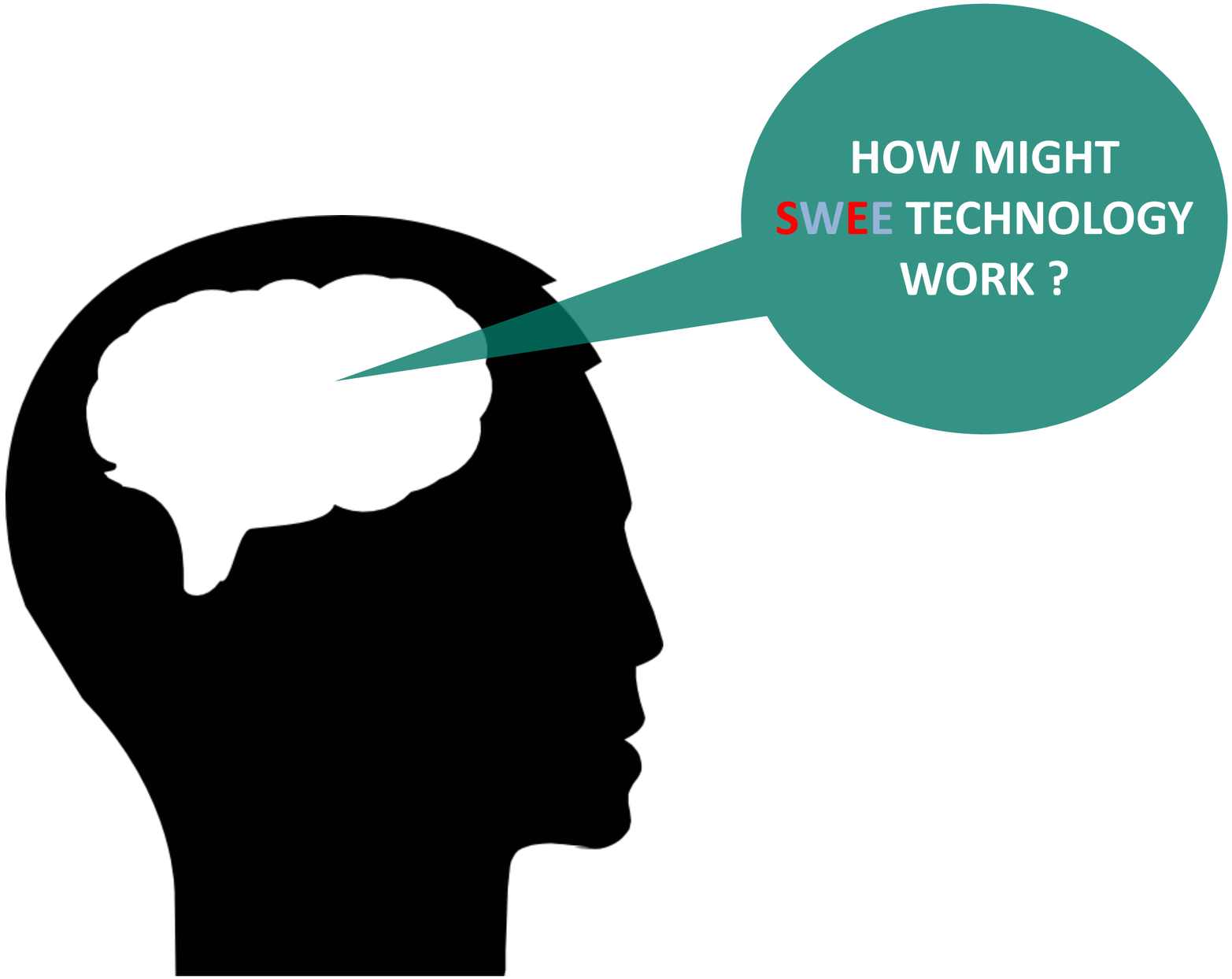
Maintenance

Repairs

Sound Abatement

Legionella




HOW MIGHT
SWEE TECHNOLOGY
WORK ?

Typical Potable Water Flow

Hot Water Usage

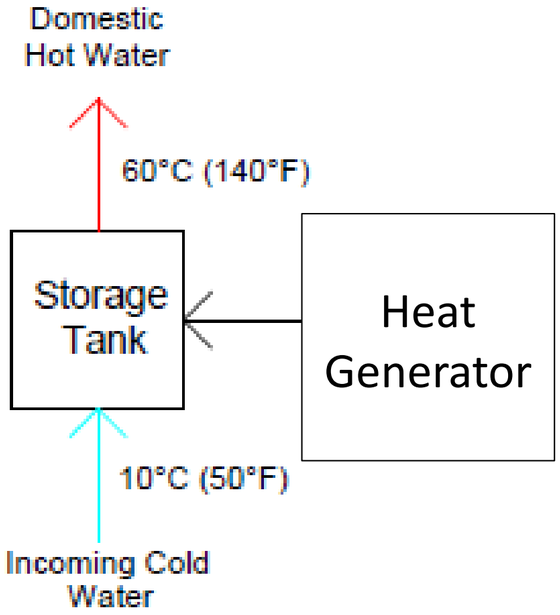
Sanitary Opportunity

- Condos & Apartments
- Commercial & Retail Buildings
- Schools
- Sport & Fitness Facilities
- Industrial Processes
- Aquatic Centers / Natatoriums
- Hospitals & Long-term Care
- University/College Campuses
- Prisons
- Industry

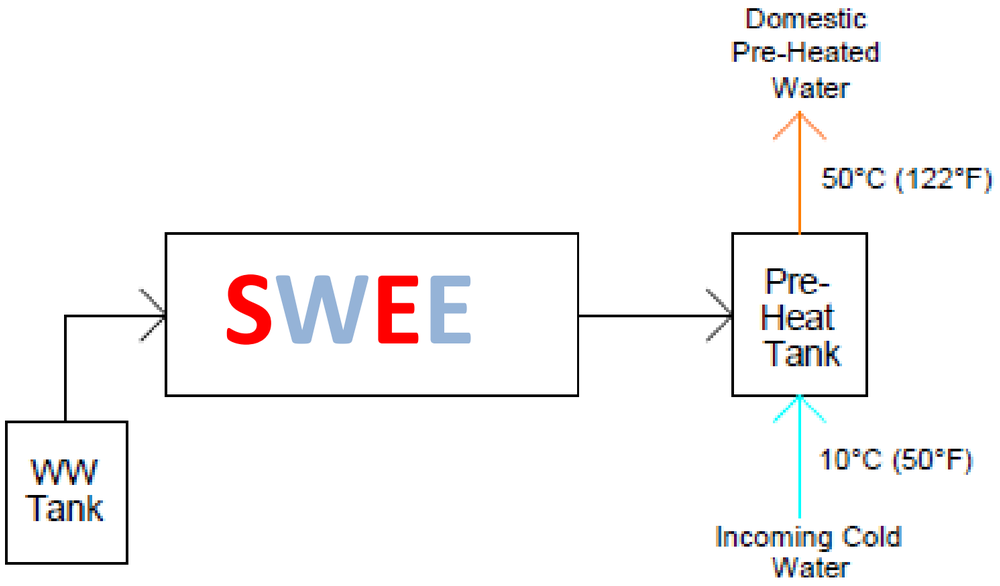
1) Hot Water Tank

Potable Water Supply

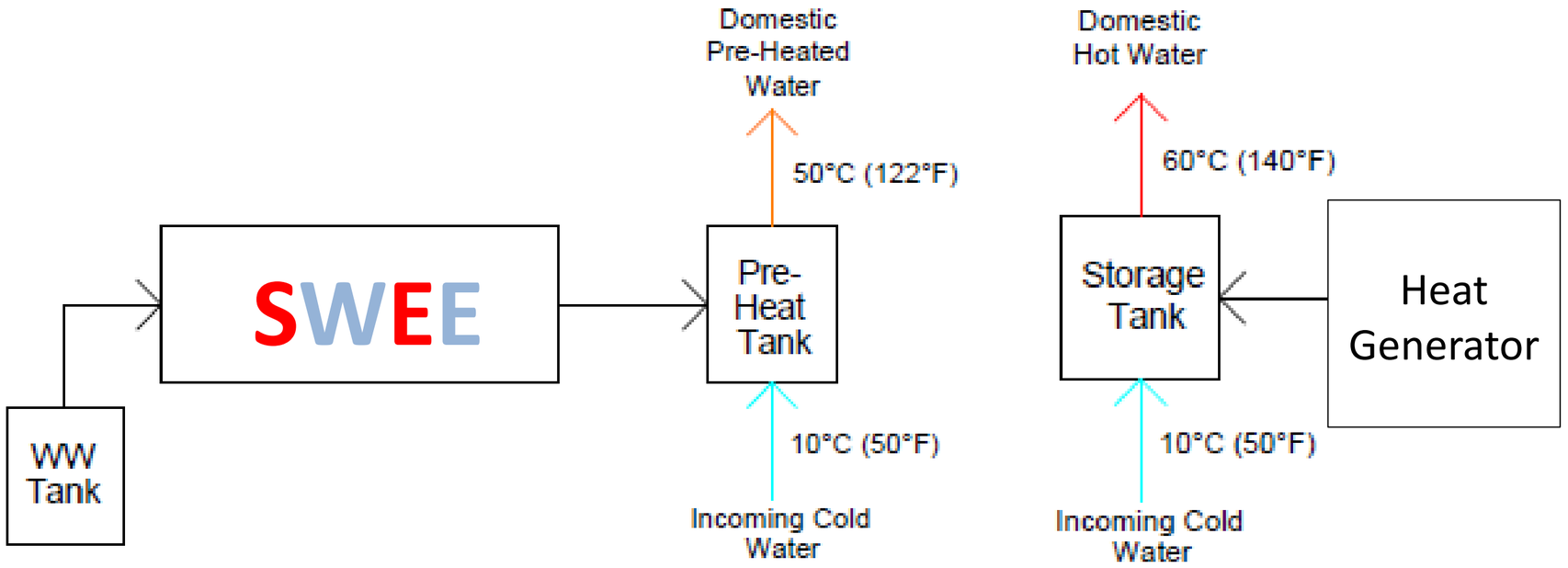
Building Integration - Standard Boiler System



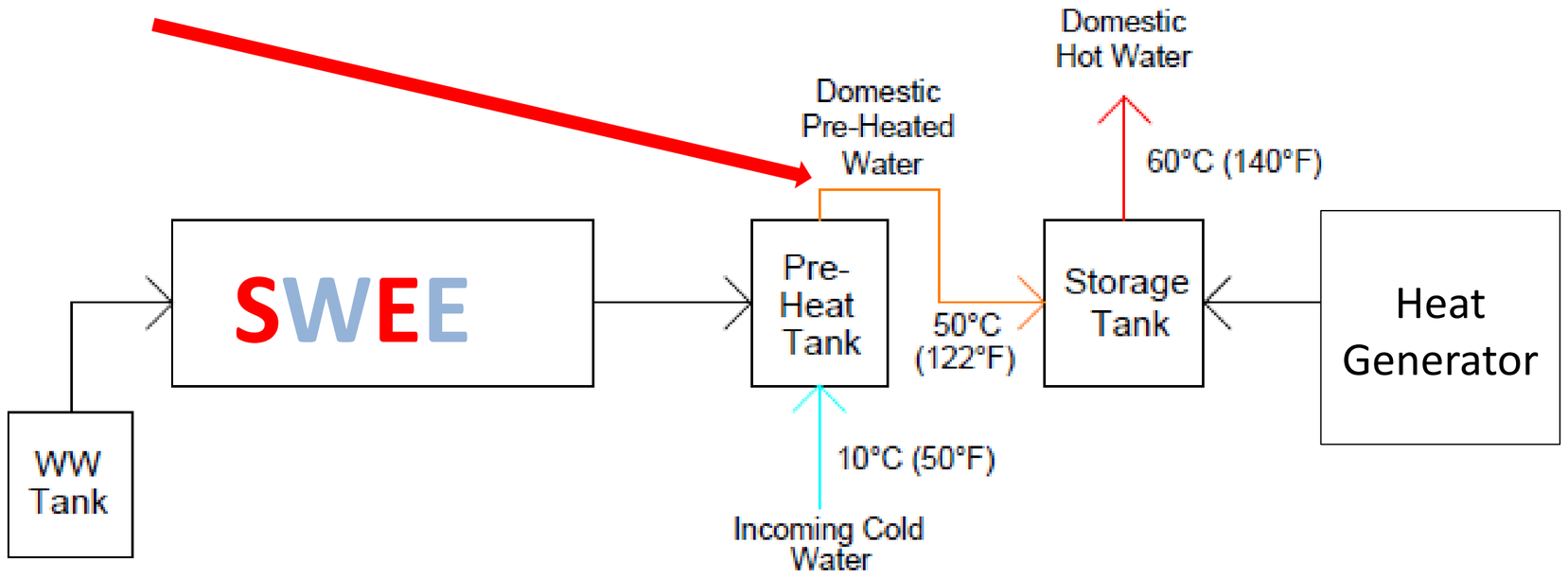
Building Integration – Standard Built-up or Self-contained Energy Exchange System

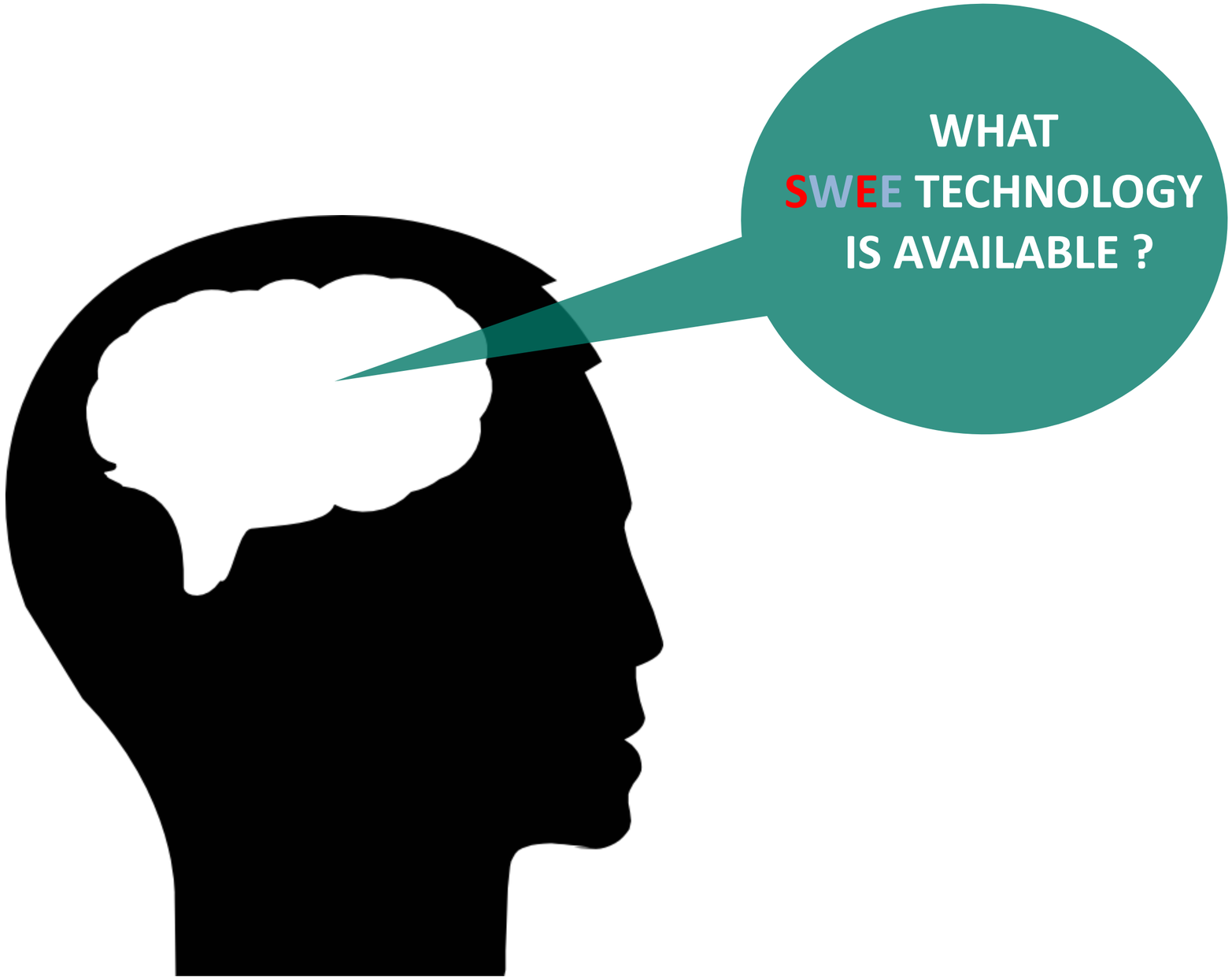


Building Integration – Adding Wastewater Heat Recovery



Building Integration – Integrated Wastewater Heat Recovery with Traditional Heating

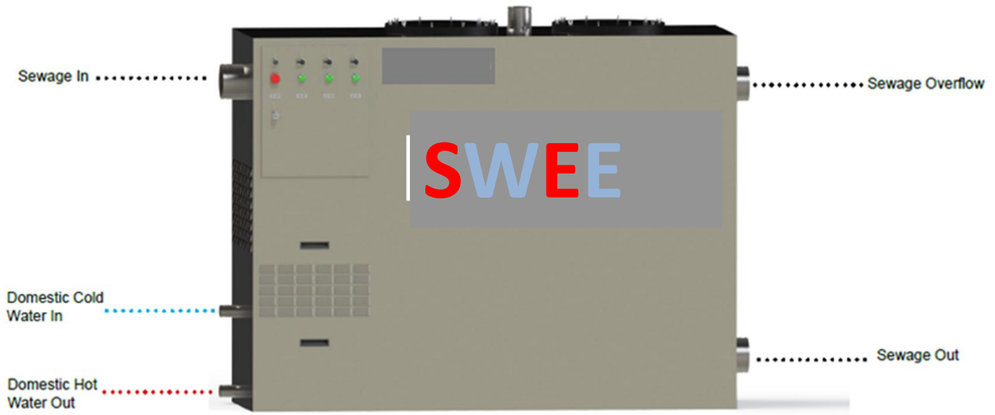



WHAT
SWEE TECHNOLOGY
IS AVAILABLE ?

CURRENT TECHNOLOGIES

Built-up Energy Exchange

Self-contained Energy Exchange



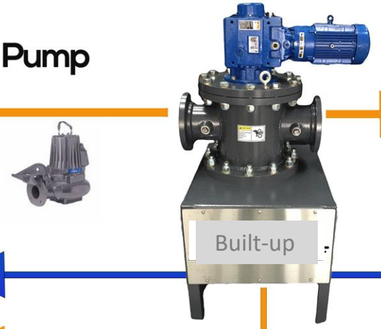
Built-up Energy Exchange

Hot Water Usage

Wastewater Storage

Heat Exchange

Pump



Solids Out

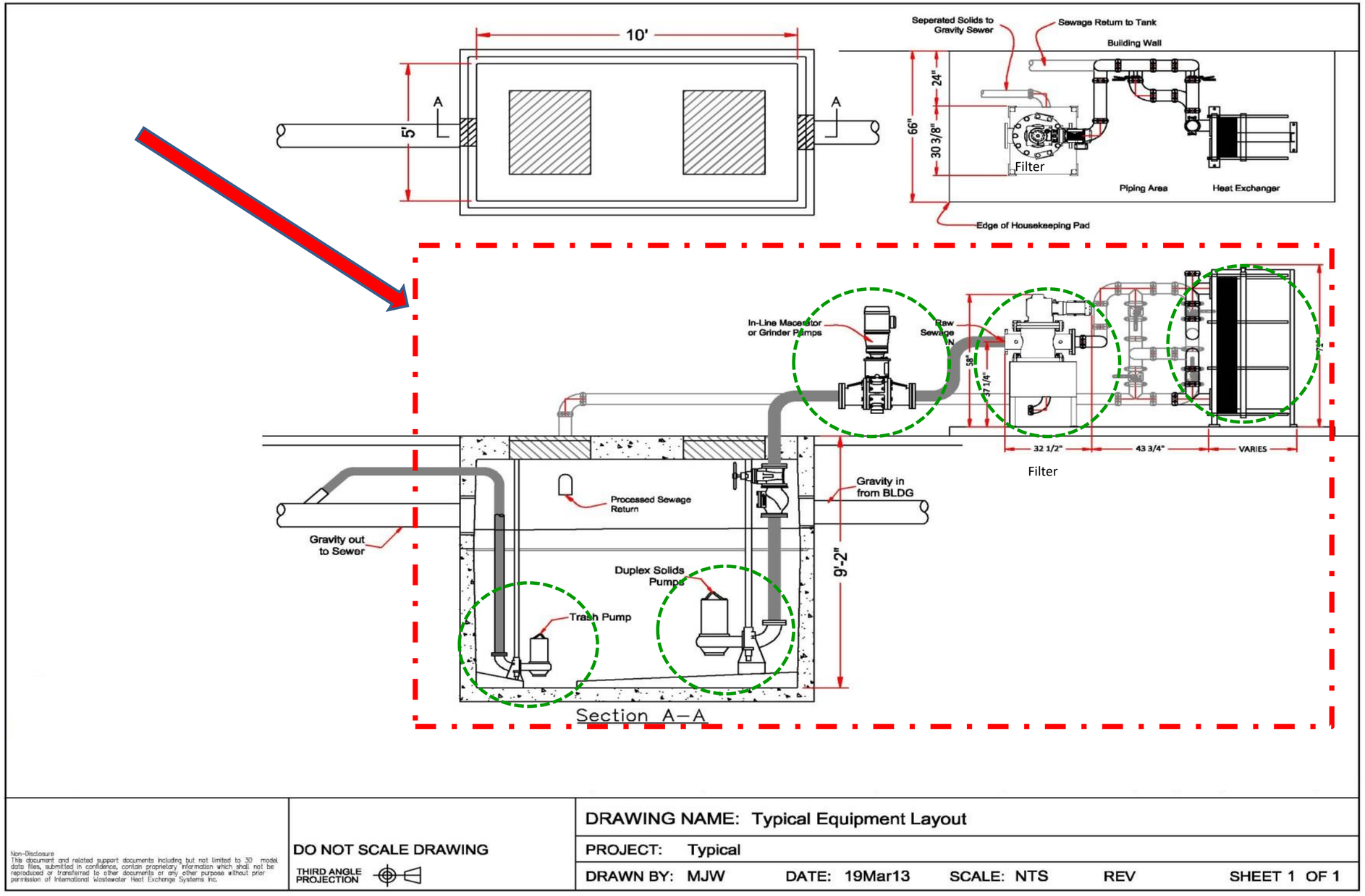
1) Hot Water Tank

2) Space Heating and Cooling

3) District Energy

Heat Pump (Optional)

Potable Water Supply



DO NOT SCALE DRAWING

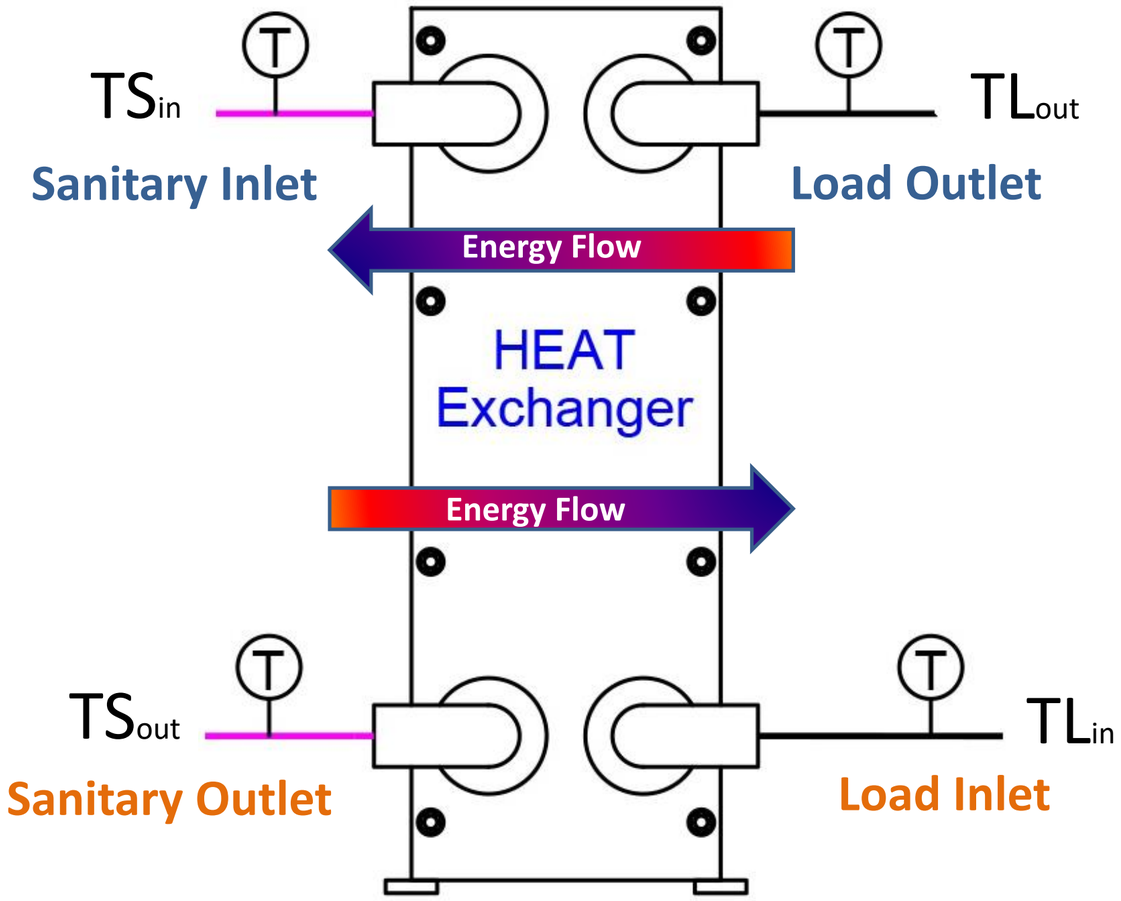
THIRD ANGLE PROJECTION

DRAWING NAME: Typical Equipment Layout

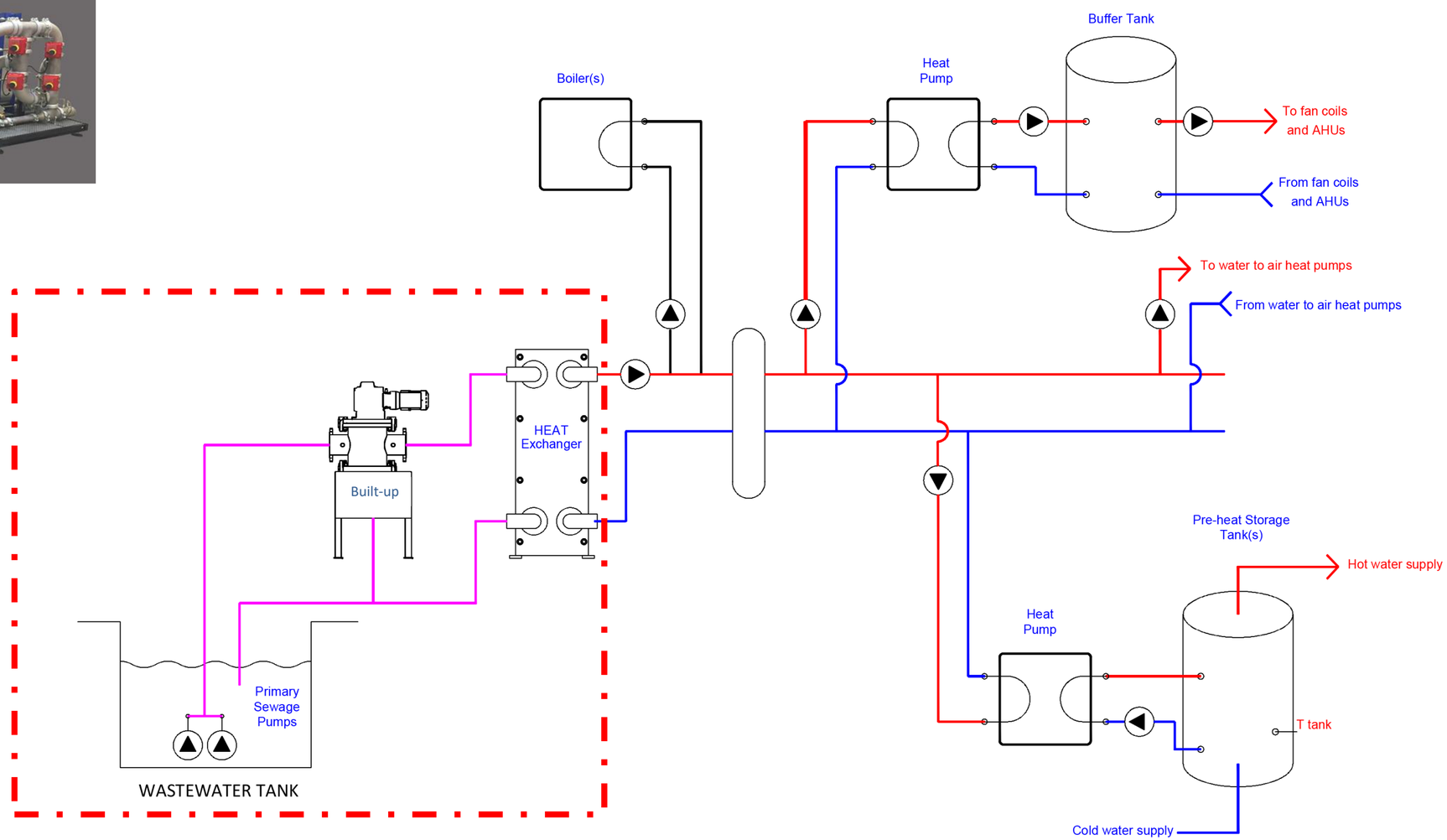
PROJECT: Typical

DRAWN BY: MJW DATE: 19Mar13 SCALE: NTS REV SHEET 1 OF 1

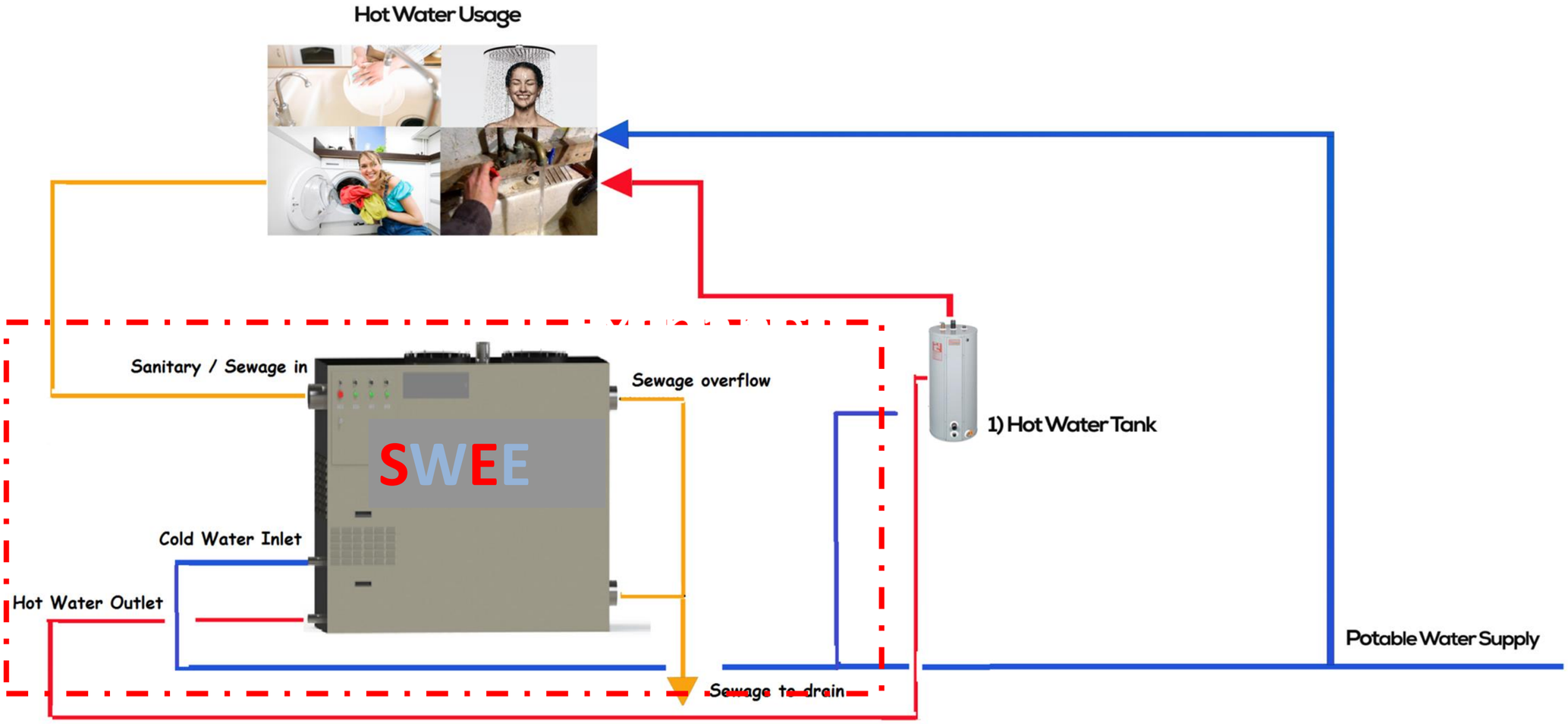
HEAT EXCHANGER



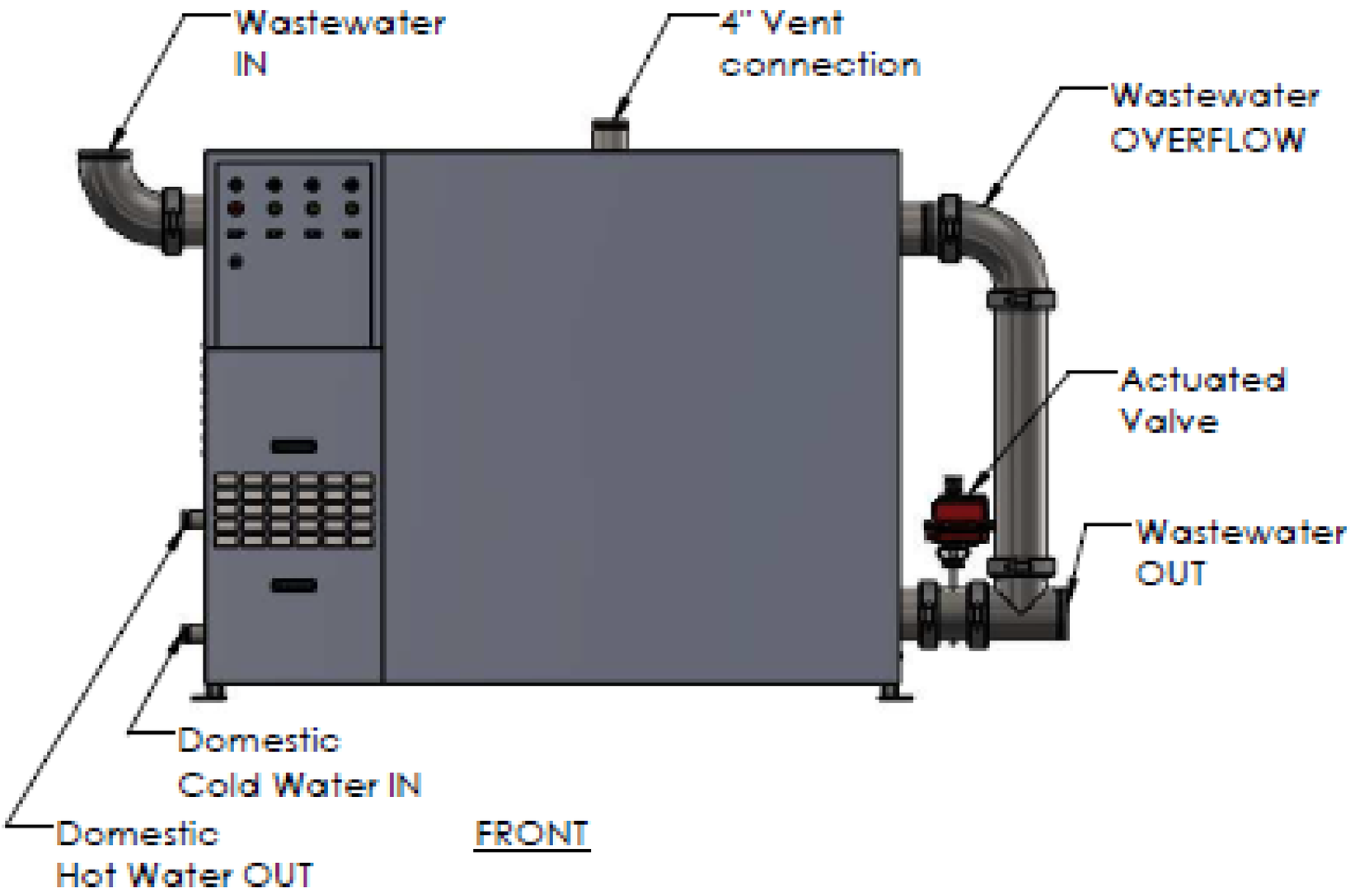
SPACE CONDITIONING & DHW HEATING



Self-contained Energy Exchange

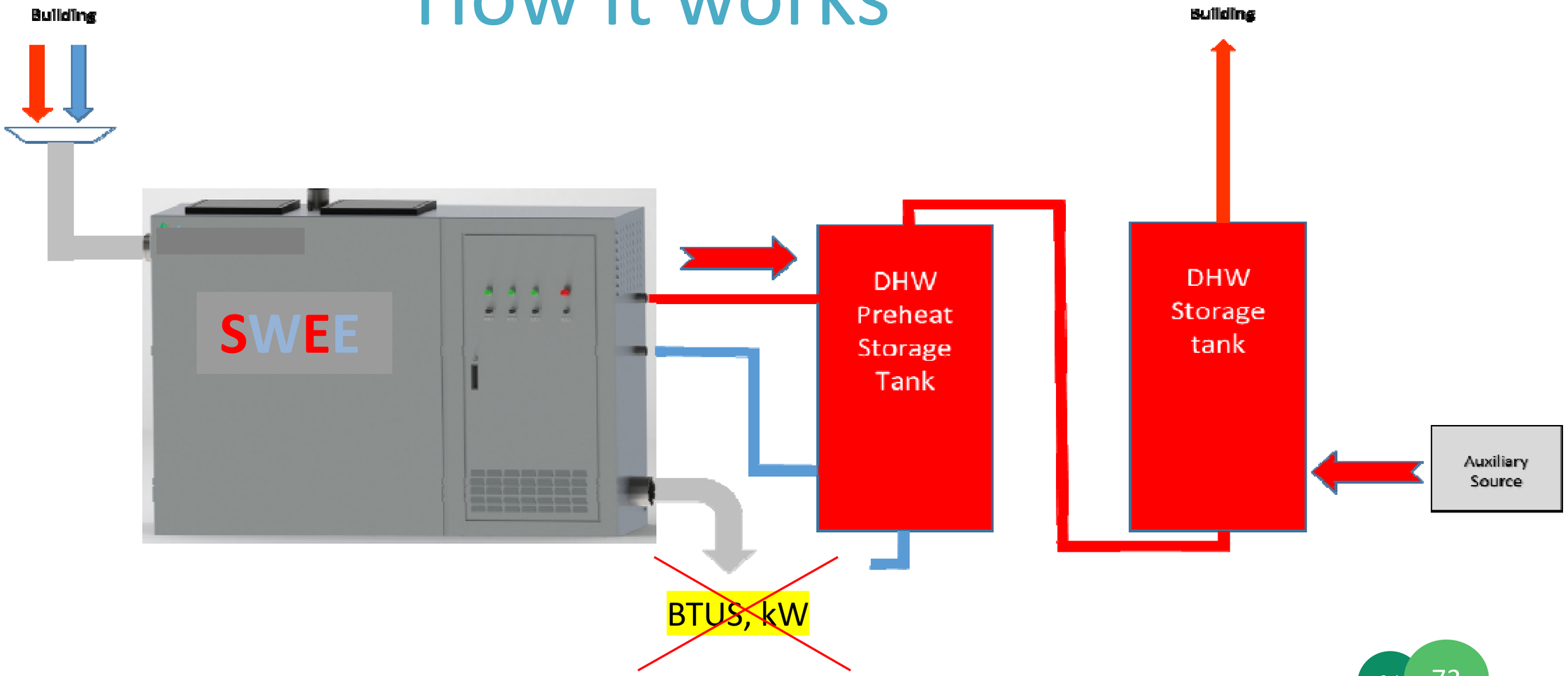


Self-contained Energy Exchange



Self-contained Energy Exchange

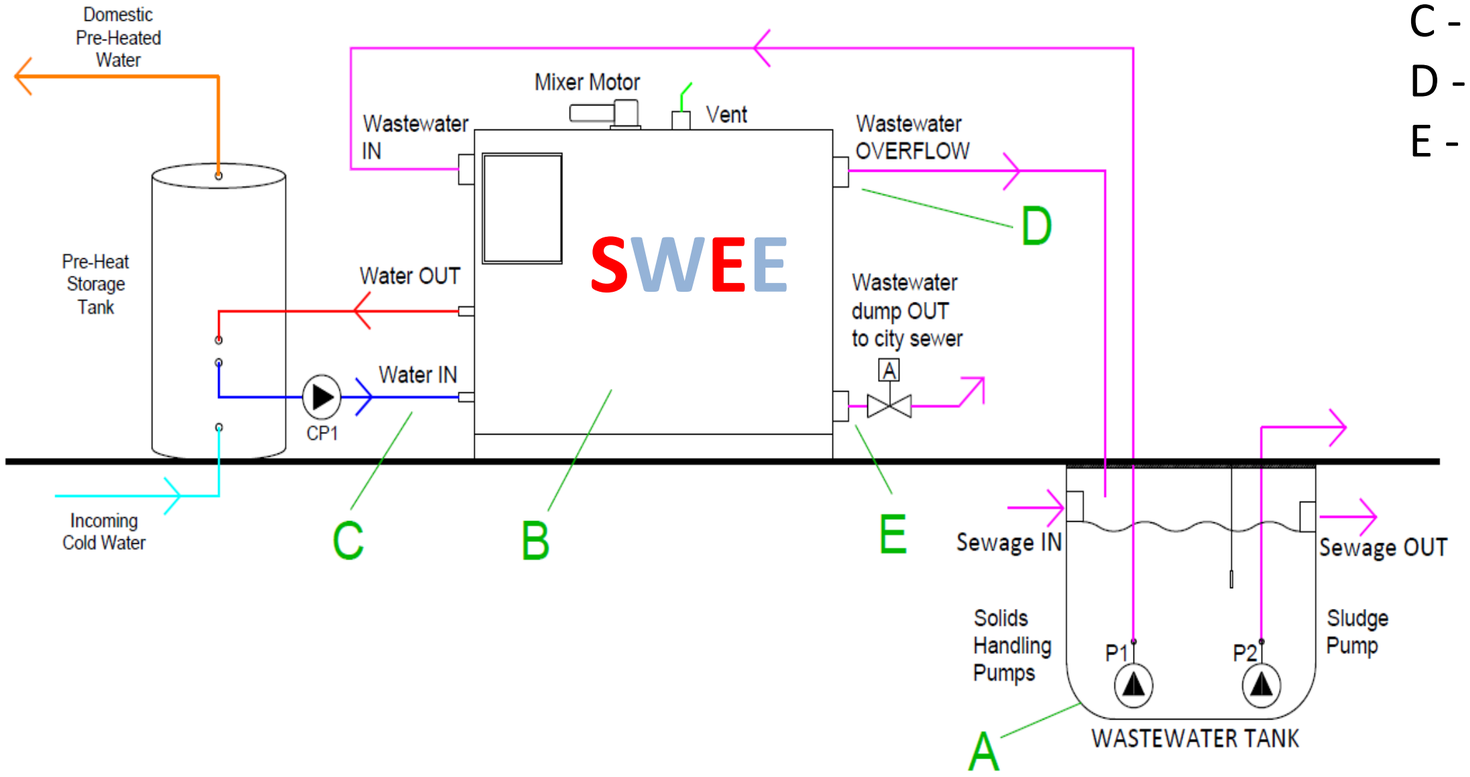
How it works



OPPORTUNITY

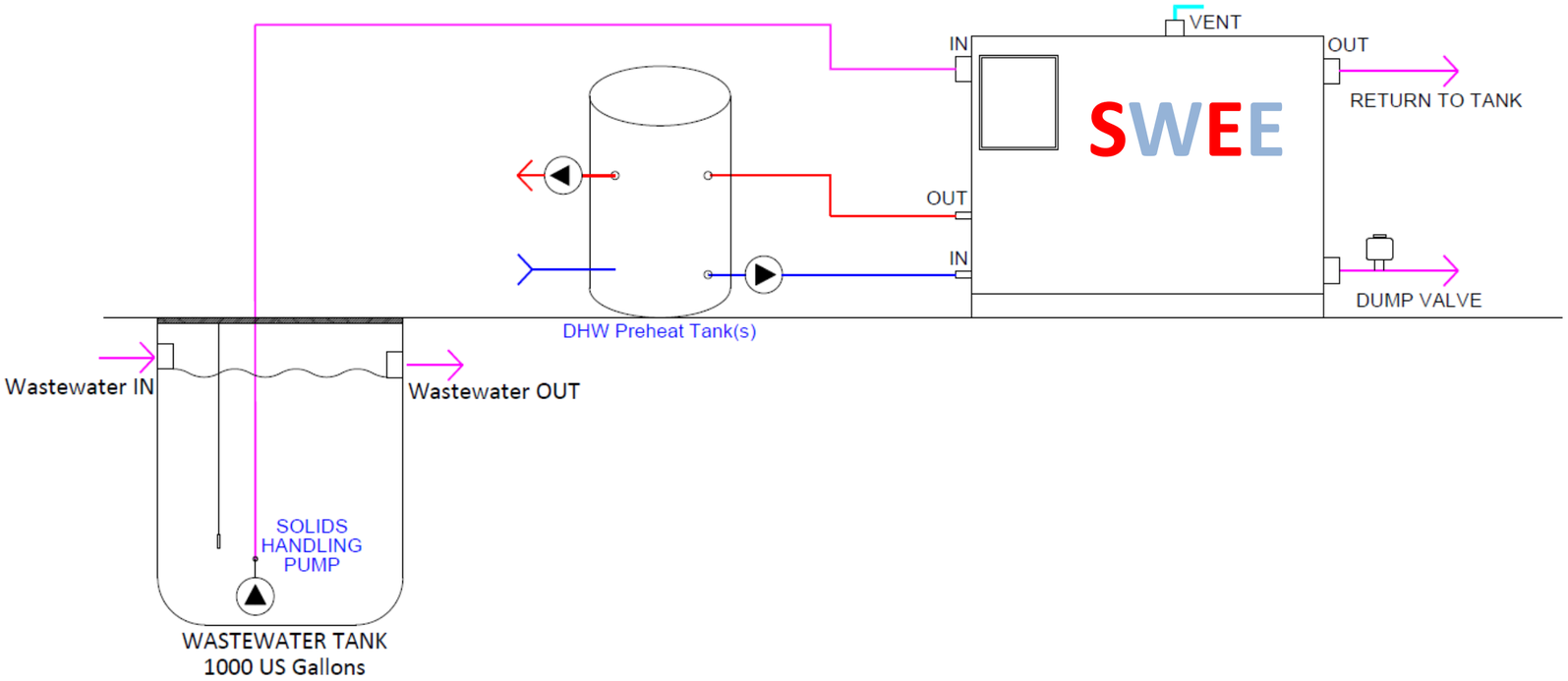
Deployment of Built-up / Self-contained Energy Exchange

Typical Self-contained Installation:

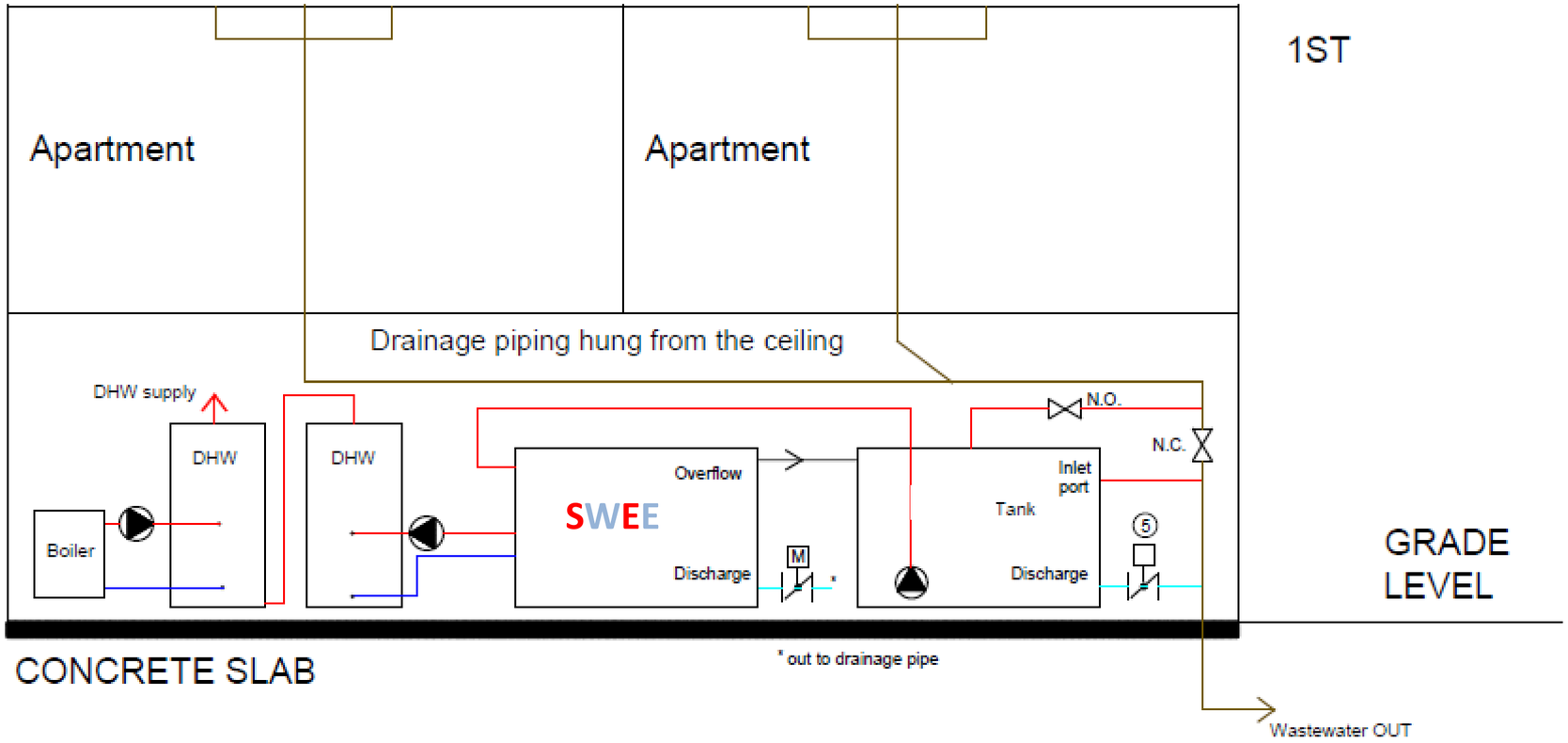


A - Holding tank
B – SWEE unit
C - Domestic water line
D - Overflow line
E - Drain line

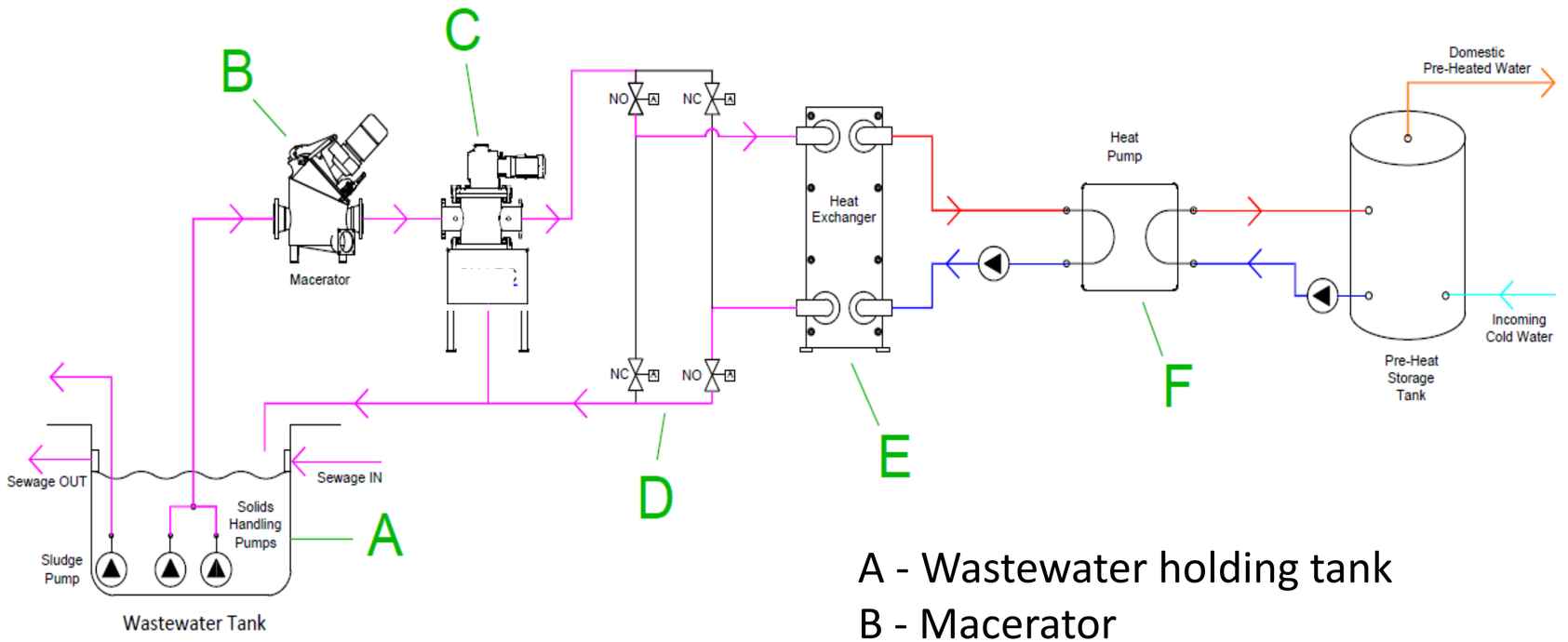
Below-Ground Tank:



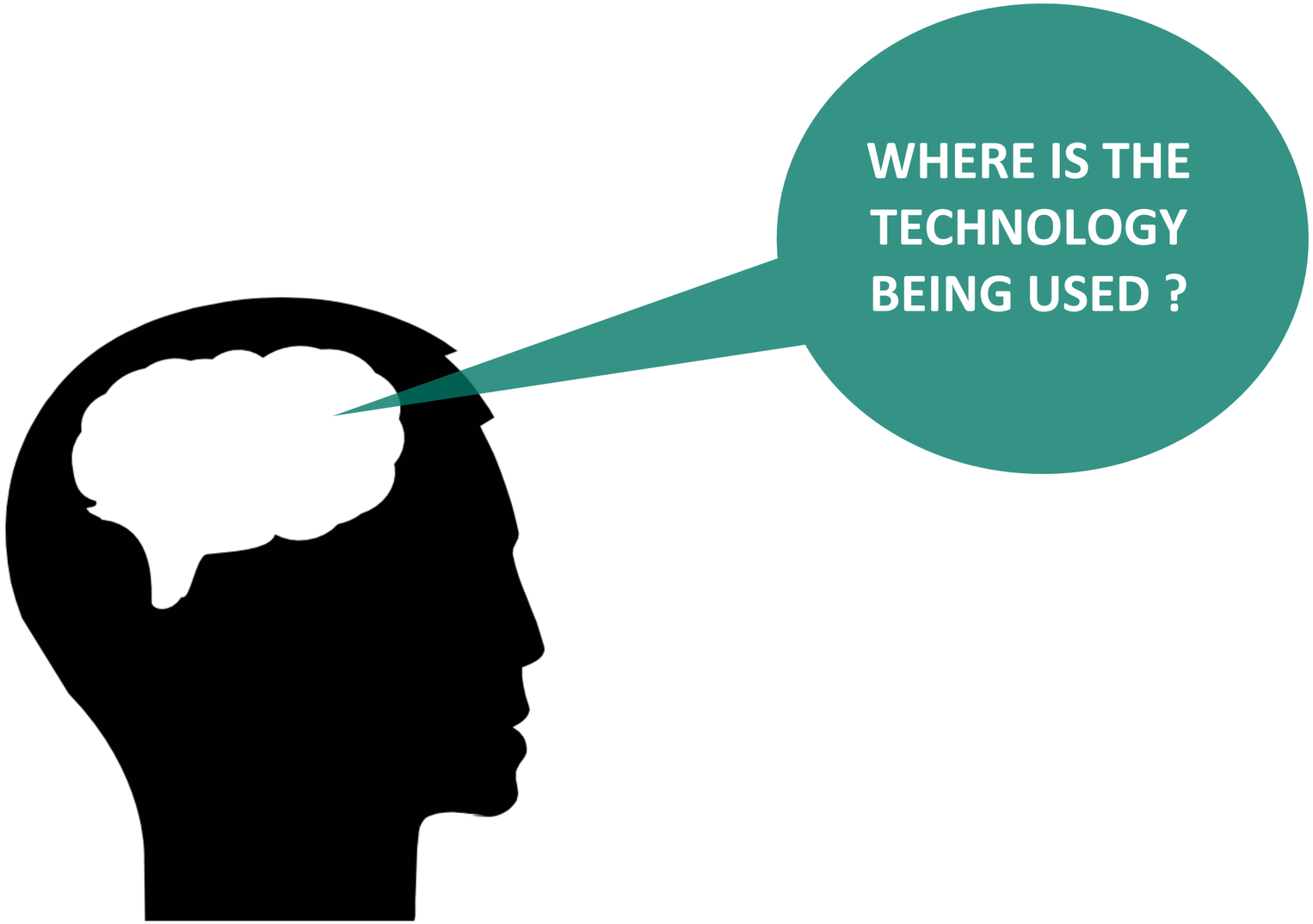
Above-Ground Tank:



Typical Built-up Installation:



A - Wastewater holding tank
B - Macerator
C – Sewage separator filter unit
D - Reversing valve tree
E - Heat exchanger
F - Heat pump


WHERE IS THE TECHNOLOGY BEING USED ?

False Creek Energy Centre

Vancouver, BC

- 1st large-scale wastewater heat recovery system in North America
- Operational since 2010
- $42 M publically funded project
- In 2018 Serves 483,100 m^2 (5,200,000 ft^2) of residential, commercial, and institutional space
- By 2028 will serve 1,858,100 m^2 (20,000,000 ft^2) of residential, commercial, and institutional space

Alexandra District Energy Utility
Richmond B.C.

Advantages to District Energy

Low-carbon, Sustainable Energy- Multiple buildings connected to more sustainable sources

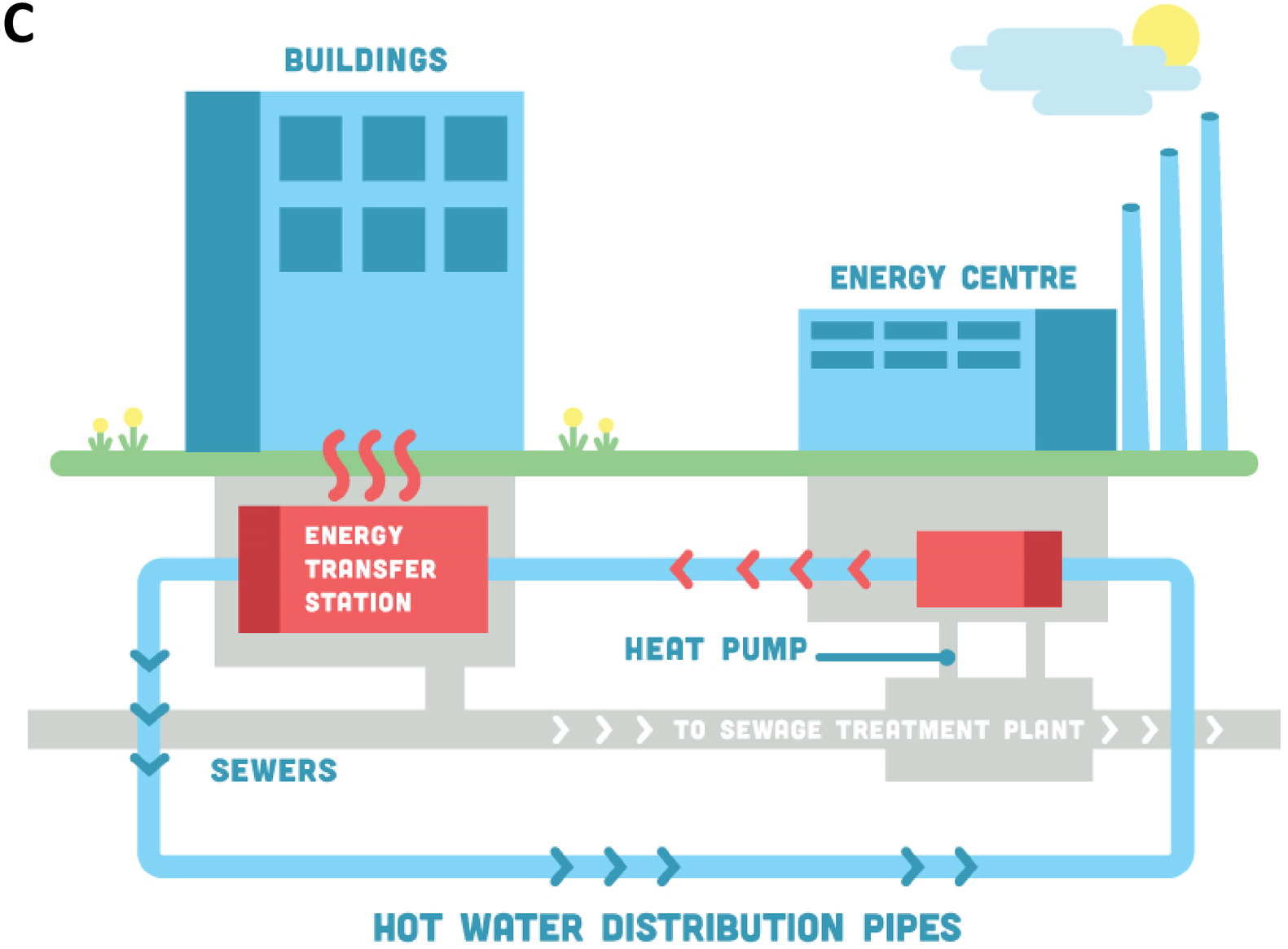
Affordable Energy – More stable and cost competitive prices

Fuel Flexibility –It's possible to switch to different fuel systems, and take advantage of future innovation

Decreased Building Costs – Less HVAC equipment for each building and more usable space

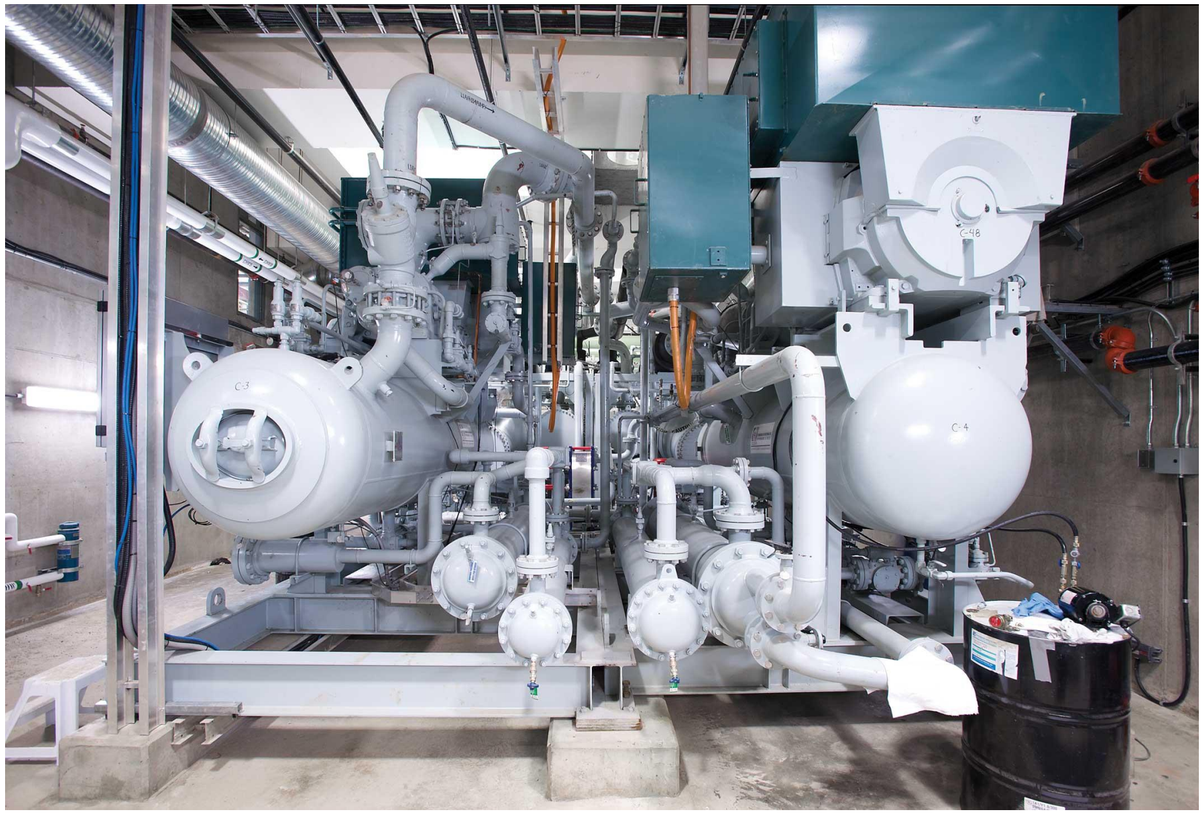
False Creek Energy Centre

Vancouver, BC



False Creek Energy Centre

Vancouver, BC



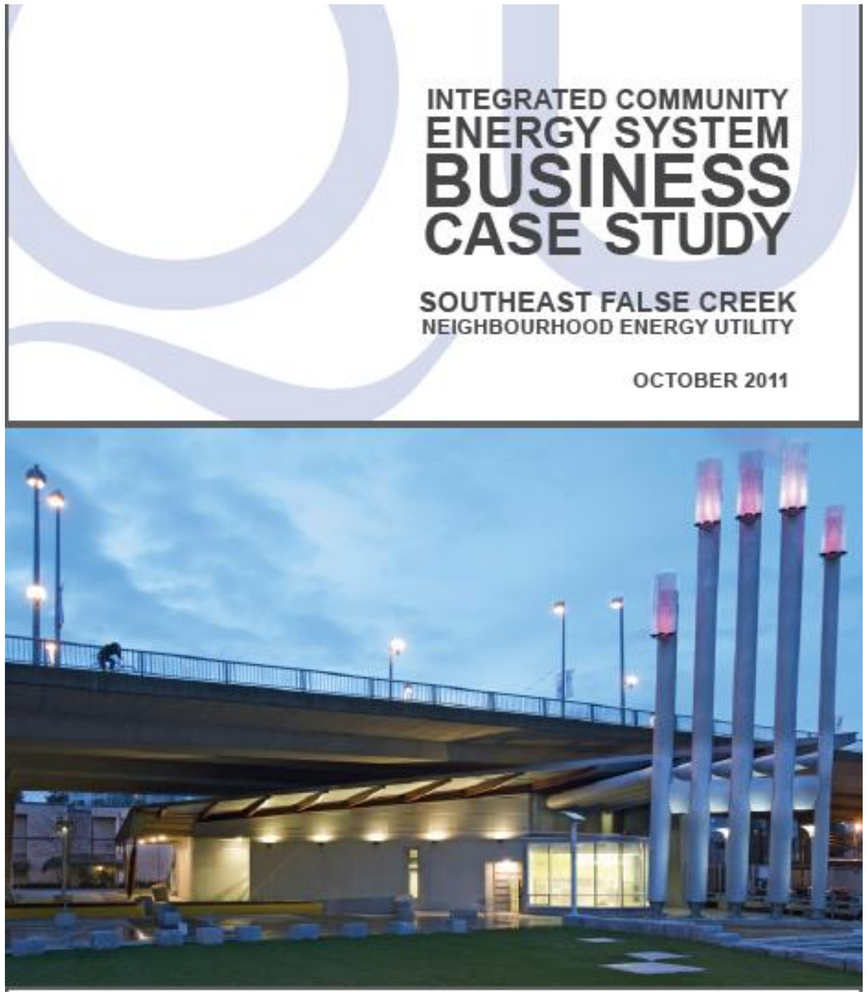
False Creek Energy Centre

Vancouver, BC

- 3500 tonnes CO_2 saved – 2017
  equivalent to ~ 100 cars off the road
- 46,000 mwh produced – 2017
- 32 additional buildings added – 2017
- 6 kM underground piping – 2017
- ~ 4700 residential units added - 2017

False Creek Energy Centre

Vancouver, BC

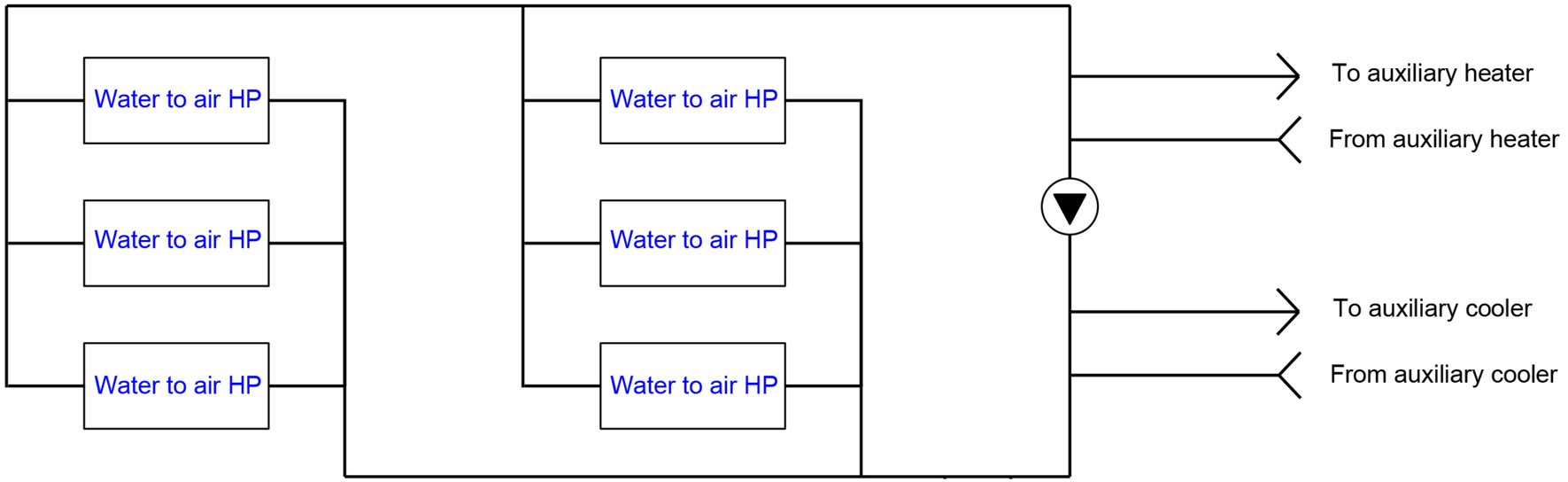


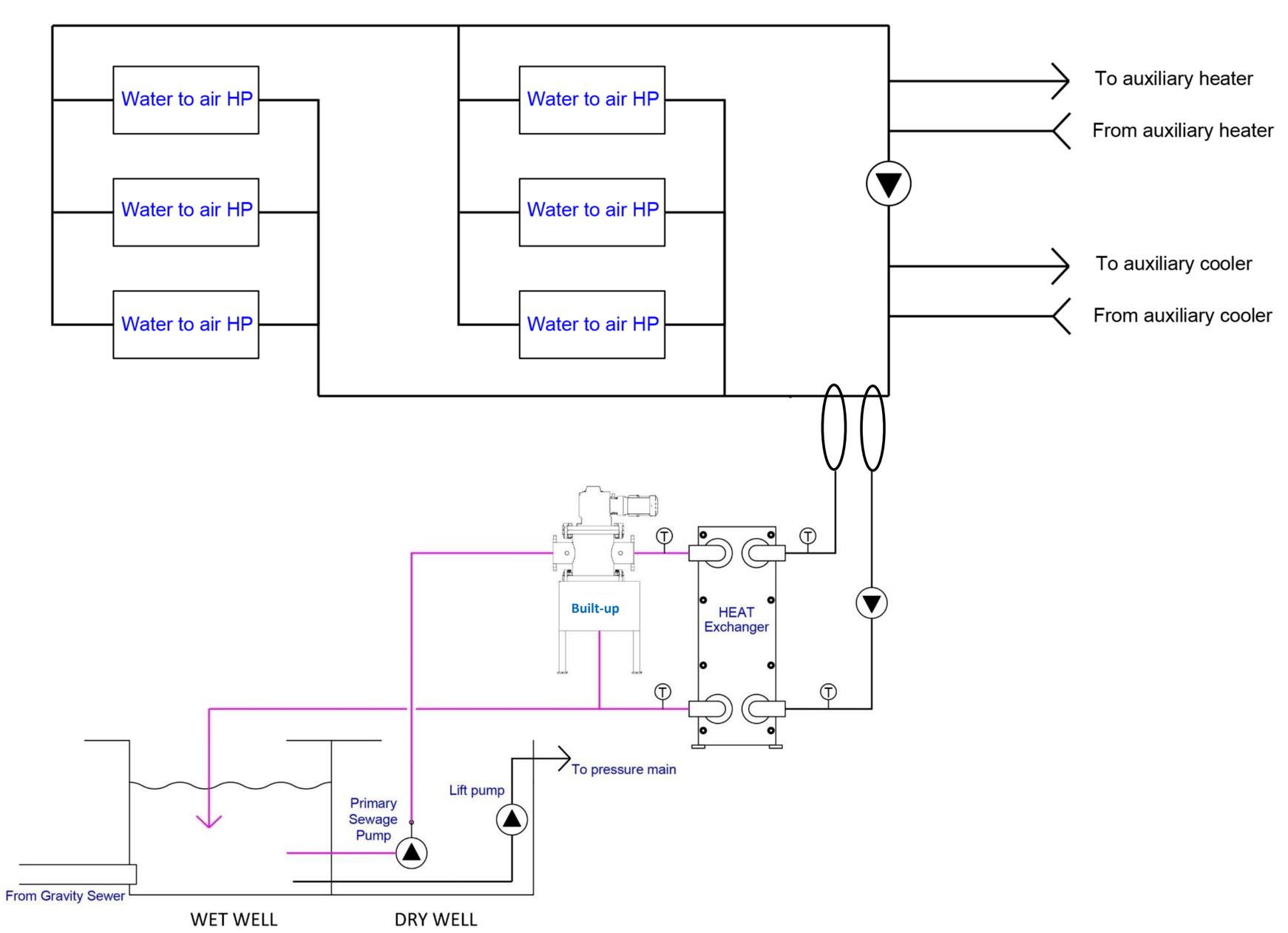
https://www.sauder.ubc.ca/Faculty/Research_Centres/Centre_for_Social_Innovation_and_Impact_Investing/Core_Themes/Low_Carbon_Economy/~/media/Files/ISIS/Reports/Carbon%20Management%20Reports/QUEST-ICES-Business-Case-Southeast-False-Creek-Neighbourhood-Energy-Utility.ashx

Gateway Theatre Richmond, BC

- 50,000 sq ft public theatre owned by the City of Richmond
- Built in 1984, an ideal candidate for significant energy retrofit projects (existing water source heat pump heating system with natural gas boiler and cooling tower)
- Theatre is built adjacent to an existing city sanitary lift station


AERCO
Built-up


Water to air HP
Water to air HP
Water to air HP
Water to air HP
Water to air HP
Water to air HP
To auxiliary heater
From auxiliary heater
To auxiliary cooler
From auxiliary cooler


Water to air HP
Water to air HP
Water to air HP
Water to air HP
Water to air HP
Water to air HP
To auxiliary heater
From auxiliary heater
To auxiliary cooler
From auxiliary cooler
Built-up
HEAT Exchanger
To pressure main
Lift pump
Primary Sewage Pump
From Gravity Sewer
WET WELL
DRY WELL

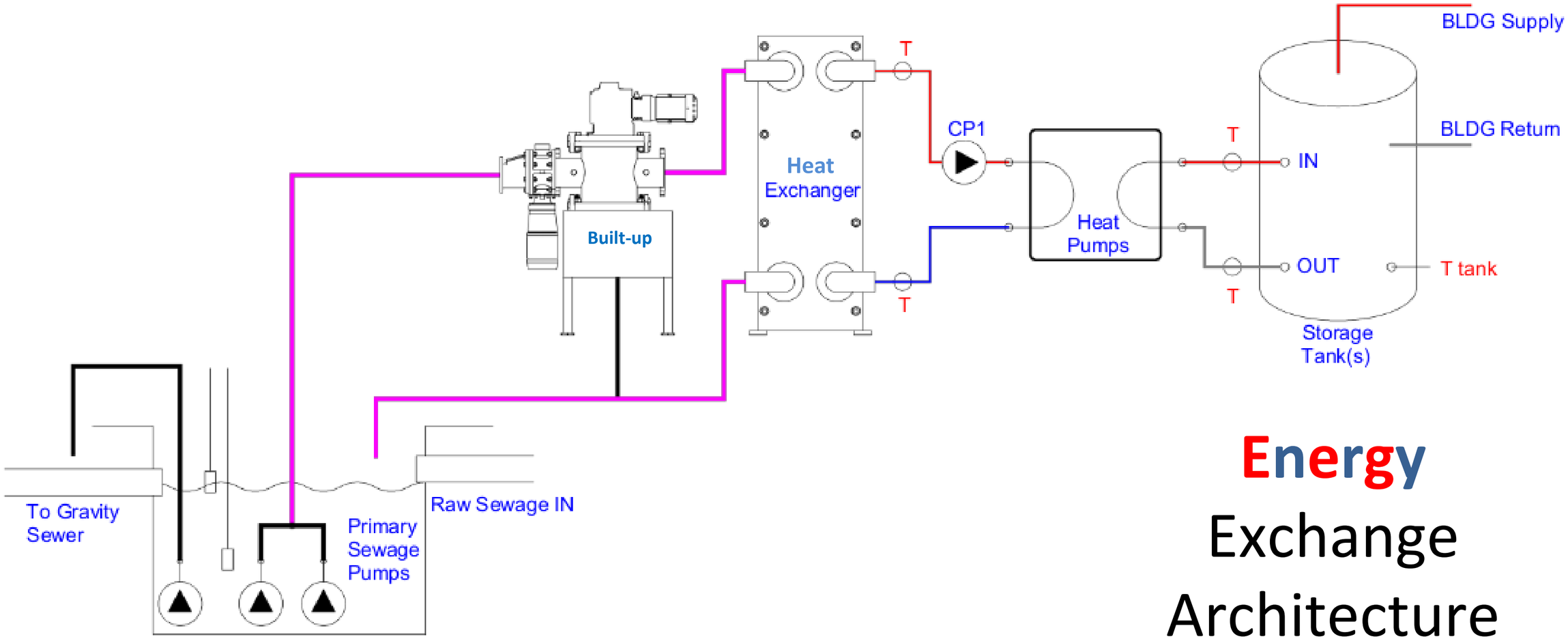
seven35

North Vancouver, BC

- Canada's first multi-family project built to LEED® Platinum and Built Green Gold Standards
- In operation since 2012
- Sewage heat exchange used for domestic hot water heating

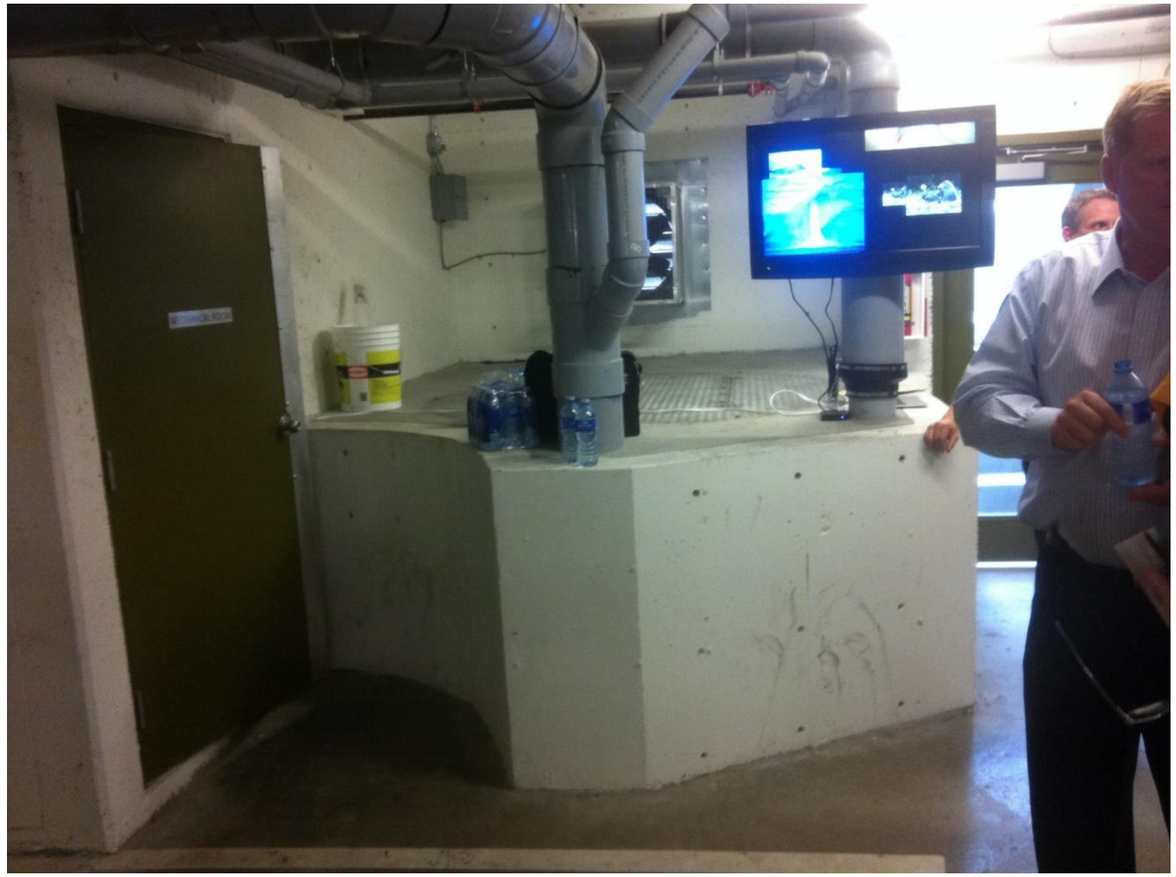
seven35

North Vancouver, BC



Energy
Exchange
Architecture

seven35 - 2012 Original Installation



Independent Owner Validation

- **75% Energy Reduction vs Ngas**
- **Offline Sanitary Energy Exchange System**
- **Primary DHW Heating system – Ngas Back-up**

September 20, 2012
File: 112520999

Attention: Richard Madden
Adera Development Corporation
2200 - 1055 Dunsmuir Street
Vancouver BC
V7X 1K8
Canada

Reference: Seven35 – Waste Water Heat Recovery

Dear Richard Madden,

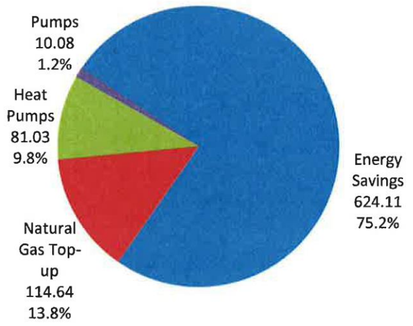
The purpose of this letter in to confirm that a waste water heat recovery system has been installed in the Seven35 development and that the system is capable of reducing domestic water heating energy use by a minimum of 75%.

The system utilizes water-to-water heat pumps to extract heat from waste water leaving the site. The water-to-water heat pumps preheat incoming domestic hot water to 52°C. Preheated water then flows to the main domestic hot water tanks where 90% efficient natural gas boilers complete the heating to 57°C.

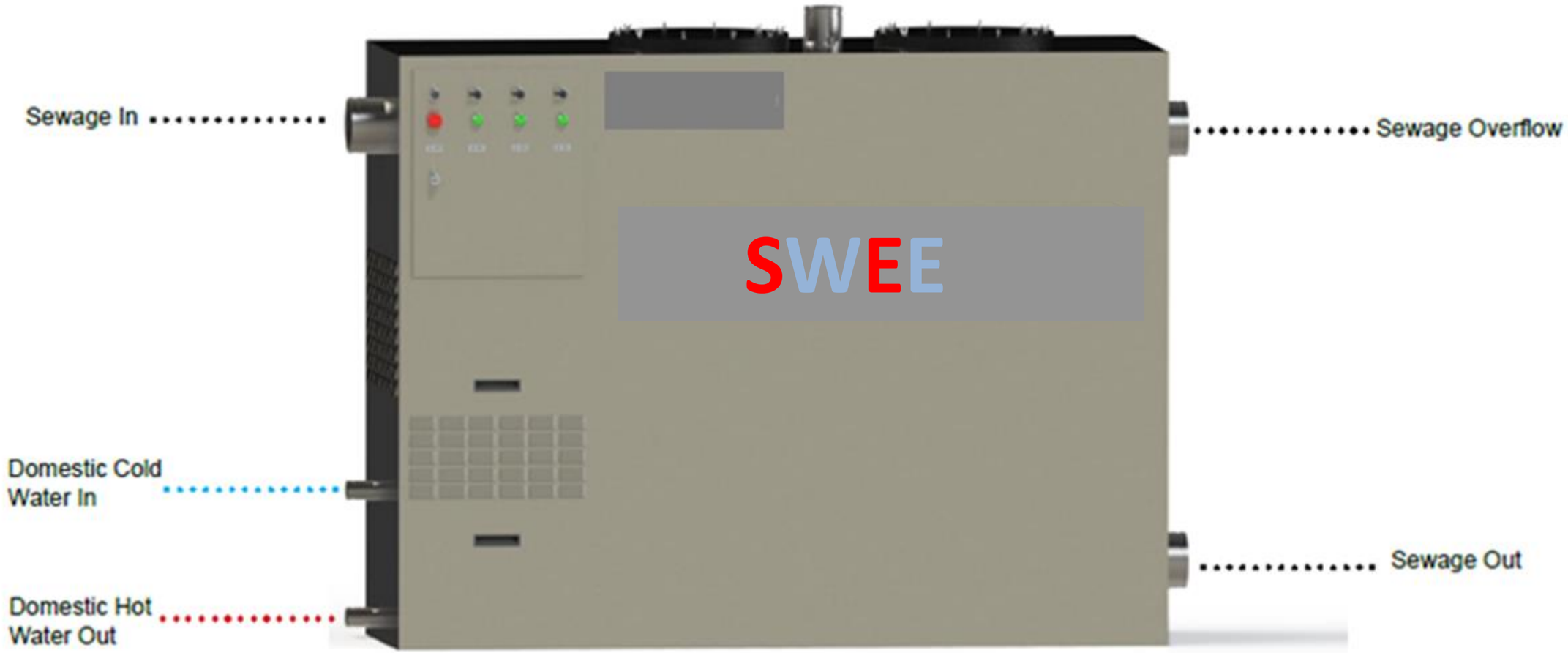
Flow meters, temperature sensors, and electrical meters were installed throughout the heat recovery system in order to monitor and log both the system operation and the amount of energy used and recovered by the system.

One week of logged data from August 18, 2012 to August 25, 2012 was submitted to Stantec for analysis. From this information, it was determined that the average domestic water heating requirement over this period was 746.87 kWh/day. Heating this domestic water using only conventional means (in this case, the 90% efficient natural gas boilers) would require 829.86 kWh/day of energy.

Analysis of the submitted data indicated that the water-to-water heat pumps had consumed 81.03 kWh/day of electricity, 10.08 kWh/day was required for pumping energy, and the natural gas boiler usage had dropped to 114.64 kWh/day. The total energy now required for domestic hot water heating is 205.75 kWh/day, resulting in a 75.2% energy savings.



2016 seven35 Self-contained SWEE System retrofit

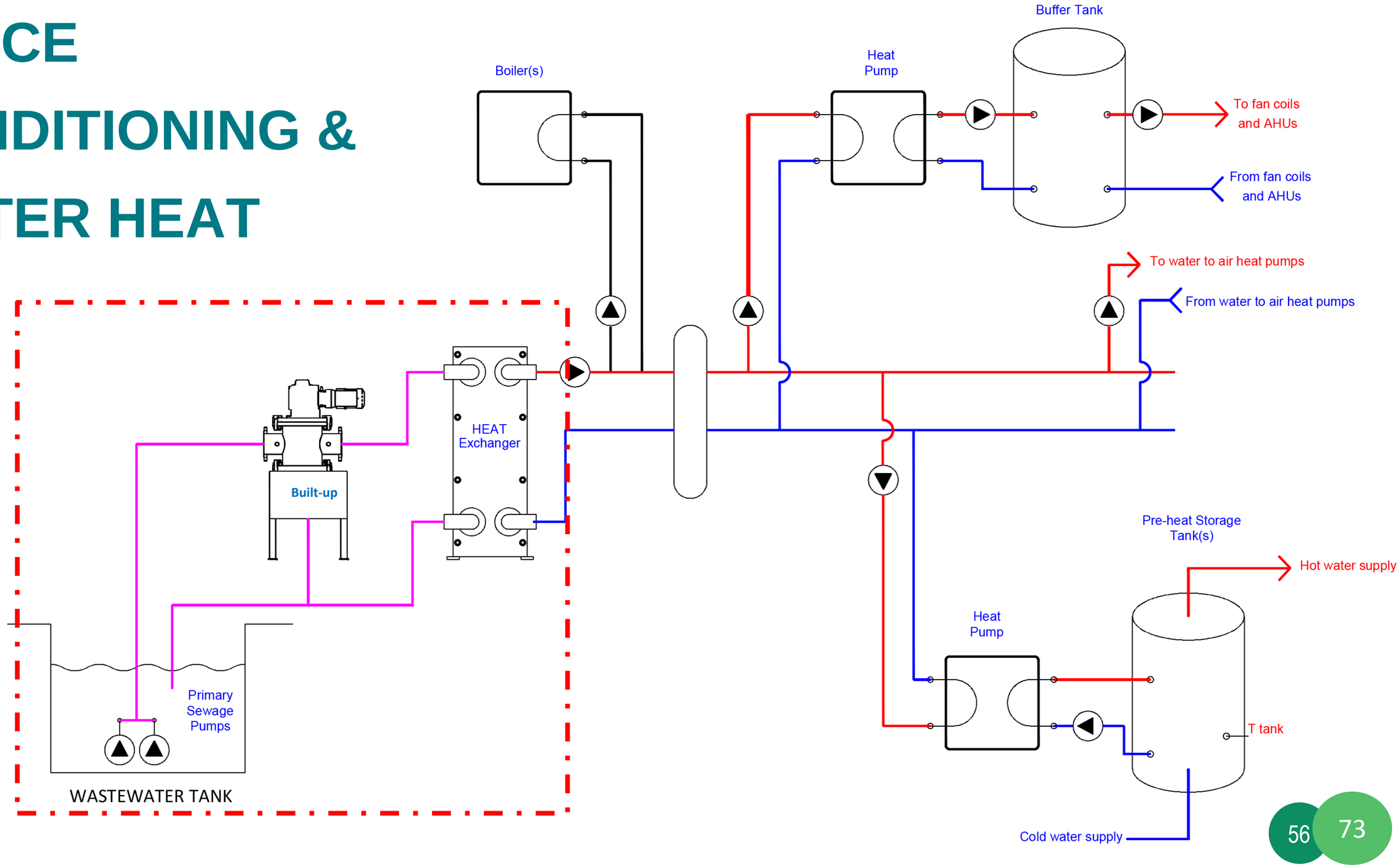


2016 seven35 In-Line SWEE System retrofit

Regional Water Resource Centre - Sechelt, BC

- Shipped to site: Aug, 2014
- Supplies building space heating & cooling using inflowing untreated wastewater
- 1,790 square metre facility
- LEED® Gold certified

SPACE CONDITIONING & WATER HEAT



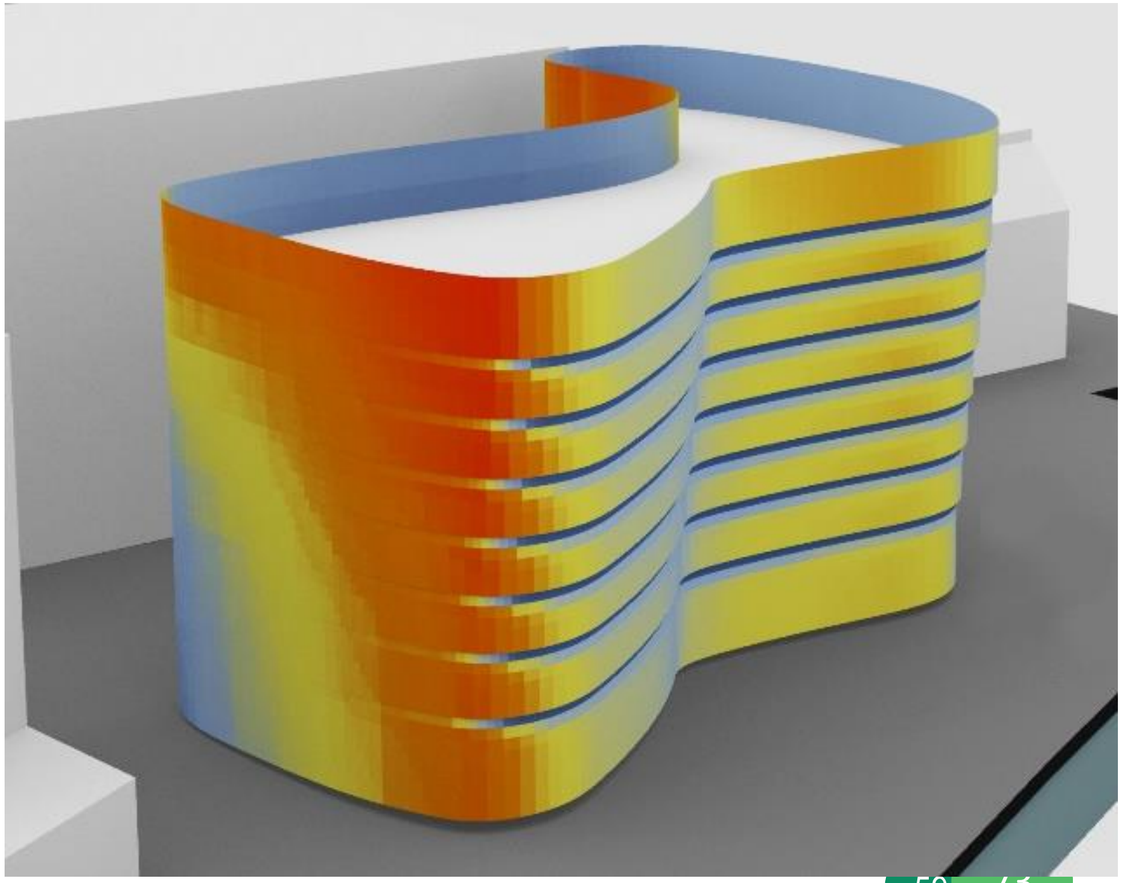
DC Water Headquarters

Washington, DC

- 150,000-square-foot, six-story headquarters facility for the District of Columbia Water and Sewer Authority (DC Water)
- Construction of the headquarters is scheduled to be complete in Sept. 2018
- Designed to achieve LEED Platinum certification

Mechanical Systems Overview

- Sewage Water Energy Exchange
- Energy Recovery Chiller
- Chilled Beams and DOAS VAV
- Outdoor Air Handling Unit

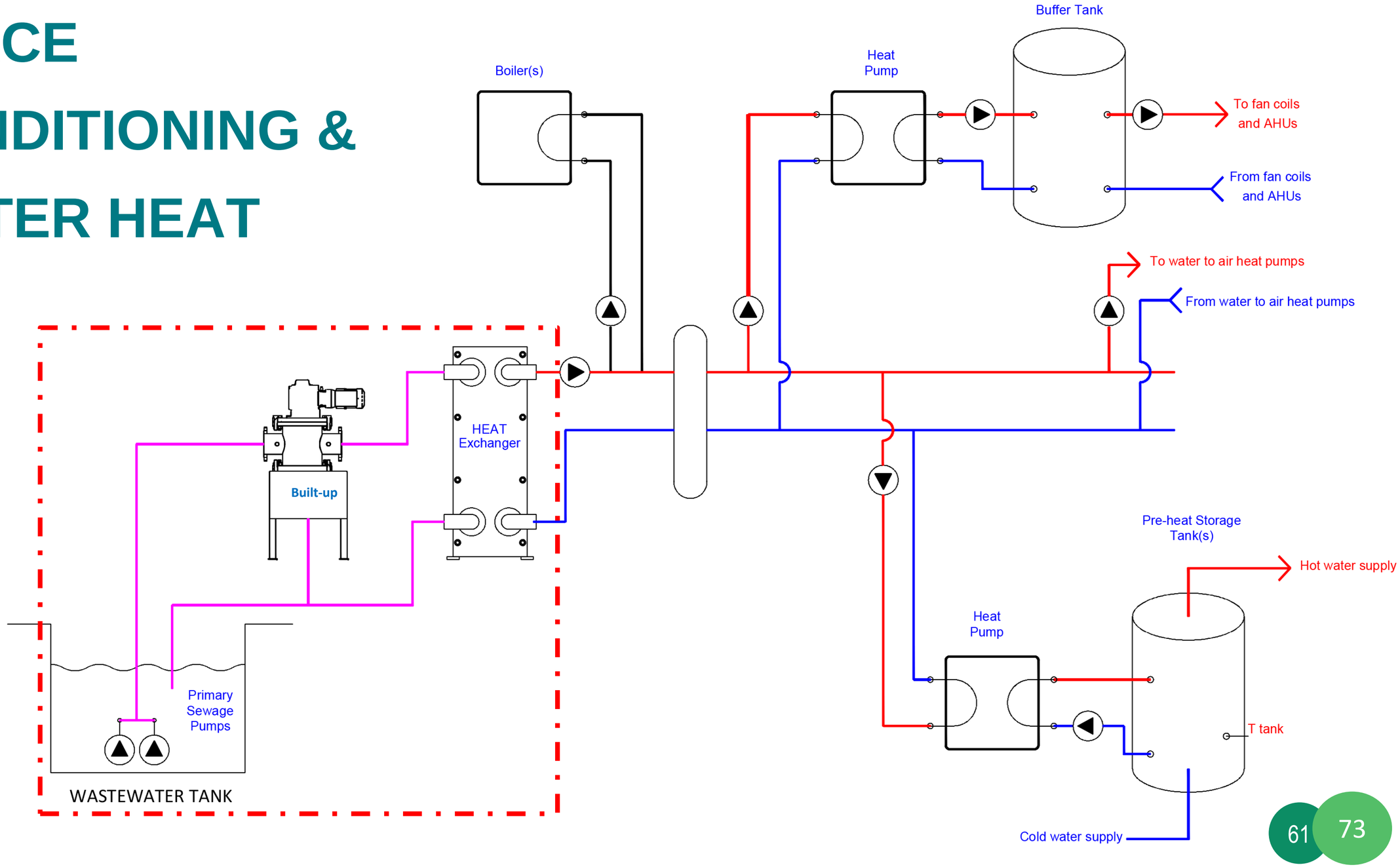


Built-up SWEE

4-Pipe Chilled Box

Energy Recovery Chiller

SPACE CONDITIONING & WATER HEAT



DC Water Headquarters

Washington, DC

Total Energy Savings = 48%

Total CO^2 Reduction = 42%

Total Water Savings = 90%

23 Site EUI

LEED Platinum - 96 Credits

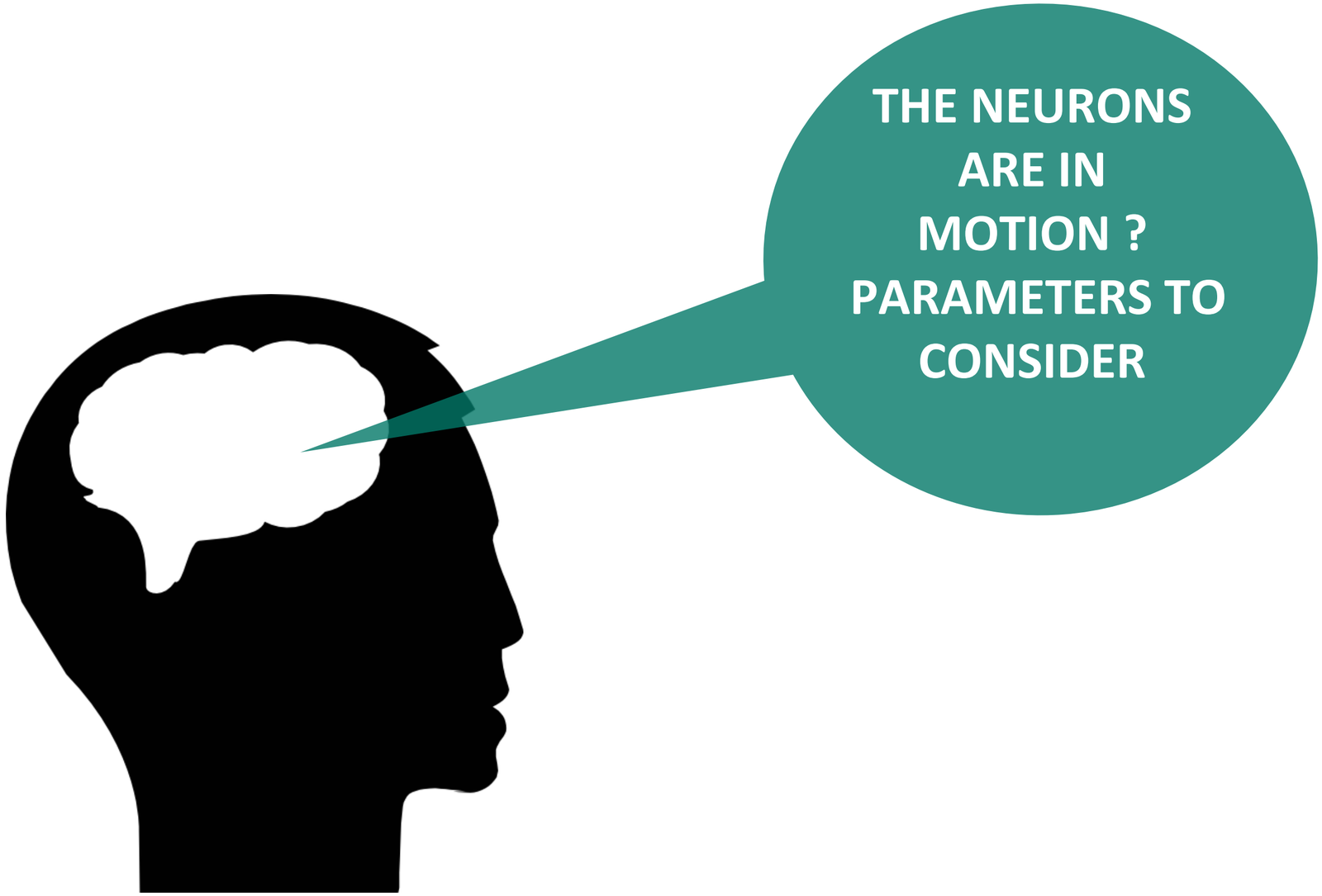
All LEED Energy Credits Achieved

All LEED Water Efficiency Credits Achieved

100% Impervious Onsite Stormwater Retention

No Cooling Tower – 900,000 gallons saved

Rainwater for Flushing – 600,000 gallons saved


THE NEURONS
ARE IN
MOTION ?
PARAMETERS TO
CONSIDER

Wastewater / Sanitary Info

What type of Sanitary supply is available?

- ❑ Connect to Sanitary Main Line of Municipality ? Is it combined or just sanitary ?
- ❑ Connect to Sanitary discharge of site/building ?
- ❑ Estimated Sanitary Supply Qty (GPD/GPM): _____
- ❑ New or Existing Pipe Diameter: _____

Have flow measurements, calculations or estimates been made for any / all of the following ?

a. Peak overall sewage/sanitary flow rate (Gals / Hr or Gals/ Min or Gals / Day);

b. Average overall sewage/sanitary flow rate (Gals / Hr or Gals/ Min or Gals/ Day);

c. Overall site water consumption and % of that figure that is to be heated.

d. Sanitary Temperatures either measured or estimated. Minimally summer and winter conditions, and a time trend profile is best.

Wastewater / Sanitary Info

e. Will there will be one or several exit points available for the site sanitary connection to the municipal system ?

f. Is there a specific purpose intended for the energy exchanged ?

g. If this is a multi-unit residential application, will any utilities (Gas / Electricity / Water) be metered at the individual apartment level ?

h. Are any utilities charged based on time-of-day rates, and if so are the rate schedule available ?

Building Info

Purpose of Energy Exchange:

- Domestic Hot Water Production
- Space Heating and/or Cooling
- Combined DHW & Space Heating/cooling
- Heat Pump(s) Will be REQUIRED
- Heat Pump(s) Will NOT be REQUIRED

What is the Simple Payback for a Marble Floor ? (*)

(*) Reinhold Wieland
Specialist in Energy Performance Contracting & Real Time Energy Management
LinkedIn November 8 2016
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Or a Fire Sprinkler System ?

An Emergency Lighting System ?

A Security System ?

Air Conditioning Maintenance ?

A New Roof ?

An Insurance Package ?

Rewire of Electrical System ?

An Energy Efficiency Project ?

Which one of these seems to require a Simple Payback calculated every time? (*)

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THANK YOU !

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