DISTRICT ENERGY SHARING SYSTEM

GEOEXCHANGE & HEAT RECOVERY IN MANCHESTER

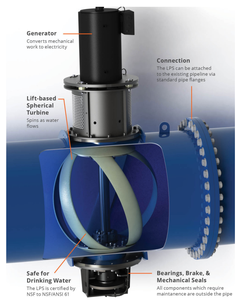
PRECEDENTS

Blatchford
District Energy Sharing System
Edmonton, AB, Canada

- Heats homes and commercial buildings for a build-out population of 30,000
- Uses four geoexchange fields located under parks and stormwater ponds
- Sewer heat recovery boosts the ambient temperature flows

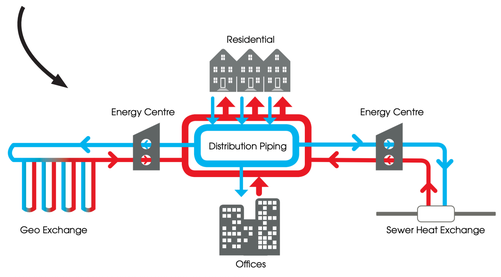
False Creek NEU
Sewer Heat District Heating
Vancouver, BC, Canada

- District heating that services 534,000m^2
- Sewer heat recovery eliminates more than 60% of greenhouse gas emissions
- New expansion is set to service 21,000,000m^2 with an anticipated CO2 equivalent reduction of 14,000 tonnes per



Lucid Energy
In-pipe Hydro Turbines
Portland, OR, USA

- Series of four turbines installed within existing water mains
- No impact on water delivery
- 900 MWh/year output
- Turbines available for three pipe diameters
- Next generation turbines expected to have double capacity outputs



EXAMPLE OF DESS SYSTEM, GRAPHIC FROM CITY OF EDMONTON

Manchester's Geoexchange

- Closed system borehole fields
- Temperature upgraded by heat pumps
- Depth: 150m
- Approximately 30 hectares of geoexchange fields at five locations under park space, storm water ponds, parking

District Energy Sharing System

- Temperature by demand at buildings
- Diverse land use allows for most efficient sharing between bulidings
- Flexible system allows for multiple green heat and electricity sources to plug in

The Manchester District Energy Sharing System (DESS) combines net-zero community heating and cooling with infrastructure tourism.

Each district energy facility has its own unique identity that celebrates different aspects of the community's intersecting systems. By making infrastructure visible, providing demonstrations, and creating opportunities for people to interact with the systems that support their community, these facilities serve to educate citizens and promote green energies and lifestyles.

18.4%
TOTAL HEAT ENERGY FOR MANCHESTER

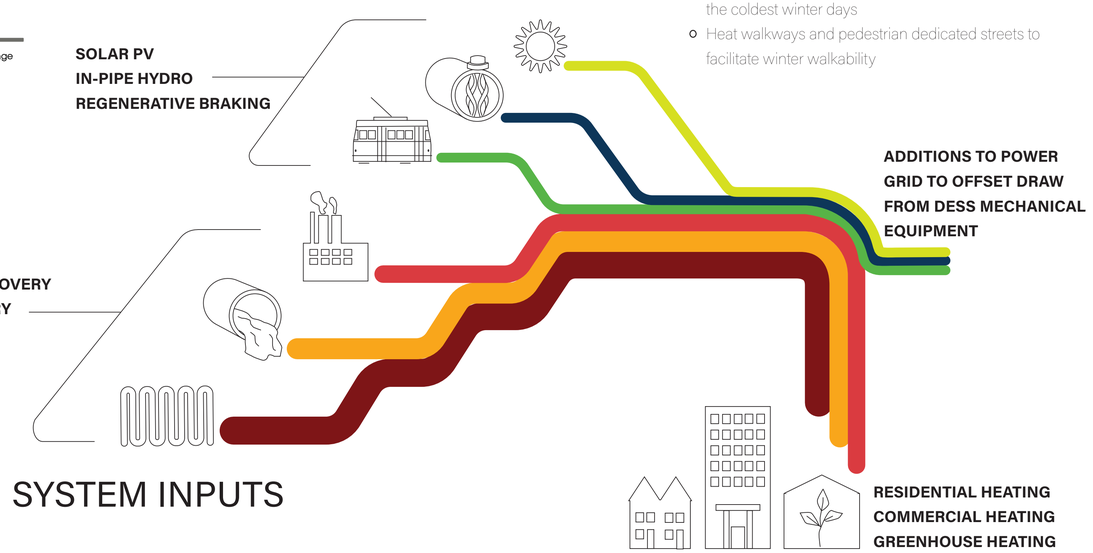
Based on Manchester's total heat demand of:
3,338,000 GJ &
477,000 GJ at Passive House Standard

613,728 GJ
PROJECTED THERMAL OUTPUT

128%
TOTAL HEAT ENERGY FOR MANCHESTER AT PASSIVE HOUSE STANDARD

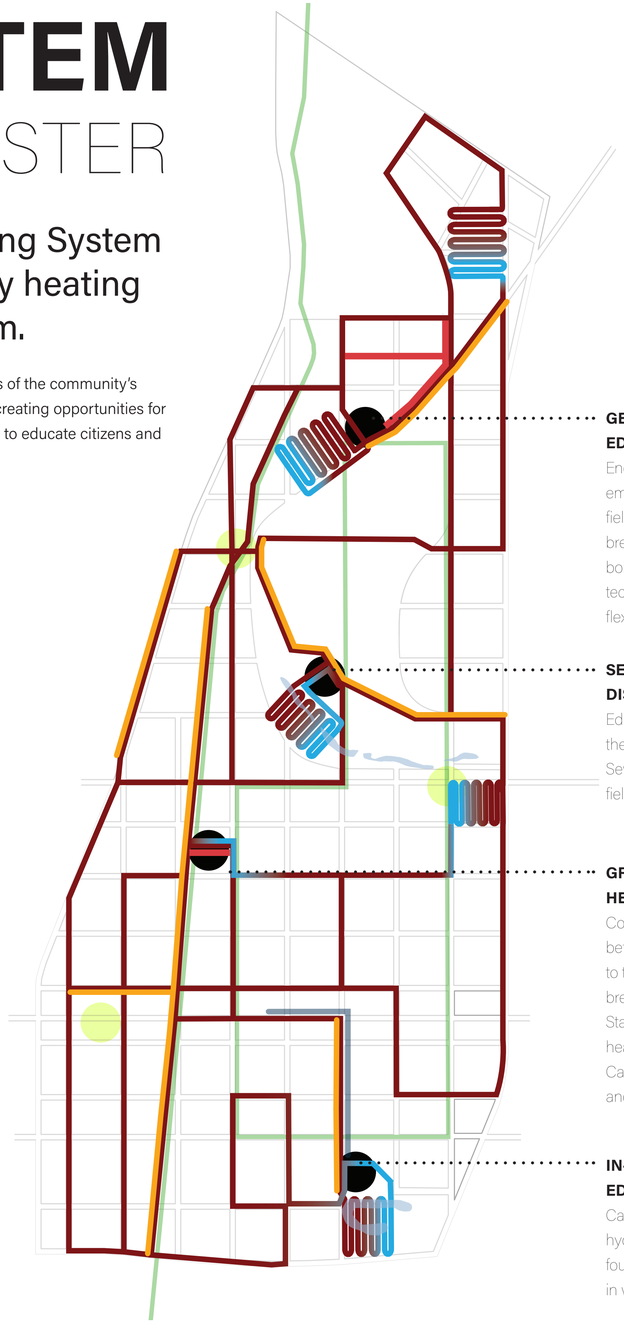
After meeting Manchester's needs, excess heat can:

- Warm more greenhouses for food production
- Heat additional buildings outside Manchester
- Be converted to electric energy
- Be stored in underground thermal storage for use during the coldest winter days
- Heat walkways and pedestrian dedicated streets to facilitate winter walkability



SYSTEM INPUTS

SYSTEM OUTPUTS



GEOEXCHANGE & ENERGY EDUCATION CENTRE
Energy station with educational emphasis on the five geoexchange fields throughout the community, brewery waste heat recovery from boiling wort. and the future of green technologies that can be tied in to the flexible system.

SEWER HEAT EXCHANGE DISCOVERY CENTRE
Educational facility with emphasis on the DESS' synergies with water systems. Sewer heat recovery and geoexchange field under stormwater pond.

GREEN RECREATION CENTRE & HEAT RECOVERY STATION
Competition sized sports facility situated between the LRT and streetcar system to take advantage of regenerative breaking power. Built to Passive House Standards and with a visible arena heat recovery exchange. (The average Canadian arena rejects between 1,000 and 2,000 MWh/y in ice production.)

IN-PIPE HYDRO ENERGY EDUCATION CENTRE
Calgary's pioneer facility for in-pipe hydro power generation. Two series of four Lucid Energy turbines are installed in water mains producing 2522MWh/y.

DISTRIBUTION & FACILITIES

- **DISTRICT ENERGY FACILITY**
- **GEOEXCHANGE FIELD**
- **DISTRIBUTION NETWORK***
  *represents primary network-secondary pipes deliver to users
- **PRIMARY SEWER HEAT RECOVERY**
- **UNIQUE INDUSTRIAL HEAT RECOVERY**
- **IN-PIPE HYDRO**
- **TRANSIT REGENERATIVE BRAKING**
- **STORMWATER POND**
- **BIOMASS FACILITY**

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