

Energy recovery for GHG reductions



Cities can significantly cut greenhouse gas emissions and operating costs by including energy recovery in normal capital planning

- Communities
- Arenas
- Data centres and more.

Host Bruce Nagy provides case examples.

Guest Linda Parkinson, City of Vancouver talks about The False Creek Neighbourhood Energy Utility

Tues Dec 7, 2:00 PM EST



Clean Air Partnership

CLIMATE SOLUTIONS WEBINAR SERIES



TODAY

LINDA PARKINSON

MANAGER, FALSE CREEK NEIGHBOURHOOD ENERGY UTILITY, CITY OF VANCOUVER

- ◇ VANCOUVER CARBON REDUCTION POLICY
- ◇ ORIGIN OF THE FALSE CREEK SEWAGE HEAT ENERGY RECOVERY PROJECT
- ◇ EXPANSION MILESTONES & FUTURE PLANS

BRUCE NAGY

CLIMATE SOLUTION GROUP, TORONTO, ONTARIO

- ◇ ENERGY RECOVERY IN THE BUILT ENVIRONMENT
- ◇ SEWAGE ENERGY RECOVERY
- ◇ ENERGY RECOVERY FROM DATA CENTRES
- ◇ ENERGY RECOVERY FROM REFRIGERATION
 - ARENAS, GROCERY STORES, REFRIGERATED WAREHOUSES



TODAY'S GUEST PRESENTER



LINDA PARKINSON, MANAGER, FALSE CREEK NEIGHBOURHOOD ENERGY UTILITY, CITY OF VANCOUVER

LINDA IS A PROFESSIONAL ENGINEER WITH OVER 20 YEARS OF DIVERSE MUNICIPAL EXPERIENCE INCLUDING WATER AND WASTEWATER UTILITIES, WASTE MANAGEMENT AND DISTRICT ENERGY. LINDA HAS BEEN MANAGING THE CITY OF VANCOUVER'S NEIGHBOURHOOD ENERGY SYSTEM SINCE JANUARY 2020. PRIOR TO THAT LINDA SPENT OVER FIVE YEARS WITH METRO VANCOUVER, WHERE SHE MANAGED THE SOURCE CONTROL PROGRAM WITHIN THE WASTEWATER DEPARTMENT. LINDA HAS HELD LEADERSHIP ROLES IN LOCAL GOVERNMENT AND CONSULTANCY, IN CANADA AND THE REPUBLIC OF IRELAND. IN ADDITION TO HER ENGINEERING QUALIFICATIONS, LINDA HOLDS A MASTERS OF BUSINESS ADMINISTRATION. LINDA CURRENTLY SERVES AS VICE-PRESIDENT OF THE BC WATER AND WASTE ASSOCIATION.

Thank you to Linda and also to webinar manager Juliet Rennick from the Clean Air Partnership.

BRUCE (BF) NAGY CLIMATE SOLUTIONS

- ◇ COLUMNIST & SPEAKER
- ◇ CONSULTANT
- ◇ AUTHOR 200+ ARTICLES ON CLIMATE SOLUTIONS
- ◇ AUTHOR *THE CLEAN ENERGY AGE*,
ROWMAN & LITTLEFIELD

SOLUTIONS, PRIORITIES, CASE EXAMPLES



BUILDINGS
NEW & RETROFIT TECHNOLOGY & PROGRAMS



TRANSPORTATION
ELECTRIC FLEETS, INFRASTRUCTURE & TRANSIT VEHICLES



POWER & STORAGE
TECHNOLOGY, PLANNING & ECONOMICS



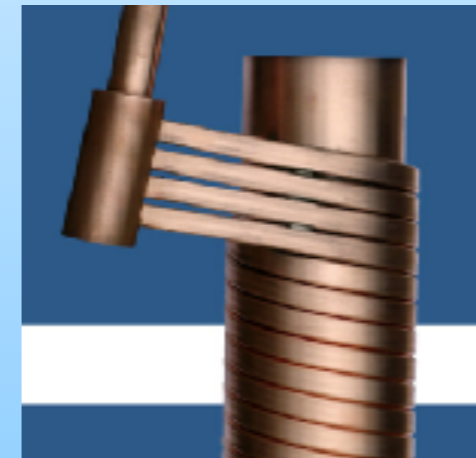
ENERGY RECOVERY IN THE BUILT ENVIRONMENT

◇ ERVs, HRVs & DRAIN WATER HEAT RECOVERY

◇ SEWAGE ENERGY RECOVERY

◇ ENERGY RECOVERY FROM DATA CENTRES

◇ ENERGY RECOVERY FROM REFRIGERATION



THE BASICS

IN A SIMPLE RESIDENTIAL APPLICATION
RECOVER HEAT AND COOLING ENERGY

**USE A HEAT RECOVERY VENTILATOR (HRV)
OR ENERGY RECOVERY VENTILATOR (ERV) TO:**

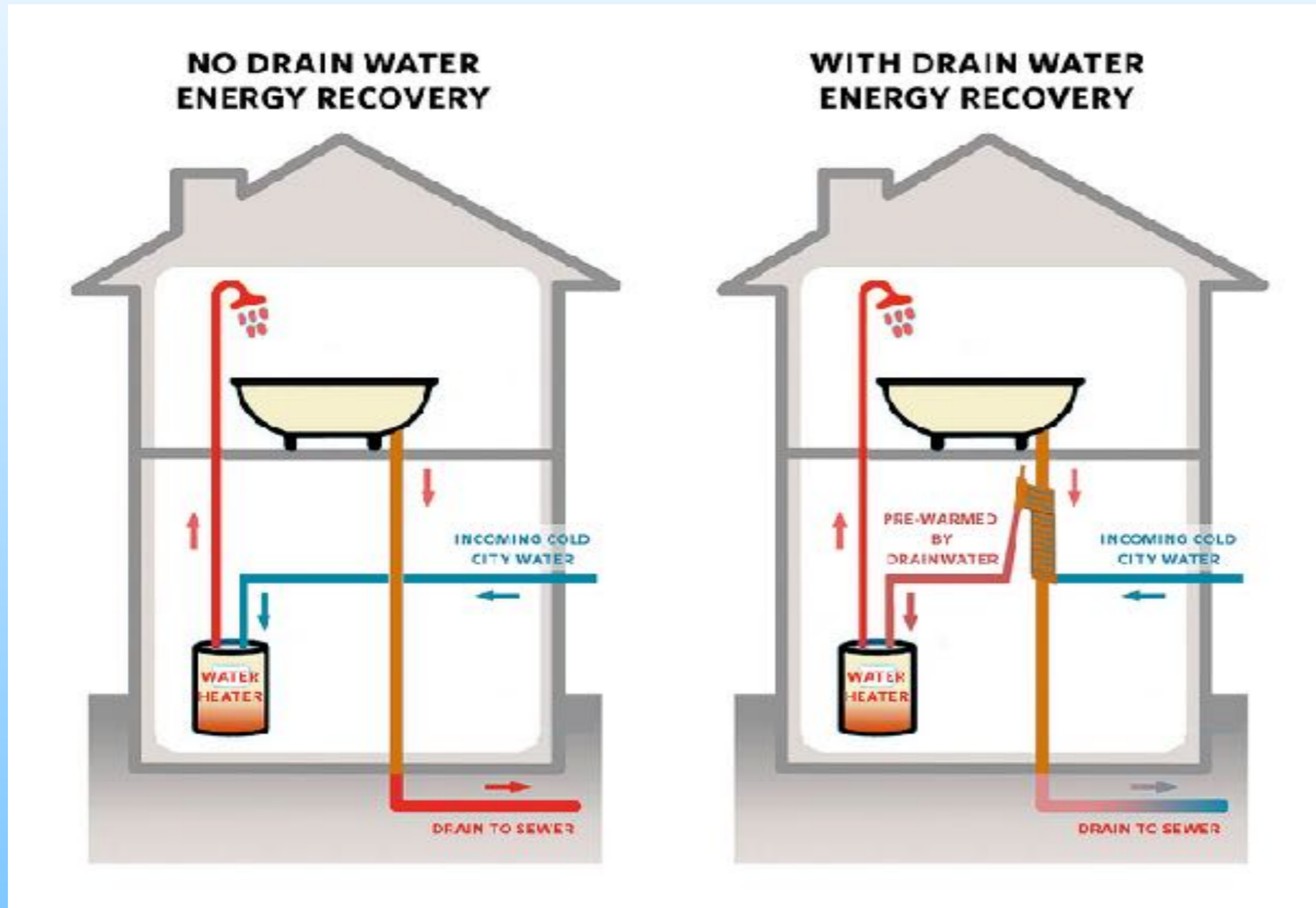
1. SUPPLY FRESH AIR TO A MODERN,
WELL SEALED HOME
2. WHILE RETAINING HEATING OR COOLING ENERGY
FROM THE STALE AIR THAT'S BEING REPLACED.
3. DO SOME HUMIDITY MANAGEMENT (ERV).



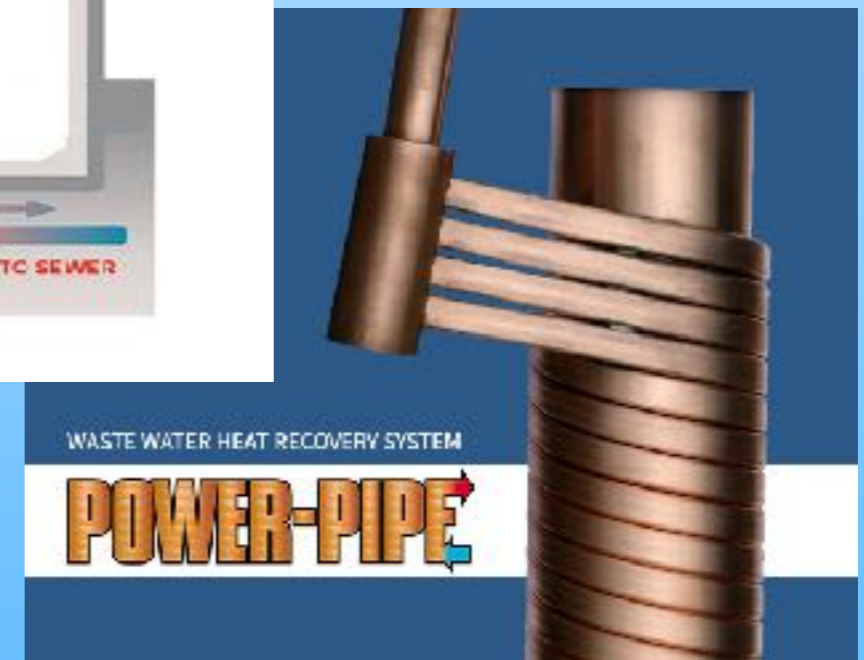
Heat Recovery Ventilator (HRV)



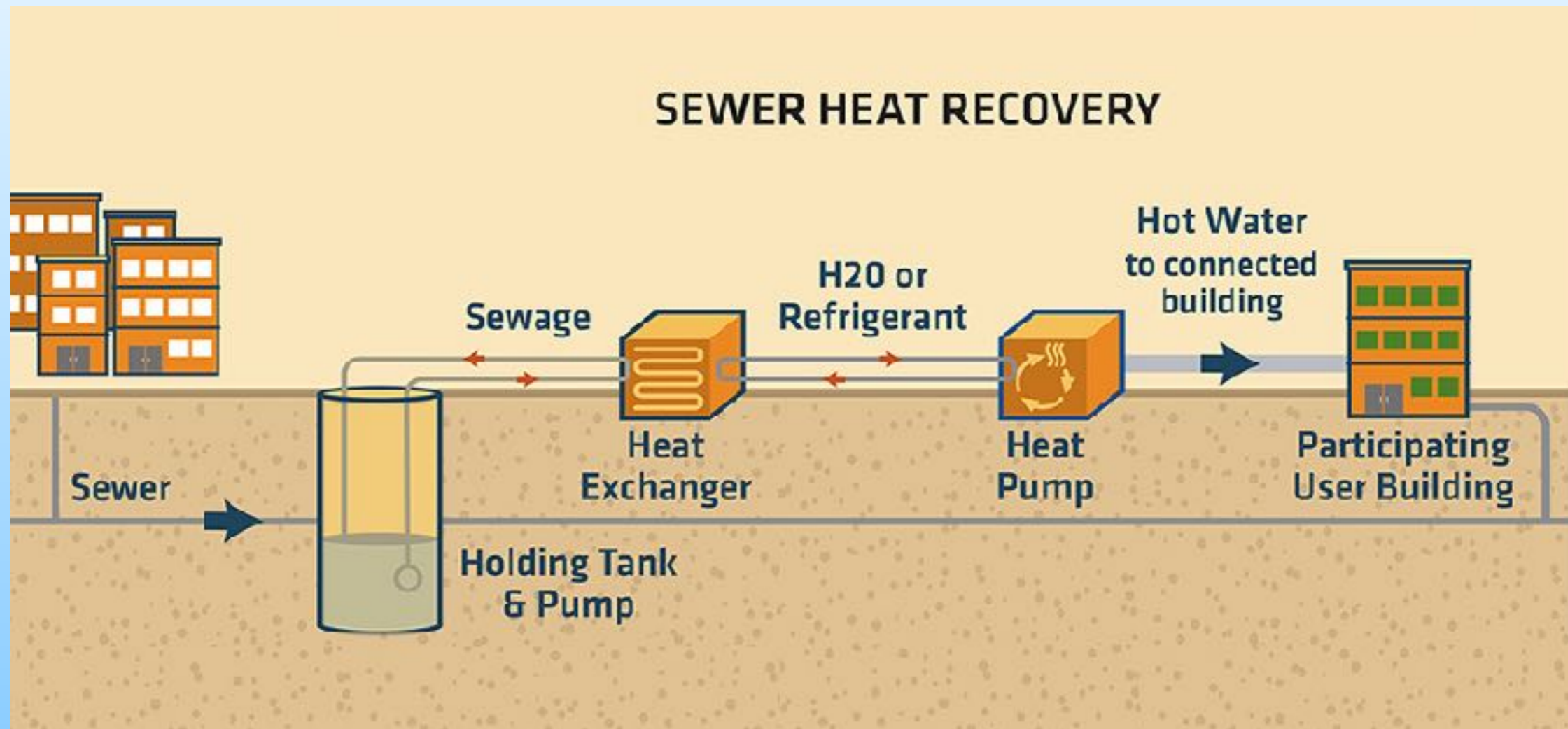
DRAIN WATER HEAT RECOVERY



SAVE ABOUT 50% ON WATER HEATING ENERGY



SEWAGE WATER HEAT RECOVERY



◇ FALSE CREEK - VANCOUVER - LINDA

◇ OTHER PROJECTS AROUND NORTH AMERICA

DC WATER HEADQUARTERS, WASHINGTON DC



◇ IN WINTER SEWER WATER IS ABOUT 20 C WARMER THAN THE OUTSIDE TEMPERATURE,
IN SUMMER ABOUT 20 C COOLER

◇ SHARC SYSTEM SAVES “35% ON AC, 85% ON HEATING, 4 TO 6 MILLION GALLONS OF WATER EACH YEAR”

◇ COOLING TOWER FOR BACKUP

◇ SHARC SYSTEMS HAS DONE INSTALLS IN UK, EUROPE, AUSTRALIA AND CANADA.

ENWAVE: DENVER'S NATIONAL WESTERN CENTER

- ◇ OPERATED BY ENWAVE, TORONTO
- ◇ ONE MILLION SQUARE FEET OF NEW INDOOR SPACE, ALL OF WHICH WILL BE HEATED AND COOLED WITH ENERGY FROM THE SEWER PIPES BELOW.
- ◇ DENVER'S 141-YEAR-OLD STEAM HEAT DISTRICT SYSTEM IS LOSING CUSTOMERS BUT SEWAGE HEAT OFFERS NEW DISTRICT ENERGY ECONOMICS AND LOW GHG



"WITH THE ADVENT OF LARGE-SCALE HEAT PUMPS, WE CAN COST-EFFECTIVELY USE, SAY, 70-DEGREE WASTEWATER TO HEAT OUR BUILDINGS AND OUR HOT-WATER SYSTEMS."

KING COUNTY, WASHINGTON STATE

**“THIS PROGRAM IS JUST ONE WAY KING COUNTY IS REIMAGINING
RESILIENT AND SUSTAINABLE COMMUNITIES.”**



KING COUNTY WASTEWATER TREATMENT DIVISION (WTD) IS OFFERING SEWER HEAT RECOVERY. PRIVATE COMMERCIAL PROPERTY OWNERS AND DEVELOPERS CAN RECOVER HEAT ENERGY FROM WTD SEWER PIPES FOR THE PURPOSE OF HEATING OR COOLING BUILDINGS.

“SEWER HEAT RECOVERY TECHNOLOGY IS FAIRLY COMMON IN EUROPE AND PARTS OF CANADA, BUT STANDARDIZED SHR USE-AGREEMENTS ARE NEW IN THE UNITED STATES.”

DATA CENTRE ENERGY RECOVERY



WHEN COOLING A DATA CENTRE (DC) EITHER WITH AIR SYSTEMS OR LIQUID SYSTEMS, YOU REMOVE HEAT WHICH CAN BE RE-USED FOR HEATING OFFICES, MULTI-FAMILY RESIDENTIAL, GREENHOUSES, AND SO ON. A MOVEMENT IN THIS DIRECTION STALLED DURING THE LAST DECADE OF COOLING TECH EXPERIMENTATION BY THE BIG 4 BUT IT IS NOW RE-GAINING SOME INTEREST.

MAJOR PUBLIC CLOUD COMPUTING COMPANIES HAVE BEEN AT THE FOREFRONT OF GREENING DCS, AS BOTH A COMPETITIVE STRATEGY AND A MATTER OF PROVING THE CLOUD BUSINESS MODEL.

FOUR BIG PLAYERS, AMAZON WEB SERVICES, GOOGLE CLOUD, MICROSOFT AZURE & ALIBABA GROUP TESTED FREE COOLING, LIQUID COOLING, OCEAN COOLING AND MANY OTHER KINDS, AND DEVELOPED NUMEROUS WAYS TO CONDUCT DATA PROCESSING OPERATIONS MORE EFFICIENTLY.

TODAY THEY SAY THAT WHEN A DC SWITCHES FROM ITS OWN SERVER RESOURCES TO THE PUBLIC CLOUD, IT CUTS GHG FROM COOLING BY ABOUT 80%, AND ADDS OTHER EFFICIENCIES ADDING UP TO RECORD PUE (POWER USAGE EFFECTIVENESS).

A MASSIVE SHARE OF PROCESSING IS NOW DONE IN THE PUBLIC CLOUD, EMISSIONS HAVE REMAINED FLAT, WHILE VOLUME HAS ZOOMED UP.

TELUS HEADQUARTERS, VANCOUVER

NEW 22-STOREY OFFICE COMPLEX AND 45-STOREY RESIDENTIAL TOWER (HOUSING MANY EMPLOYEES) WERE BUILT ON THE SAME SITE WITH A TELUS DATA CENTRE, EXPELLING 5 GIGA-JOULES OF WASTE HEAT ENERGY EACH DAY.

DURING DAYLIGHT HOURS THE RESIDENCES HAVE LOW OCCUPANCY WHILE OFFICES REACH THEIR PEAK, AND IN THE EVENING, VICE VERSA.

HEATING AND COOLING SYSTEM THAT SAVES 80% OVER A COMPARABLE CONVENTIONAL BUILDING, BY REUSING THE DATA CENTRE ENERGY AND EMPLOYING OTHER INNOVATIVE TECHNOLOGIES.

HEAT PUMPS , ELECTRIC CHILLERS, 50 KW PHOTOVOLTAIC SOLAR ARRAY ON THE ROOF, RAINWATER COLLECTION, 1400 SQ FT GREEN ROOFS AND GARDEN AREAS, ETC.



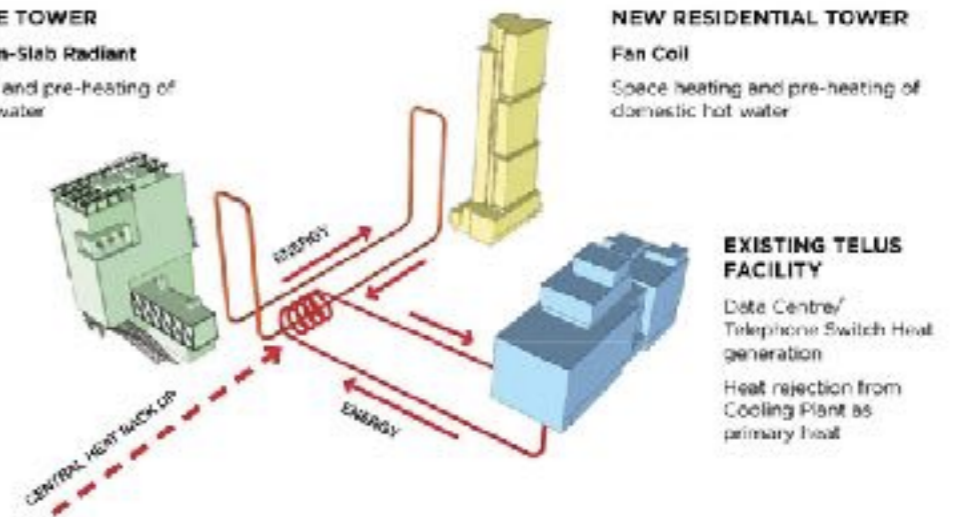
TELUS Garden Waste Heat Recovery

NEW OFFICE TOWER

Fan Coil and In-Slab Radiant
Space heating and pre-heating of domestic hot water

NEW RESIDENTIAL TOWER

Fan Coil
Space heating and pre-heating of domestic hot water



QUÉBECOR DATA CENTRE, WINNIPEG

"WHILE IT WAS -35 C OUTSIDE, I WOULD BE PAYING A TREMENDOUS AMOUNT OF MONEY TO COOL THE DATA CENTRE AND TO HEAT THE ROOMS AROUND IT."

QUÉBECOR ADDED HEAT RECOVERY TO THE 2,500-SQUARE-FOOT DATA CENTRE. NOW HEATING QUÉBECOR OFFICES IS FREE, PLUS 100% OF WINNIPEG SUN NEWSPAPER OFFICES UPSTAIRS, PLUS THE MAJORITY OF A WAREHOUSE BUILDING NEXT DOOR, WHICH HAS POOR INSULATION AND LOADING BAYS THAT OPEN AND CLOSE CONSTANTLY.



"WE WERE CONCERNED WE WOULDN'T HAVE ENOUGH EXCESS HEAT CAPACITY, BUT WE WERE ACTUALLY RUNNING OUT OF PLACES TO APPLY IT."

FACEBOOK DATA CENTRE, DENMARK

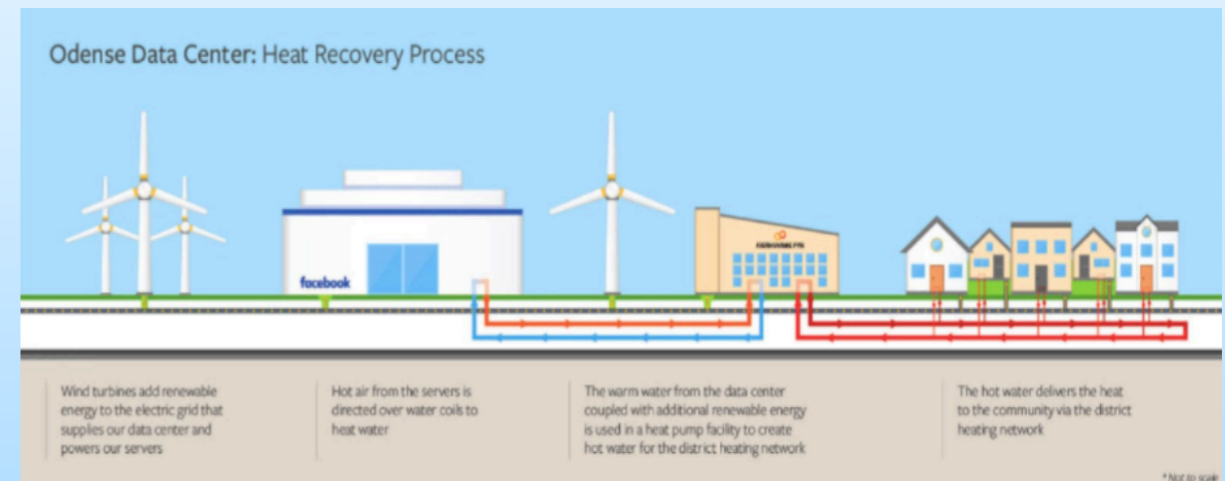
FACEBOOK OPERATES A TWO-BUILDING, 50,000 SQUARE-METER DATA CENTRE IN ODENSE, DENMARK.

FACEBOOK HAS PARTNERED WITH FJERNVARME FYN TO REDISTRIBUTE THE HEAT GENERATED BY THE FACILITY'S SERVERS TO THE NEARBY COMMUNITY.

TRANSFERRED VIA COPPER COILS FILLED WITH WATER, WHICH LINK A HEAT PUMP FACILITY TO THE 176 COOLING UNITS IN THE DATA CENTRE.

WARMS HOMES, A LOCAL HOSPITAL AND OTHER BUILDINGS. WHEN RUNNING AT FULL CAPACITY, IT WILL RECOVER 100,000 MWH OF ENERGY ANNUALLY, ENOUGH FOR 6,900 HOMES.

IN ADDITION, THE DATA CENTRE IS ENTIRELY SUPPLIED BY WIND POWER.



NORTH VANCOUVER



LONSDALE ENERGY CORPORATION PROVIDES DISTRICT ENERGY FOR HEATING AND COOLING COMMUNITIES AND INDUSTRIAL PROCESSES IN NORTH VANCOUVER. IT HAS ENTERED INTO AN AGREEMENT WITH A CRYPTO CURRENCY COMPANY.

PROponents SAY THE ARRANGEMENT WILL REDUCE GREENHOUSE GAS BY 20,000 TONS/MEGAWATT BY REUSING HEAT FROM THE CRYPTO CURRENCY MINING OPERATION, WHICH REQUIRES MASSIVE AMOUNTS OF COMPUTING POWER 24/7, 365 DAYS OF THE YEAR.

CRYPTO CURRENCIES ARE CONTROVERSIAL INSTRUMENTS THAT AT BEST CAN BE SEEN AS A NON-SOVEREIGN TRADING PLATFORM AND AT WORST AS AN ANONYMOUS HIGH RISK CURRENCY ON THE DARK WEB, USED FOR RANSOM DEMANDS IN CYBERCRIME.

STOCKHOLM, SWEDEN



STOCKHOLM: 900,000 PEOPLE. STOCKHOLM DATA PARKS WARMS 2,500+ RESIDENTIAL APARTMENTS NOW, TARGETTING 10% OF THE ENTIRE CITY BY 2035.

DATA CENTRES BY SWEDEN IS LAUNCHING STOCKHOLM-LIKE PROJECTS ACROSS THE COUNTRY, SAYING 10 MW OF ENERGY HEATS 20,000 MODERN RESIDENTIAL APARTMENTS. TYPICAL FACEBOOK DATA CENTRE (DC) USES 120 MW (240,000 HOMES).

PARTNERSHIP WITH CORPORATE DCS LIKE ERICSSON, RETAIL CHAIN H&M, GAMING COMPANY INTERXION. COMPANIES SELL WASTE HEAT AND RECEIVE FREE COLD WATER FOR COOLING. "IT'S NOT PHILANTHROPIC. WE'RE TURNING IT INTO A SECONDARY BUSINESS." (BUT THEY ARE SHARING THEIR ENGINEERING PLANS PUBLICLY).

COLD WATER FEEDS THROUGH PIPES INTO THE DATA CENTRE, WHERE IT'S USED TO CREATE THE COLD AIR BLOWN ONTO SERVERS. THIS HEATS THE WATER, WHICH RUNS BACK OUT OF THE PIPES AND INTO UTILITY PLANTS WHERE IT IS DISTRIBUTED FOR HEATING.

HISTORY: DISTRICT HEATING PROGRAM BEGAN IN STOCKHOLM IN THE 1950S. FORTUM VÄRME, THE LOCAL HEATING AND COOLING AGENCY, WAS PIPING HOT WATER TO HOSPITALS. IN THE OIL CRISIS IN THE 1970S IT EXPANDED INTO HOMES.

TODAY FORTUM SELLS HEAT TO ABOUT 12,000 BUILDINGS OR 90% OF THE CITY OF STOCKHOLM.

DC AT NOTRE DAME HEATS GREENHOUSE

SINCE 2008 PAUL BRENNER, A RESEARCHER HAS BEEN USING WASTE HEAT FROM COMPUTERS TO HEAT A LOCAL MUNICIPAL GREENHOUSE, THE POTOWATOMY CONSERVATORY AT NOTRE DAME UNIVERSITY IN SOUTH BEND, INDIANA. SERVER RACKS ARE HOUSED INSIDE THE GREENHOUSE, AND HUMIDITY OR PARTICULATE COUNTS HAVE THUS FAR NOT BEEN A PROBLEM.



HE USES GRID SCHEDULING SOFTWARE TO DELIVER A DESIRED TEMPERATURE WITHIN A RANGE, BY ADDING OR THROTTLING COMPUTE JOBS ON THE GREENHOUSE CLUSTER, WHICH COMMUNICATES WITH NOTRE DAME VIA A WIDE-AREA WIRELESS BROADBAND CONNECTION.



SIMILARLY, IBM SWITZERLAND USES DC HEAT FOR A NEARBY SWIMMING POOL.

NHL HOCKEY ARENAS

HEAT RECOVERY FROM ICE MAKING

◇ AS OF DEC 2018 ST LOUIS BLUES, SAN JOSE SHARKS, ANAHEIM DUCKS, ARIZONA COYOTES, RYERSON RAMS AT MAPLE LEAF GARDENS (MATTAMY CENTRE) & MAPLE LEAF GARDENS LOBLAWS ALL USED AMMONIA SYSTEMS WITH HEAT RECOVERY. MORE NHL TEAMS WERE EXPECTED TO FOLLOW SUIT.

◇ ARENA GURU SCOTT WARD, STEVENS ENGINEERING HAS WORKED ON DESIGNS FOR HEAT RECLAMATION SYSTEMS FOR 225+ ARENAS



ST. LOUIS BLUES



ANAHEIM DUCKS



MAPLE LEAF GARDENS (MATTAMY CENTRE)



SAN JOSE SHARKS.



ARIZONA COYOTES

UPPER CANADA COLLEGE

WILLIAM P. WILDER ARENA & SPORTSPLEX

- ◇ ECO CHILL 150A HEAT RECOVERY PACKAGE USING R-717 AMMONIA WAS INSTALLED IN 2014.
- ◇ CONNECTED TO A THERMAL EQUALIZED GLYCOL SYSTEM, USES WASTE HEAT FOR SUB FLOOR WARMING BELOW TWO ICE SHEETS.
- ◇ USED FOR ICE AND SNOW MELT, AND SERVICE WATER HEAT FOR THE ZAMBONI.
- ◇ COMBINED WITH A GROUND SOURCE GEOTHERMAL FIELD BENEATH A NEARBY FOOTBALL/SOCCER FIELD.
- ◇ THE COMBO ALSO SUPPLIED DOMESTIC HOT WATER AND SOME RADIANT HEAT FOR DRESSING ROOMS, PUBLIC WASHROOMS, ARENA BENCH SEATING, AND VISITORS' GALLERIES.
- ◇ LEED CERTIFIED.



BENTLEY ARENA, NEAR BOSTON

LEED PLATINUM BENTLEY ARENA IN WALTHAM, MASSACHUSETTS, 2018

- ◇ 160-TON INDIRECT FLOODED SYSTEM WITH 50 TONS OF HEAT RECOVERY, OR ABOUT 30%.
- ◇ RECOVERED HEAT USED FOR PERMAFROST PREVENTION BELOW THE SUB FLOOR. PERMA-FROST PREVENTION IS REQUIRED FOR ARENAS OPERATING MORE THAN 6 MONTHS TO PROTECT BUILDING FOUNDATION.
- ◇ RECOVERED HEAT ALSO PRE-WARMS DOMESTIC HOT WATER IN THE BUILDING TO BETWEEN 110°F AND 130°F.
- ◇ ALSO USED AT 85°F TO MELT RINK SURFACE SHAVINGS IN AN ICE PIT. ZAMBONI DOES NOT DEPOSIT ICE & SNOW OUTSIDE, ELIMINATING MESS & ENERGY LOSS THROUGH BIG OUTSIDE DOORS. SAVES MORE ENERGY, WATER, SUPPORTS HUMIDITY CONTROL.
- TOTAL ENERGY REDUCTION IS 60%.



BERWICK, NOVA SCOTIA

KINGS MUTUAL CENTURY CENTRE (“APPLE DOME”)

CASCADING DOUBLE LOOP AMMONIA SYSTEM, SABROE HEAT PUMP FOR HEAT RECOVERY FROM THE ICE PLANT, ADVANCED CONTROLS, RECIPROCATING COMPRESSORS.

DID NOT DELIVER PROMISED SAVINGS, SO RECOMMISSIONED:

- ◇ EQUALIZED PIPING
- ◇ SET-UP CONTROLS PROPERLY
- ◇ HEATING LOOP DESIGNED FOR 150°F, REDUCED TO 120°F CUT CONDENSING PRESSURE FROM 500 TO 300 PSI
- ◇ SAVED ENERGY, REDUCED WEAR AND TEAR ON THE HEAT PUMP COMPRESSOR. OPERATING COSTS WENT FROM \$110,000 DOWN TO LESS THAN \$75,000.
- ◇ BEGAN RUNNING ONE COMPRESSOR & ONE BRINE PUMP AT A TIME, SHUT SYSTEM AT NIGHT, INSTALLED VARIABLE FREQUENCY DRIVES, CONTROLLED AMPERAGE DRAW AND REDUCED BRINE FLOW AT COLDER TEMPERATURES. THIS DECREASED HEAT GAINS IN THE BRINE CAUSED BY FRICTION.



WHOLE STORE GROCERY SYSTEMS



TRANSCRITICAL CO₂ REFRIGERATION SYSTEMS IN 13 STORES

STOUFFVILLE, ON, NOV 2018 "NEAR NET-ZERO ENERGY SUPERMARKET" REDUCED CO₂ EMISSIONS BY 1,500-2,000 METRIC TONS PER YEAR

- ◇ 40,000FT² (3,716M²)
- ◇ 35% LESS ENERGY THAN THE AVERAGE
- ◇ PRODUCES 65% OF ITS OWN ENERGY
- ◇ 247 KW SOLAR PANELS ON ROOF, FACADE,
39KW ON CARPORT
- ◇ 100KW LITHIUM-ION STORAGE BATTERY



LONGO'S STOUFFVILLE: CO₂ & HEAT RECOVERY

SOLAR PV & BATTERY

SOBEY'S

63 STORES USING A CO2 TRANSCRITICAL SYSTEM, AND 15-20 STORES OPENING EVERY YEAR WITH CO2.

NORTH AMERICAN LEADERS WITH HEAT RECOVERY, DEVELOPING TRANSCRITICAL FOR NORTH AMERICA IN THE EARLY 2000s

COST PREMIUM DISAPPEARED BUT SAVINGS & REGULATORY CERTAINTY REMAINED.

TWO CANADIAN MANUF WERE ALSO NORTH AMERICAN LEADERS, CARNOT AND LMP INC.



LOBLAW

TESTED CO₂ & TRANSCRITICAL IN 2013 AT MAPLE LEAF GARDENS STORE - COMMITTED TO CO₂ AT THAT TIME BUT THE PROGRAM STALLED.

IN 2019 ANNOUNCED \$48 MILLION TO CONVERT ALL 370 STORES, CUT 25% OF LOBLAW'S TOTAL EMISSIONS.

INCLUDES \$12 MILLION FROM FEDERAL GOVERNMENT.



NEWFOUNDLAND SEAFOOD PLANT

HEAT RECOVERY AT ICEWATER SEAFOOD, ST. JOHN'S

“WE WERE USING 160,000 LITRES OF OIL FOR HEAT EACH YEAR. WE DECIDED TO ADD HEAT RECOVERY AND USE THAT INSTEAD OF PAYING FOR OIL.” -**CEO ALBERTO WAREHAM.**

- ◇ INVESTMENT ABOUT \$400,000
- ◇ GOVERNMENT PGM PAID ABOUT 50%
- ◇ 70,000 SQ FT
- ◇ GREENHOUSE GAS REDUCTION ABOUT 355 TONS
- ◇ USING A LARGE VOLUME OF HOT WATER IN OPERATIONS
- ◇ HEAT RECOVERY SYSTEM INCREASES PRESSURE

“NOW THEY HAVE PLENTY OF FAR LESS EXPENSIVE HOT WATER AT 158°F WITHOUT FOSSIL FUELS.” -**COLIN JAMES MAYEKAWA**



MAYEKAWA IS A 100 YEAR OLD JAPANESE COMPANY THAT IMPORTS EQUIPMENT INTO NORTH AMERICA AND WORKS PRIMARILY WITH NATURAL REFRIGERANTS. IT IS ALSO CREATING INNOVATIVE NEW REFRIGERATION SYSTEMS THAT USE NOTHING BUT AIR OR WATER AS A REFRIGERANT.





JULIET PLEASE SWITCH TO LINDA PARKINSON, CITY OF VANCOUVER

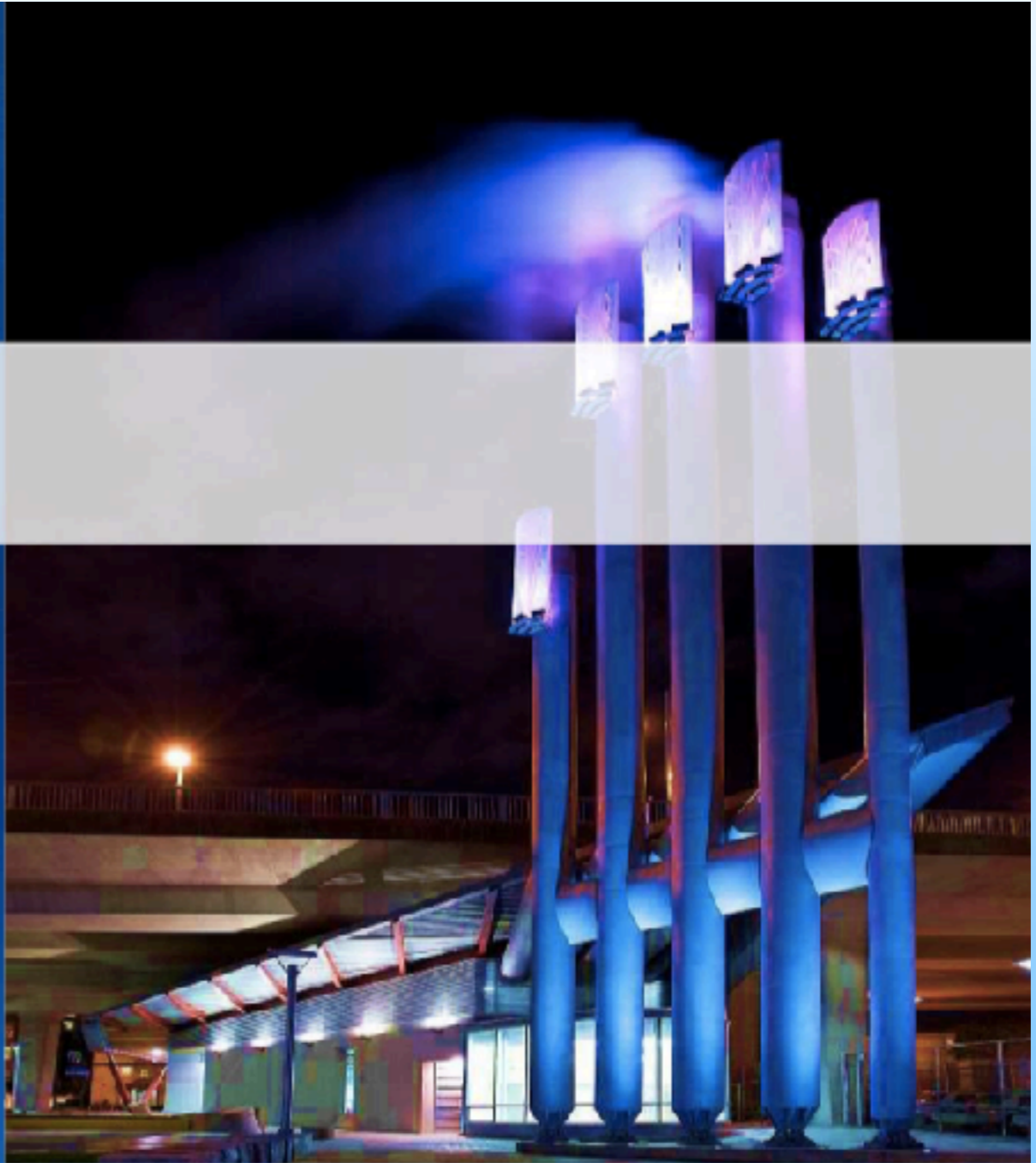
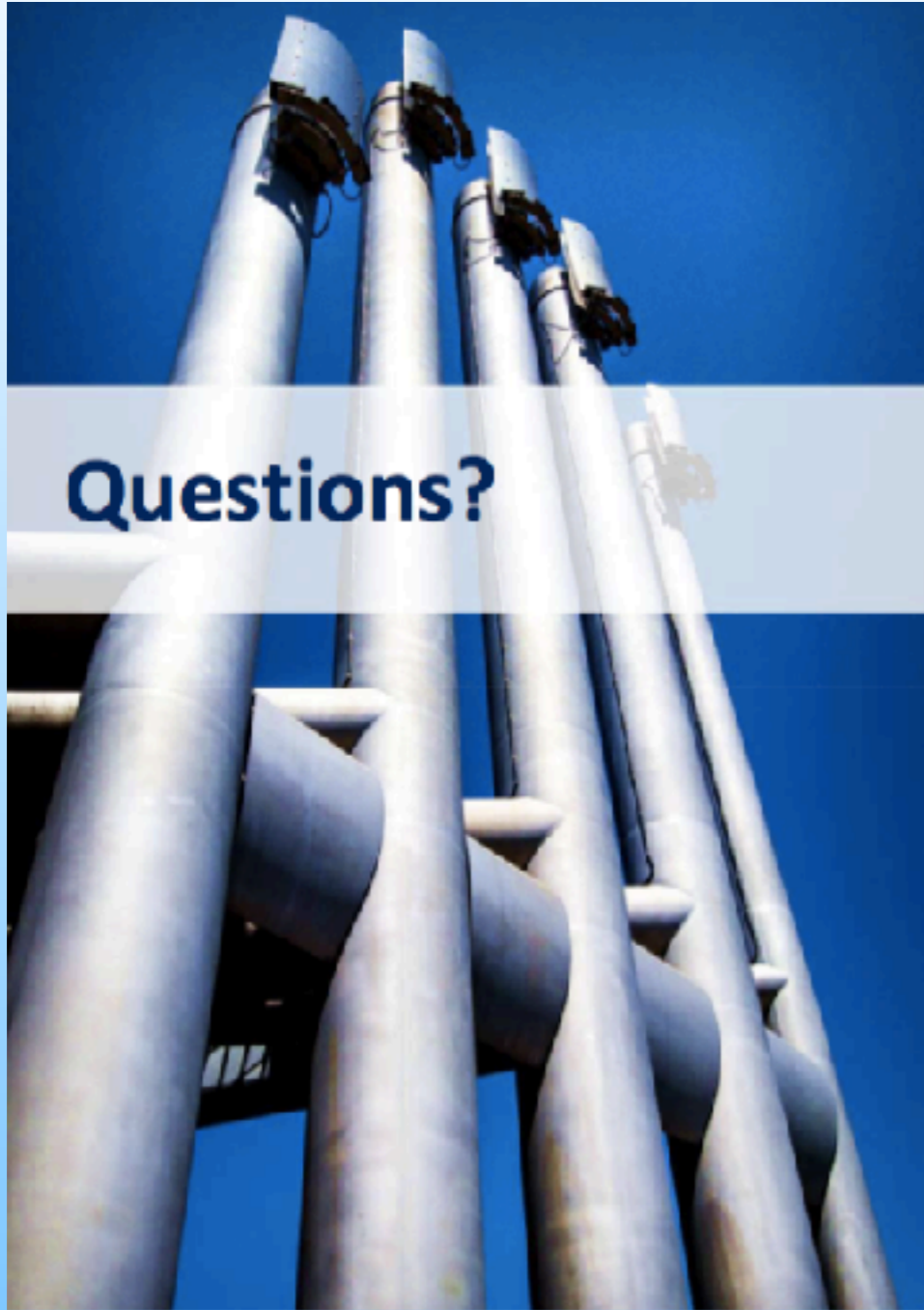


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Questions?



THANK YOU

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