



Geothermal multi-unit communities

Low Carbon Case Examples

Thurs March 12, 2020 | 2:00 - 3:00 PM ET

Bruce (BF) Nagy & Adam Alaica



Clean Air Partnership

CLIMATE SOLUTIONS WEBINAR SERIES





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WEBINAR SERIES - UPCOMING:

- Rainwater, grey water, sewage heat recovery (Seattle & Washington DC)
- Retrofit housing & passive house (Hamilton & Boston)
- Energy, batteries, micro-grids & new kinds of storage (Goderich & beyond)
- Electric municipal fleet vehicles & buses (NY & Vancouver)
- And much more...

BRUCE (BF) NAGY CLIMATE SOLUTIONS

- Columnist & features
- Consultant
- Author 200+ articles on climate solutions
- Author *The Clean Energy Age*, Rowman & Littlefield



Climate solutions
Expert best practices
Case examples
Clear priorities



SOLUTIONS, PRIORITIES, CASE EXAMPLES



BUILDINGS

NEW & RETROFIT TECHNOLOGY & PROGRAMS



TRANSPORTATION

ELECTRIC FLEETS, INFRASTRUCTURE & TRANSIT VEHICLES



POWER GENERATION & STORAGE

TECHNOLOGY, PLANNING & ECONOMICS

AGENDA

INTRODUCTION

5 MINUTES

GEOHERMAL MICROGRID IN
AUSTIN, DISTRICT ENERGY IN
RICHMOND, BC

25 MINUTES

GEOHERMAL LOW RISE IN
TORONTO & SIMILAR PROJECTS

25 MINUTES

DISCUSSION
& WRAP

5 MINUTES



GEO THERMAL HEATING & COOLING

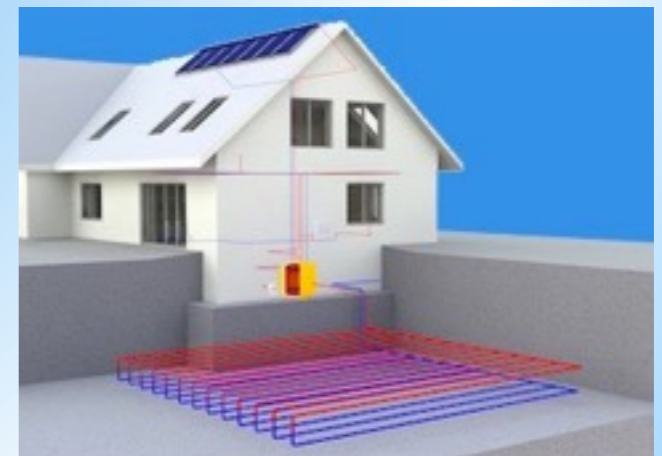
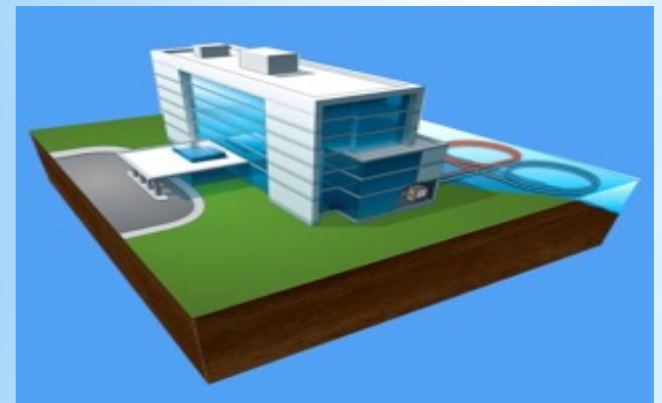
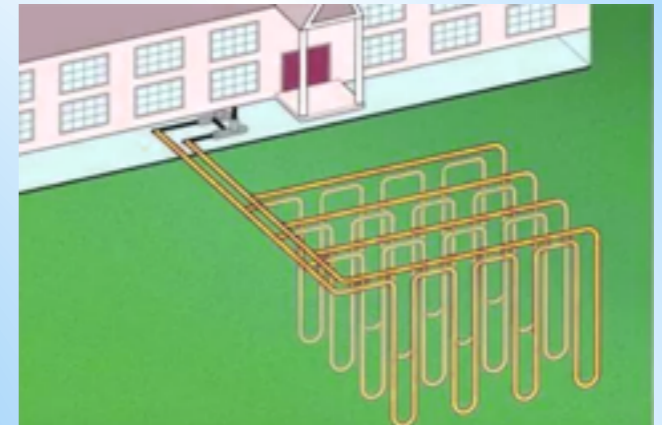
THE ABOVE-GROUND AIR IS COLDER IN WINTER & WARMER IN SUMMER THAN THE BELOW-GROUND TEMPERATURE

ELECTRIC GROUND SOURCE HEAT PUMPS BUILD ON THAT TEMPERATURE DIFFERENTIAL, RESULTING IN A HIGHLY EFFICIENT, GENERALLY CLEAN RUNNING HEATING & COOLING SYSTEM

IT CUTS ATMOSPHERIC DAMAGE CAUSED BY GHG, REDUCES NO_x, CARBON MONOXIDE & VOLATILE ORGANIC COMPOUNDS.

SYSTEM COMPONENTS:

1. GEO FIELD CONTAINING MOSTLY WATER IN TUBES IN THE GROUND OR IN A WATER BODY - VERTICAL OR DIAGONAL BOREHOLES, OR HORIZONTAL TRENCHES
2. GROUND SOURCE HEAT PUMP - LIKE A SMALL FURNACE
3. IN-BUILDING HEAT OR COOLING DELIVERY - CAN BE FORCED AIR OR WATER-BASED (RADIATORS, IN-FLOOR RADIANT, OFFICE CEILING PANELS, ETC.)



PROJECT EXAMPLES

AUSTIN TEXAS: WHISPER VALLEY
LARGE MICRO-GRID SUBDIVISION (GEO)



RICHMOND BC: LULU'S ALEXANDRA
DISTRICT HEATING & COOLING (GEO)

TORONTO:
THE PLANT IN LIBERTY VILLAGE (GEO)

OTHER GEOTHERMAL PROJECTS



PLEASE DON'T HESITATE TO ASK FOR
CONTACT INFORMATION RE CASE
EXAMPLES, TECHNICAL DETAILS.
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WHISPER VALLEY, AUSTIN, TEXAS

- ONE PROGRESSIVE DEVELOPER,
FIVE LARGE BUILDERS
- AIM: ESTABLISH MODEL FOR
FUTURE MASTER PLANNED COMMUNITIES
- 7500 AVERAGE PRICE HOMES
IN AUSTIN
- HIGH TECH PACKAGE, GEOTHERMAL
COOLING, SOLAR – ALL STANDARD
- SYSTEMS MONITORED,
CONTINUOUS DATA ANALYSIS



PRODUCTION BUILDING WITH CLEAN ENERGY

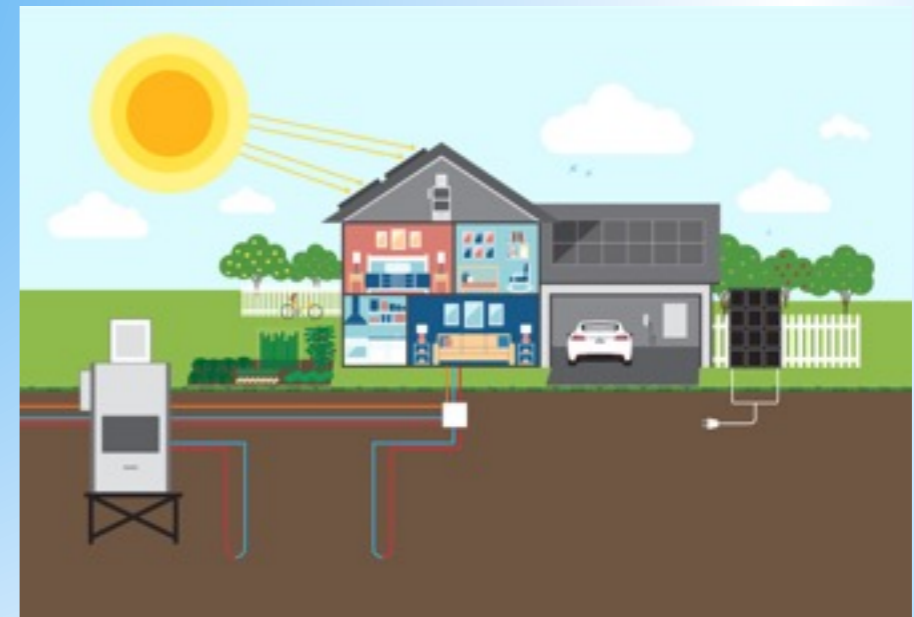
“The adjustments that I’ve made as a traditional land developer have not been dramatic. I can embrace these principles without making major changes in my business model. The changes that we need to make in this industry...can be implemented by all developers, all builders, all cities.”



DOUGLAS GILLILAND, PRESIDENT OF DEVELOPER TAURUS OF TEXAS, AND MANAGING PARTNER OF WHISPER VALLEY.

EASY FOR BUILDERS

- SIMPLE TO CONNECT TO
GEOHERMAL COOLING & HEATING
- NO ELABORATE ACCOMMODATIONS FOR SOLAR,
SMART HOME, ENERGY STAR APPLIANCES
- NO PROBLEM SELLING THEM AS A FIRST OR SECOND
HOME, OR EMPTY-NESTER DOWNSIZE
- ECOSMART MANAGES AND MAINTAINS THE
GEO-GRID MUCH LIKE A GAS COMPANY
AND BILLS THE HOMEOWNERS.



ECONOMICS FOR OCCUPANTS

- SOLAR/GEO PREMIUM \$25K - \$30K FOR HOMES AT \$300K - \$400K PRICE POINT
- MORTGAGE COMPANIES NOW EASILY APPRAISING THE INVESTMENT
- MORTGAGE PAYMENT ABOUT \$120/MONTH HIGHER, MORE THAN OFFSET BY THE ENERGY SAVINGS.
- AVERAGE 1700 SQUARE FEET
UTILITY BILLS NORMALLY \$150-\$200, NOW \$50 OR LOWER
- HOMEOWNER TAX CREDIT FOR BOTH SOLAR EQUIPMENT AND GEO HEAT PUMP.



HOW DID THEY SAVE WHEN BUILDING IT?

1. COORDINATE INSTALL (OF GEO PLUS HIGH TECH FIBER) ACROSS ALL LOTS BEFORE HOMES GO UP.



2. OPTIMIZED MICRO-GRID LOOP SYSTEM - ANY HOUSE IN ISOLATION MIGHT NEED 2.5 BOREHOLES, BUT MICROGRID OPTIMIZATION MEANS 1.0 BOREHOLE TO ACHIEVE THE SAME CAPACITY (60% SAVING).



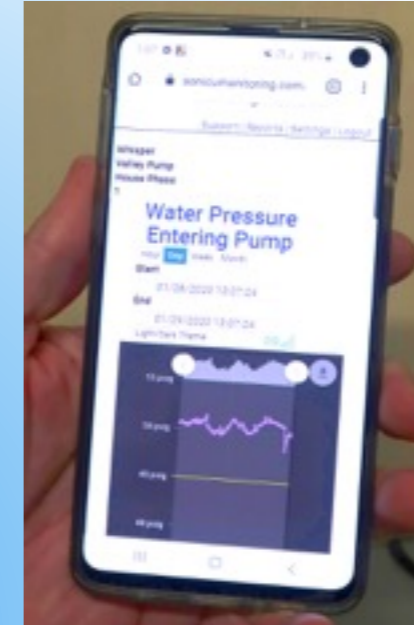
**BOSCH, ENERTECH HEAT PUMPS PROVIDE
2-4 TONS OF CONDITIONING.**



BACKUP & MAINTENANCE

EACH HOME'S SYSTEM CAN

- OPERATE AS PART OF THE COMMUNITY GRID
- CAN BE ISOLATED AND OPERATE FROM ONLY ITS BOREHOLE DURING MAINTENANCE (SMALL GEOTHERMAL MANHOLE IN EACH YARD BUT UNLIKELY TO BE USED).



EACH PHASE OF THE PROJECT (A FEW HUNDRED HOMES) INCLUDES ONE PUMP HOUSE AND ONE BACKUP ELECTRIC COOLING TOWER. COOLING TOWER IS USED FOR A HANDFUL OF DAYS EACH YEAR DURING SUMMER IN AUSTIN. MONITORING SYSTEM SENDS ALERTS TO OFFICE AND MOBILE DEVICES RE TEMPERATURE, WATER PRESSURE ANOMALIES.



SOLAR FOR ZERO ENERGY

- STANDARD EQUIPMENT
SOLAR ARRAYS OF AT
LEAST 37.5 MEGAWATTS.
- HOME BATTERY STORAGE
NOW OPTIONAL,
SOON TO BE STANDARD
- 25-YEAR WARRANTY



BUYERS WANT TECH, GREEN, WELLNESS

- FIRST OR SECOND HOME BUYERS
- EMPTY NEST DOWN-SIZERS
- CLEAN ENERGY & TECH: GOOGLE FIBRE, NEST THERMOSTATS, ELECTRIC VEHICLE CHARGERS, SMART HOME SECURITY & ENTERTAINMENT
- HEALTHY LIFESTYLES: 700 ACRES OF OUTDOOR SPACE, WOODS, BIKE PATHS, JOGGING TRAILS, COMMUNITY RECREATION SPACE, SWIMMING POOL, YOGA CENTRE, COMMUNITY GARDEN WITH FULL TIME FARM MANAGER, ELEMENTARY SCHOOL, RETAIL STORES, SOME MULTI-FAMILY HOUSING.



MODERN MAINSTREAM BUYERS WANT GEOTHERMAL!

ALEXANDRA DISTRICT ENERGY UTILITY

ALEXANDRA IS MANAGED BY RICHMOND'S WHOLLY-OWNED UTILITY LULU ISLAND ENERGY COMPANY. TWO LULU PROJECTS, ALEXANDRA & OVAL VILLAGE WILL REDUCE GHG EMISSIONS BY MORE THAN 70,000 TONNES.

EMISSIONS 70% - 80% LESS THAN CONVENTIONAL. ALEXANDRA HAS WON 13 LOCAL, NATIONAL AND INTERNATIONAL AWARDS.

IN THE PAST 50 YEARS RICHMOND POPULATION HAS DOUBLED, AND IS EXPECTED TO GROW BY ANOTHER 40%. PER HOUSEHOLD ENERGY USE WILL INCREASE BY 25%, NEXT 15 YEARS.

NEVERTHELESS, RICHMOND EMISSIONS ARE DECLINING.



ALEXANDRA HISTORY

COUNCIL ADOPTED EMISSIONS TARGETS,
REALIZED DISTRICT ENERGY & BUILDINGS
ARE WITHIN ITS MANDATE & CAN MAKE AN IMPACT.

IT HAD DIFFICULTY FINDING EXPERTISE
& THEN CAME THE 2008 CRASH.

IN 2010 A DEVELOPER APPROACHED THE CITY,
REQUESTING USE OF THE PARK FOR
GEOTHERMAL HEATING AND COOLING.

RICHMOND DECIDED TO CO-OPT
& CONTROL A BIGGER PROJECT.



ALEXANDRA HISTORY

COUNCIL MANDATE REQUIRED THAT THE PROJECT COULD NOT BECOME AN ADDED BURDEN ON TAXPAYERS, MUST BE SELF-SUSTAINING, & UTILITY RATES MUST BE COMPETITIVE WITH CONVENTIONAL ENERGY COSTS.

ENDORSED CONSTRUCTION OF 3100 RESIDENCES, SOME COMMERCIAL, 3.9 MILLION SQUARE FEET, 19 MEGAWATTS, 2000-6000 TONNES ANNUAL GHG REDUCTION.

Thank you to Alen Postolka, P.Eng, CEM, CP, Manager, District Energy. On request I can pass along his contact info, and contact info for several other key people. This project was part of FCM's Partners for Climate Protection program. Partial funding of pre-feasibility and feasibility studies was provided by BC Hydro's Sustainable Communities Program.

ALEXANDRA DEVELOPMENT TIMELINE
• February 2010 - ADEU prefeasibility study completed.
• February 2010 to October 2010 - partnership negotiations with developer
• November 2010 - Council approves Oris Geo Energy Ltd for design/build Remy (Seniors & affordable 81 units) & Alexandra Gate (Condos)
• January 2011 - Council adopted ADEU Bylaw to expand the ADEU service to larger Alexandra neighborhood (estimated 3.9 million square feet of residential, commercial, office & institutional space).
• March 2011 - construction of Phase 1 of the ADEU commenced
• May 2012 - construction of Phase 1 of the ADEU completed
• July 2012 - ADEU system commissioning completed & first 100 residential units connected
• By the end of 2012 more than 600 residential units scheduled to be connected
• 2012-2014 - Three residential buildings connected.
• 2015-2017 phase 3 & 4 - Six residential structures & a large retail development. Walmart, daycare, some market rate private, some affordable city properties
• 2018-2020 phase 5 - in process, residential
• Modelling has been accurate, with energy and operating costs savings slightly better than modelled.

GEO THERMAL

- ADDRESSES CLIMATE CHANGE WITH ZERO TO LOW GREENHOUSE GAS EMISSIONS.
- STABLE ELECTRIC TECHNOLOGY WITH LOW DRAW MINIMIZES RISK OF ENERGY PRICE VOLATILITY.
- CITY CONTROL PROTECTS TENANTS FROM DRAMATIC OR UNFAIR RATE INCREASES.
- HEALTH & COMFORT BENEFITS FOR OCCUPANTS.

Geo fields are relatively simple tech with a useful life of at least 50 years. Like furnaces, ground source heat pumps have a useful life of 15-25 years with regular technology improvements becoming available. Heat pumps require significantly less maintenance than combustion appliances.



JOBS & SKILLS

- LULU ESTIMATES* IT HAS PROVIDED 630 DESIGN & CONSTRUCTION JOBS & 10 FULL-TIME PERMANENT OPERATIONS POSITIONS.
- TRIGGERS LOCAL WORKFORCE SKILLS DEVELOPMENT RE NEW TECHNOLOGY OPERATIONS & MAINTENANCE.
- LOCAL ARTISTS CREATE PUBLIC ART FOR ENERGY PLANT EXTERIORS.
- ONE QUARTER OF CONTRACTORS HEADQUARTERED IN RICHMOND, PROVIDING STABLE EMPLOYMENT & KNOWLEDGEABLE CONTRACTORS FOR THE CITY.



*Using NREL: "District Energy Economic Model (DEEM) Development and Testing: Phase II Final Report, ICF Marbek," April 2011.

ECONOMICS

- GENERATES REVENUE, REDUCES MUNICIPAL DEPENDENCY ON TAXES.
- LONG TERM INCOME STREAM PAYS BACK CAPITAL AND COVERS ON-GOING OPERATING COSTS.
- THE BUSINESS MODEL RESULTS SHOW A 7.5% RATE OF RETURN OVER A 30 YEAR PERIOD.



- LULU ENERGY HAS BECOME A VALUABLE ECONOMIC & SOCIAL ASSET FOR THE RICHMOND COMMUNITY.
- ELECTRICITY FROM NEARBY RENEWABLE SOURCES, KEEPS ENERGY DOLLARS IN THE LOCAL ECONOMY.



EXECUTION

- FUNDING FOR ADEU PHASE 1 CAME FROM THE CITY'S WATER UTILITY RESERVE.
- RICHMOND IS ALSO EXPLORING SOURCES SUCH AS CITY RESERVES, EXTERNAL BORROWING, 3P, GOVERNMENT GRANTS.
- THIS ADDS TO LEARNING, & BUILDS BEST PRACTICE MODELS.
- BECAUSE IT IS A CITY OWNED & CONTROLLED UTILITY, INFRASTRUCTURE ADDITIONS ARE PHASED TO MATCH THE SPEED OF DEVELOPMENTS.
- JUST-IN-TIME APPROACH AVOIDS UNNECESSARY TIE-UP OF CAPITAL.



DISTRICT ENERGY

- DISTRICT ENERGY SAVES THROUGH VOLUME ENERGY PURCHASES.
- CUTS DUPLICATION, REDUCING LONG TERM MAINTENANCE COSTS.
- EASY TO ADAPT FOR FUTURE TECHNOLOGIES & ENERGY SOURCES SUCH AS ADDING THERMAL STORAGE, SEWAGE HEAT RECOVERY, ETC.
- DISTRICT ENERGY SAVES SPACE BY SHARING & OPTIMIZING PLANT & EQUIPMENT.



PROJECT MANAGEMENT LESSONS

COMMUNITY LEADERSHIP
BY COUNCIL & SENIOR
ADMINISTRATION IS KEY.

DEFINE ACCEPTABLE
FINANCIAL EXPECTATIONS
SUCH AS PAYBACK TIME
& RATE STRUCTURE,
AS WELL AS COMMUNITY
& ENVIRONMENTAL BENEFITS.



TECH & TECH CHALLENGES

Geotility field consists of 385 boreholes, each 76m (250') deep, creating a huge geo-exchange field, beneath a city greenway corridor. 400+ tons of cooling and heating provided by thirty 1" loops per header, with 4" supply and returns back to the vault, and from there 10" hdpe to and from the properties. Careful purging of debris and airlocks for expected efficiency. Every test documented and signed off. Two 75 horsepower pumps at 1750 gpm, two 50 horsepower circulation pumps, and three 500-gallon expansion tanks located in the energy centre. The furthest building is 500 metres from the energy centre. Each building's controls modulate the flow of water from the utility according to conditioning loads. Individual building controls and the controls in the Energy Centre are all remotely monitored and data analyzed. Ground source pumps elevate water temperatures for heat or reject heat back into the system for cooling. Minimum supply temperature of -1°C (30°F), maximum of 32°C (90°F). Backup and peak heat supplement: 1.0 MW condensing, gas-fired boiler.



- HIGH WATER TABLE MEANT DROPPING LOOPS INTO TRENCHES FULL OF WATER WITH SOCKET & BUTT FUSING & OBSESSIVE PRIOR PRE-TESTING.
- LOCATED ON AIRPORT FLIGHT PATH MEANS MOST BUILDINGS KEEP OPERABLE WINDOWS CLOSED, ADDING TO COOLING LOADS.

THE PLANT & OTHERS WITH ADAM ALAICA



SWITCH TO ADAM



QUESTIONS & DISCUSSION

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- Energy, batteries, micro-grids & new kinds of storage (Goderich & beyond)
- And much more...

THANK YOU

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