Neighbourhood Scale Decarbonization

Panel 4C

NATIONAL BUILDING DECARBONIZATION FORUM | APRIL 2024

Moderator: Sachi Gibson

CANADIAN CLIMATE INSTITUTE | L'INSTITUT CLIMATIQUE DU CANADA

April 18, 2024

Neighborhood- Scale Decarbonization

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Trent Berry, Principal, Reshape Infrastructure Strategies

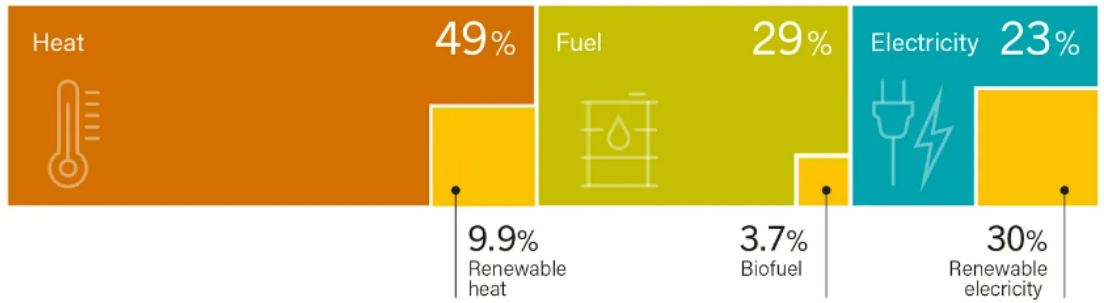
RESHAPE STRATEGIES

April 18, 2024

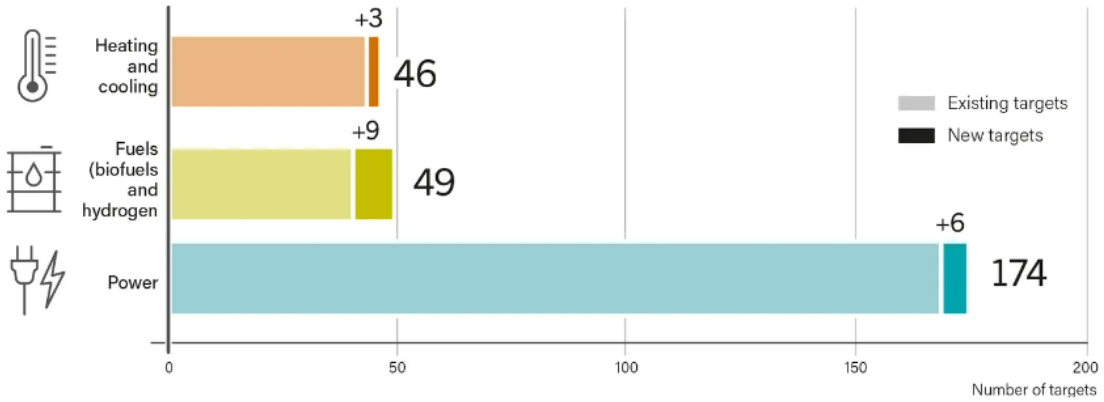
Heat: The Sleeping Giant of the Energy Transition

Buildings & industrial processes

Total Final Energy and Total Modern Renewable Energy Share, by Energy Carrier, 2020



Renewable Power and Heating and Cooling Targets, 2022



Source: Renewables 2023 Global Status Report, REN21 (Data from IEA World Energy Balances)
https://www.ren21.net/gsr-2023/modules/energy_supply/01_energy_supply/

Almost complete decarbonization of heat is required by 2050 to meet Paris commitments.

Few countries progressing at adequate rate or scale on heat.

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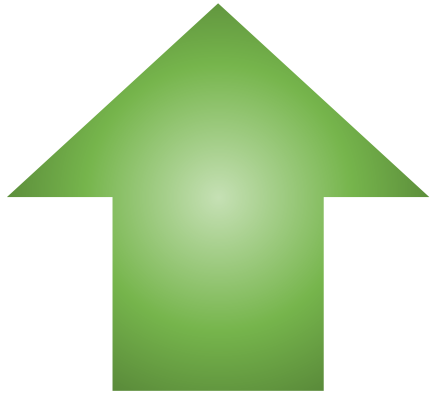
Simplistic Narrative



Electricity Use
+ Green Electricity Sources

Gas Use
+ Green Gases

“Moving away from fossil fuels is more than just a fuel change – it is a transformation of the way we design, build and invest in the infrastructure for a net-zero future.”

- Agora Energiewende

Photo: By mguido stock.adobe.com

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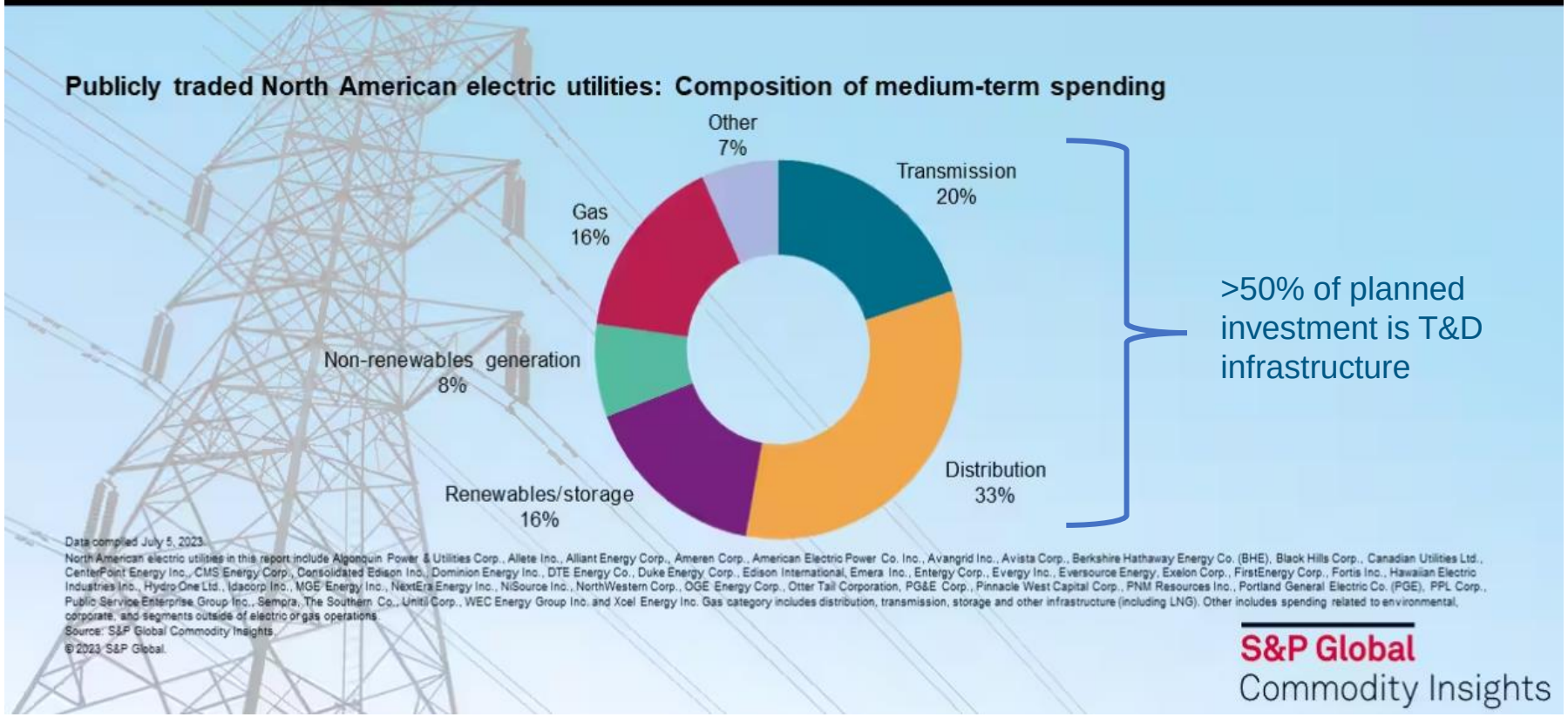
Spending from North American electric utilities will be focused on the transmission and distribution segments



Key Drivers:

- Aging infrastructure
- Resilience
- Electrification
- Distributed electricity sources

Source: https://www.spglobal.com/commodityinsights/en/ci/research-analysis/north-american-power-electric-utility-capex-growth-is-expected.html

Blindspots

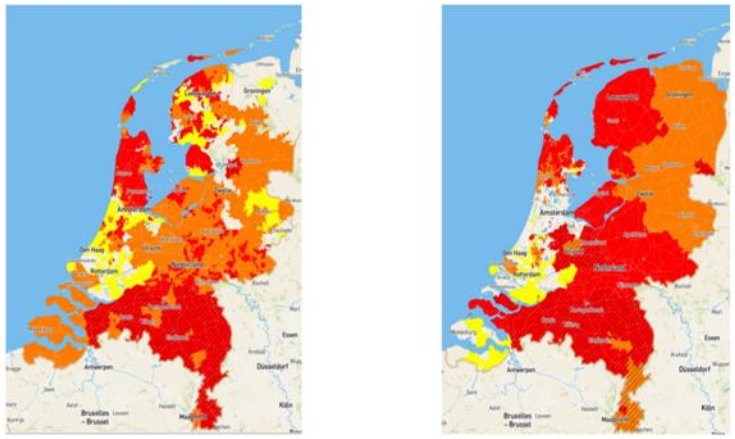
Electric Grid Constraints

Wood Mackenzie

OPINION

The Netherlands' gridlock: a cautionary tale for the US

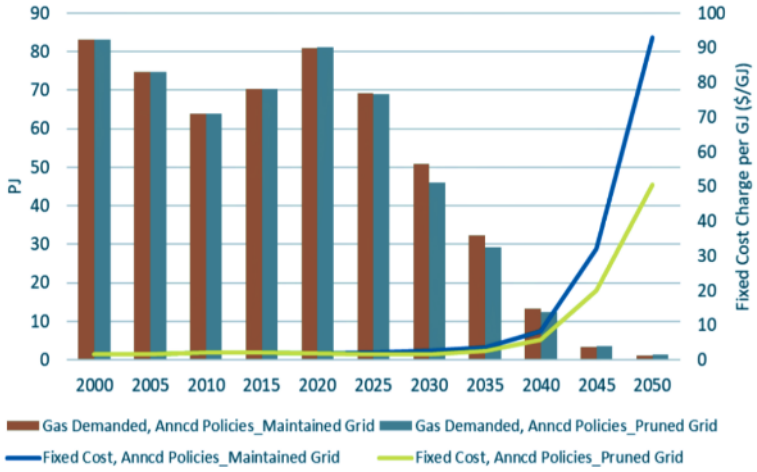
Grid congestion map: load connection (left) and generation connection (right)



Transparent: Transport capacity available
Yellow: Limited transport capacity available
Orange: No transport capacity available for the time being pending the outcome of the congestion management study
Red: No transport capacity available: congestion management cannot be applied

Source: https://capaciteitskaart.netbeheernederland.nl/

Gas Grid Implications

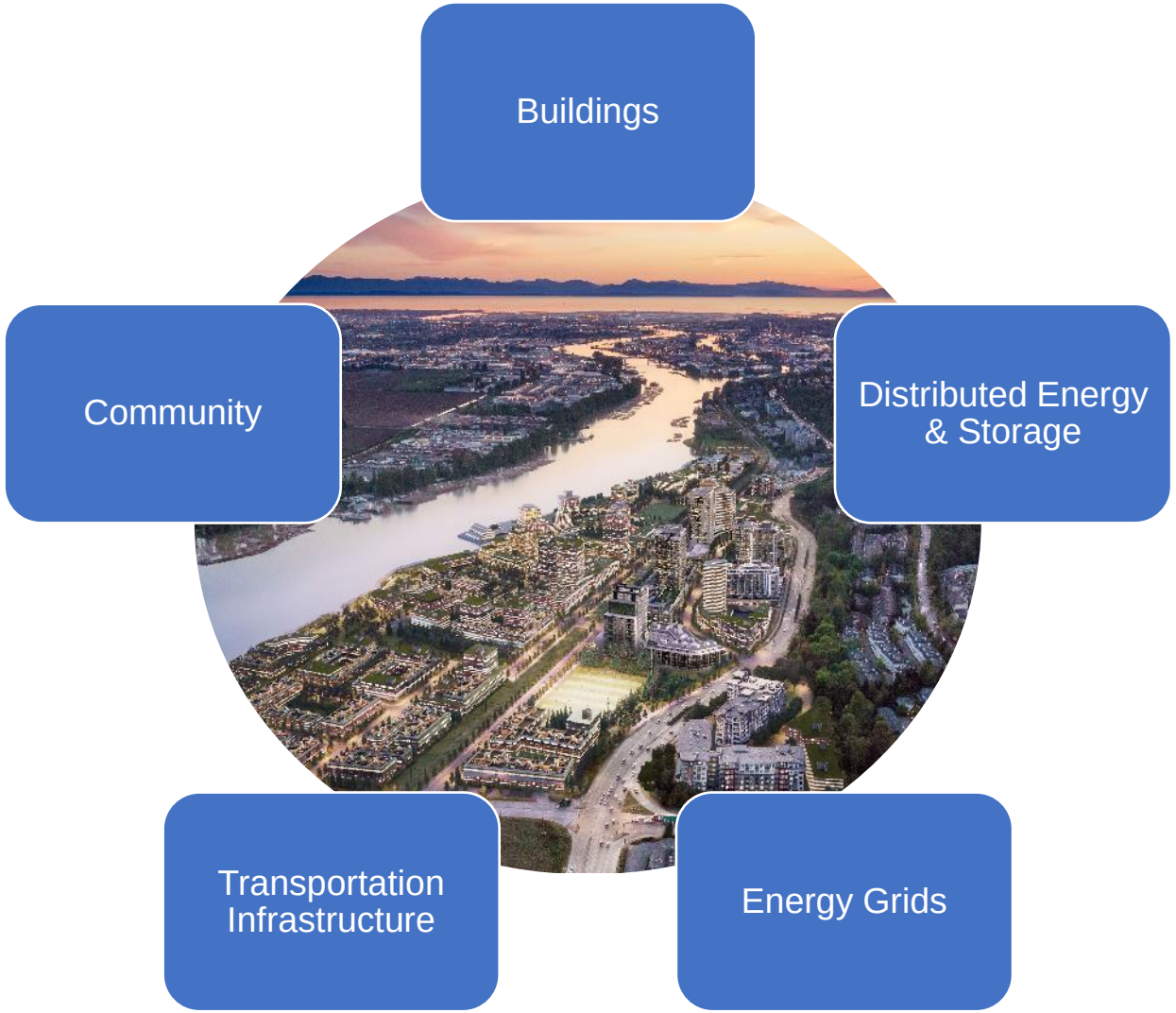


"Towards net zero heating: An analysis of technology and policy pathways for decarbonizing building heat in British Columbia" (Thompson, 2023).

Complementary Solutions

- Waste heat
- Thermal networks & storage
- Integrated energy systems
- Spatial prioritization & coordination of solutions (area-based planning)

Neighbourhoods: The Last Kilometer of the Energy Transition



- Coordinate/ integrate multiple infrastructures and energy sources
- Leverage community & place
- Increase scale & speed

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Neighbourhood Energy Systems

Neighbourhood Energy Systems

Thermal Networks

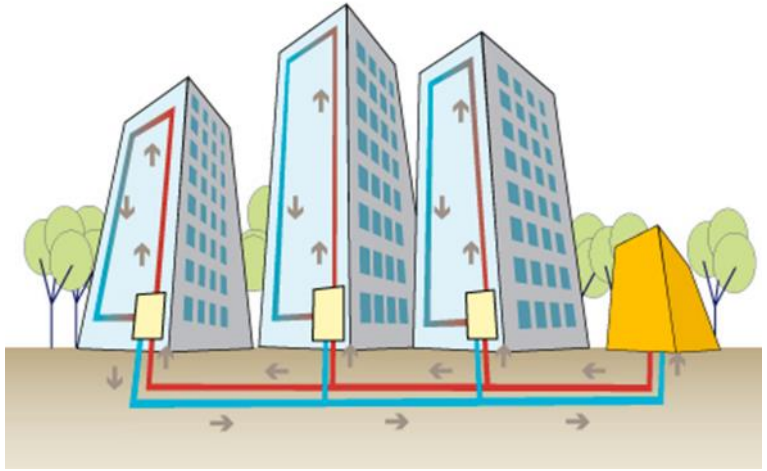
Heating
(including domestic hot water)

Cooling

Microgrids

Primary Power

Emergency Power



Short video “Why District Energy”

https://www.youtube.com/watch?v=7BznKyEb0bc&*t=15s*

from International District Energy Association

Short video “Microgrids: Evolving the Power Grid

https://www.youtube.com/watch?v=cVuQsskKITk&feature=emb_logo

from International District Energy Association

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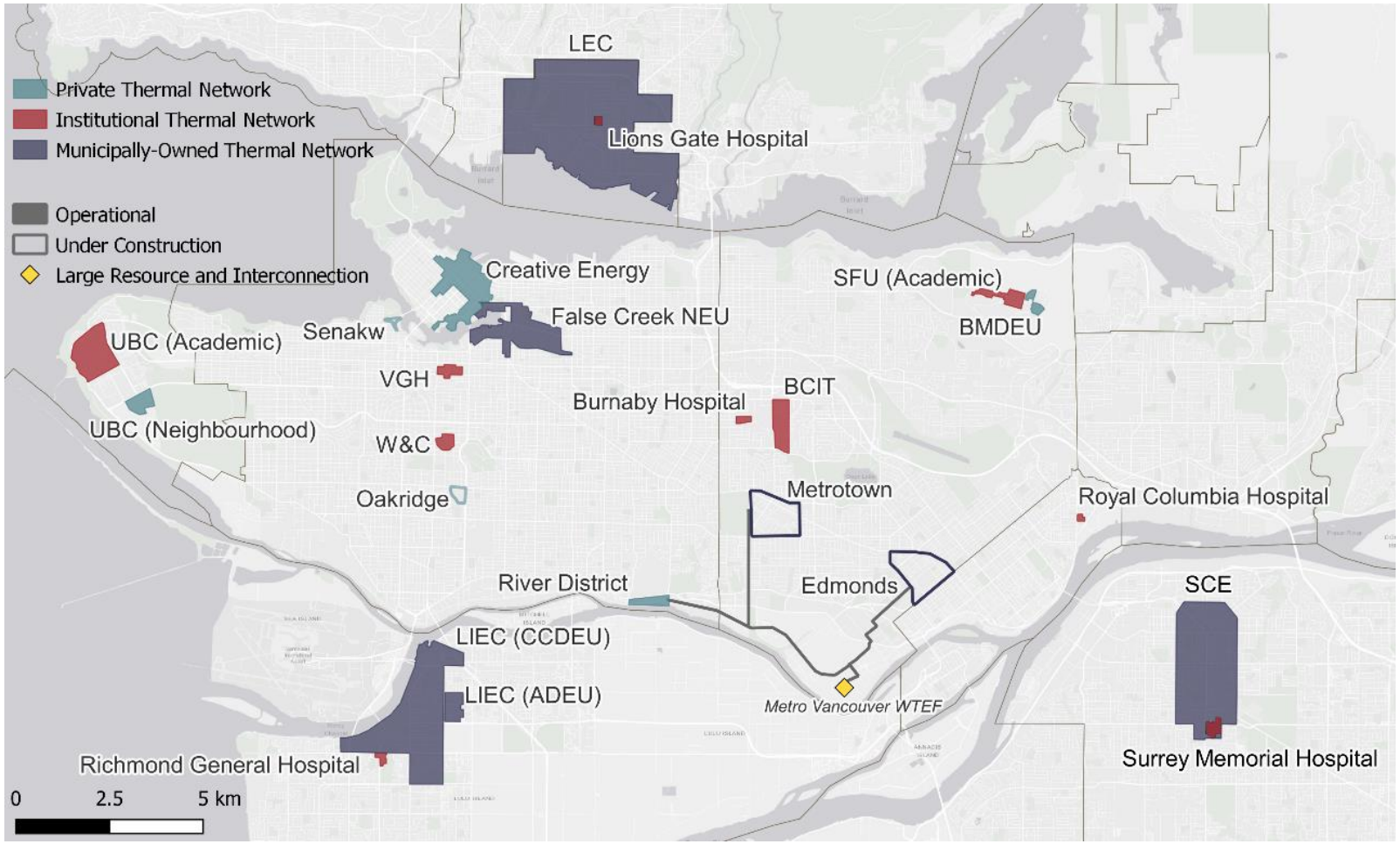
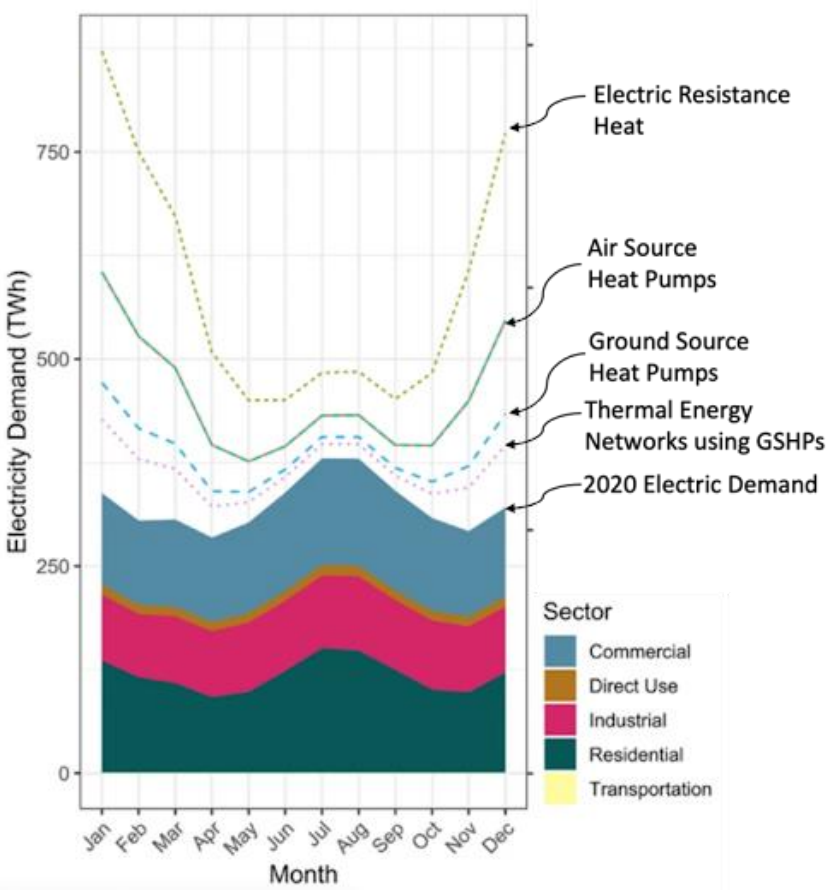
Thermal Networks in Lower Mainland of B.C.



Electric & Gas Grid Benefits

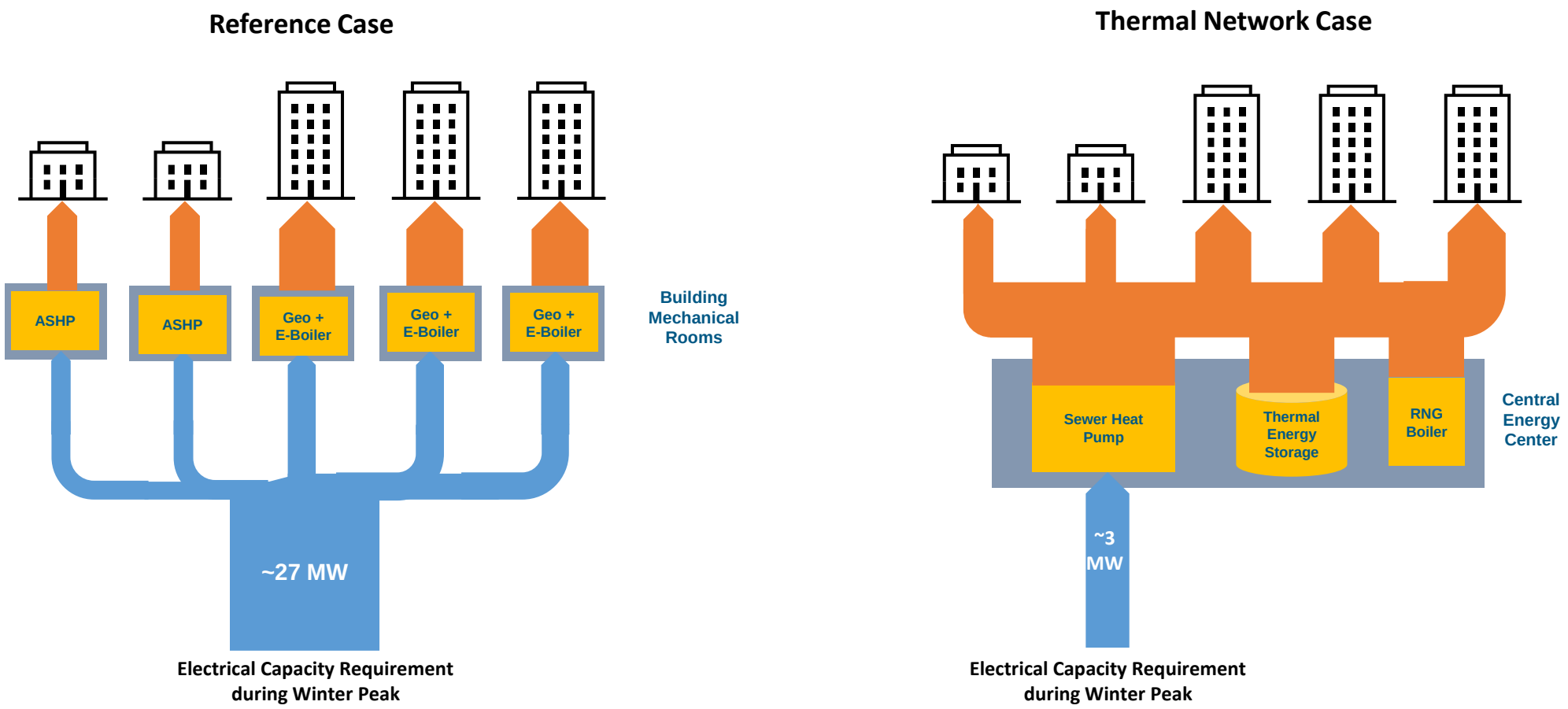
US monthly total electricity demand by sector and projected changes to total building energy demand under different building electrification scenarios.



Solid area represents 2010-2022 monthly demand on the US electric grid from buildings. Dashed lines represent projected monthly electricity demand from buildings under four electrification scenarios. Source (with modifications from Sightline Institute): Buonocore, J.J., Salimifard, P., Magavi, Z. et al. Inefficient Building Electrification Will Require Massive Buildout of Renewable Energy and Seasonal Energy Storage. Sci Rep 12, 11931 (2022).

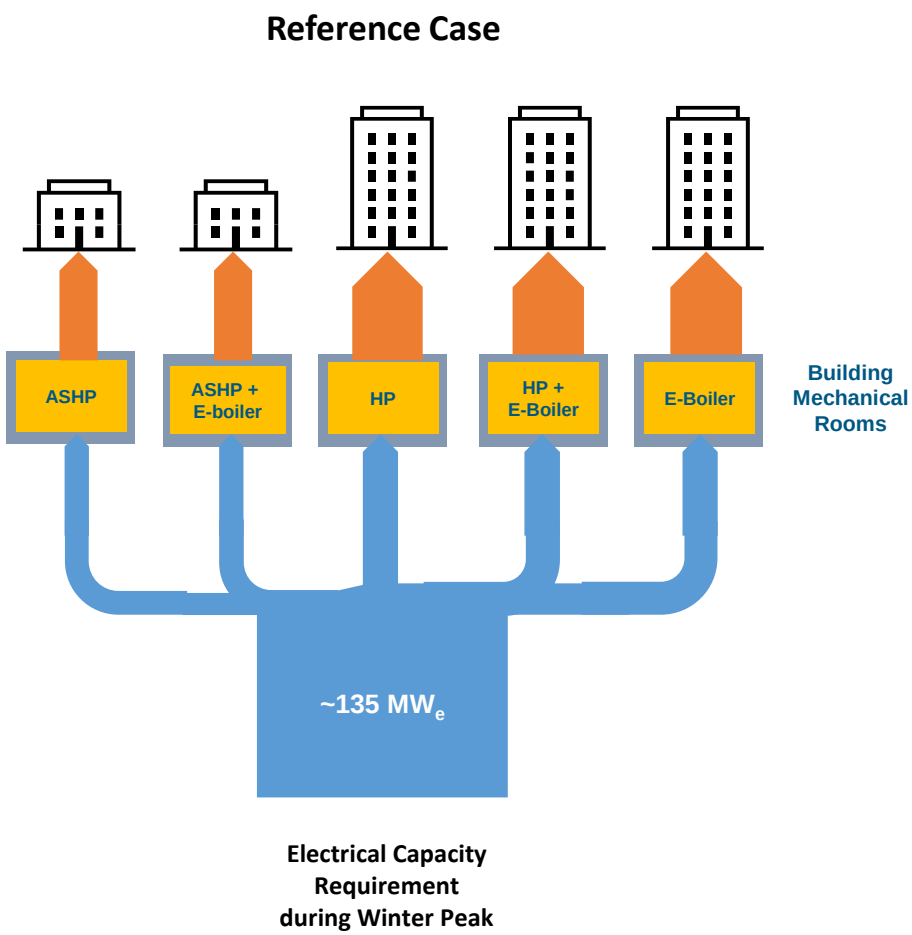
- More efficient electric heat sources
- Waste heat and non-electric energy sources
- Thermal storage
- Centralize gas use (for pruning gas grid and integration of novel gases)

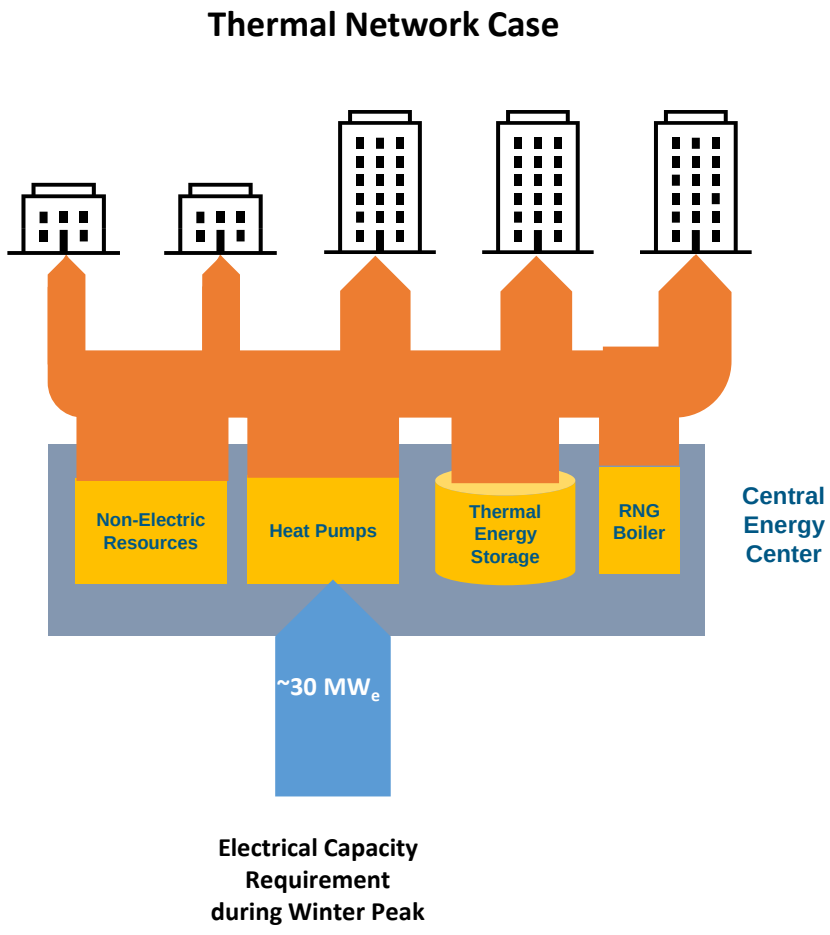
Example: New Neighbourhood in B.C.



Source: Reshape Infrastructure Strategies. 2023. *BC Hydro Sector Coupling Study*.

Example: Existing Neighbourhood in B.C.

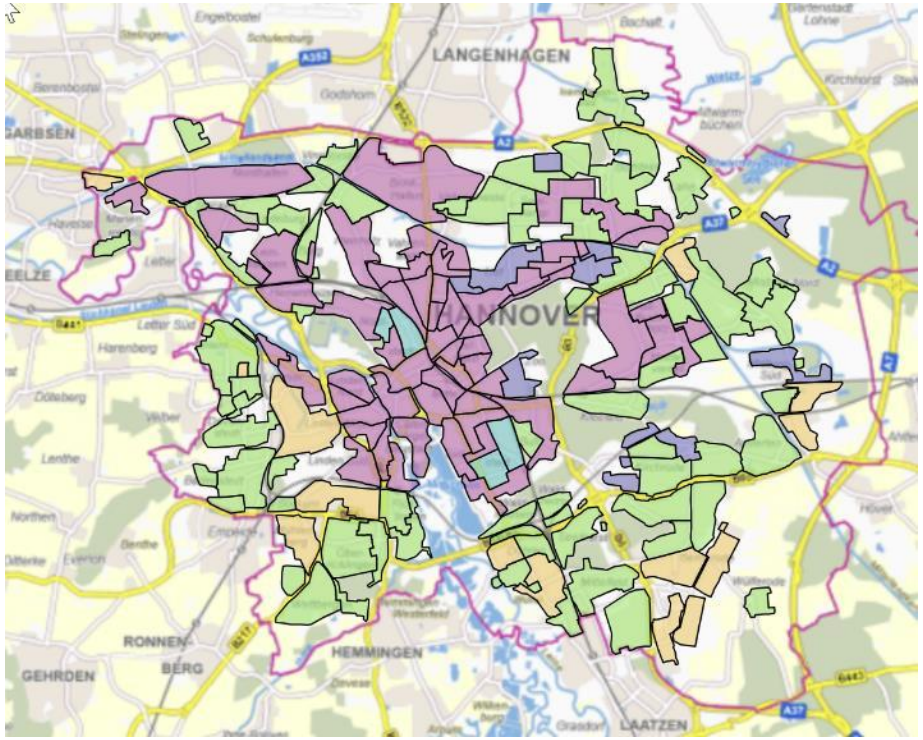




Source: Reshape Infrastructure Strategies. 2023. *BC Hydro Sector Coupling Study*.

Area-Based Plans and Approaches

Heating & Cooling Plan for Hannover, Germany



- Existing thermal network zones
- Thermal network expansion zones
- Thermal network study areas (expansion)
- Thermal network study areas (localized)
- Decentralized heating solutions (building scale)

- Optimal transition pathways by neighbourhoods
- Coordinated planning of local energy infrastructure
- Spatially targeted policies and delivery for building retrofits
- Citizen engagement and participation
- Coordination and facilitation by local governments

RESHAPE STRATEGIES

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Zürich Heating & Cooling Plan

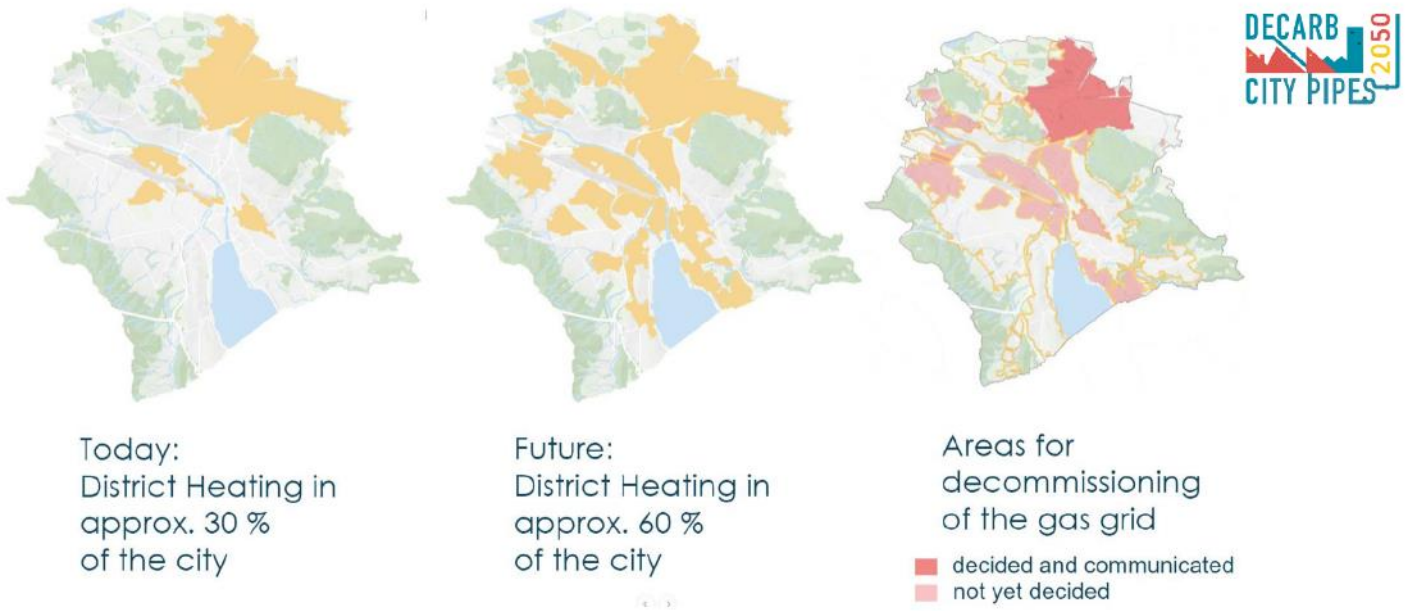


Image Credit: Decarb City Pipes 2050 from, "Legislative Barriers And Solutions To Unlock Cities' Heating And Cooling Strategies" (July 2023)

Some Features:

Clarity on areas for thermal networks

Clarity on areas for pruning gas grids (timing or further study)

Clarity for electric system upgrades

Examples of National Targets for Thermal Networks
(Current vs. Target Penetration)

Germany	UK	Netherlands	France
14%	2%	5%	3.5%
↓	↓	↓	↓
30% (2030)	20% (2050)	25% (2050)	15% (2035)

Examples of Requirements for Local Heating & Cooling Plans

European Union

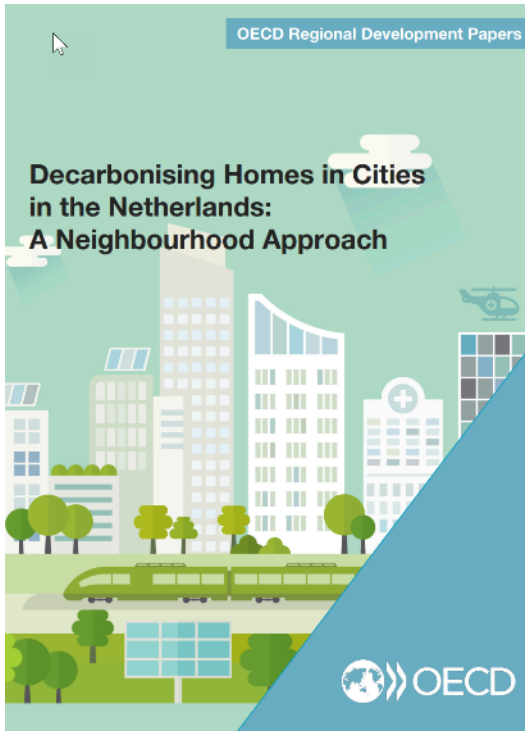
New EU mandate for all member states will require municipalities greater than 45,000 people to prepare local heating and cooling plans

Germany

New nation-wide mandate for community heat plans by 2026 for cities over 100,000 people and 2028 for smaller cities

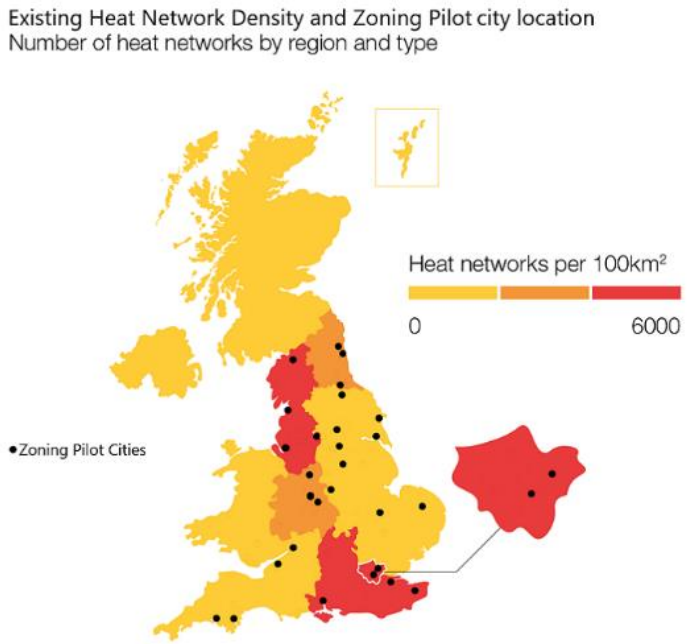
Examples of Pilots & Bottom-up Initiatives

Dutch Gas-free Neighbourhoods Pilot



https://www.oecd-ilibrary.org/urban-rural-and-regional-development/decarbonising-homes-in-cities-in-the-netherlands_b94727de-en

UK Heat Zoning Pilots



https://www.gov.uk/government/publications/heat-networks-zoning-pilot

Thank you!

RESHAPE STRATEGIES

Reshape Infrastructure Strategies
409 Granville Street, Suite 925
Vancouver, B.C. Canada, V6C 1T2

www.reshapestrategies.com

Neighborhood Scale Decarbonization

The Future of Building Decarbonization

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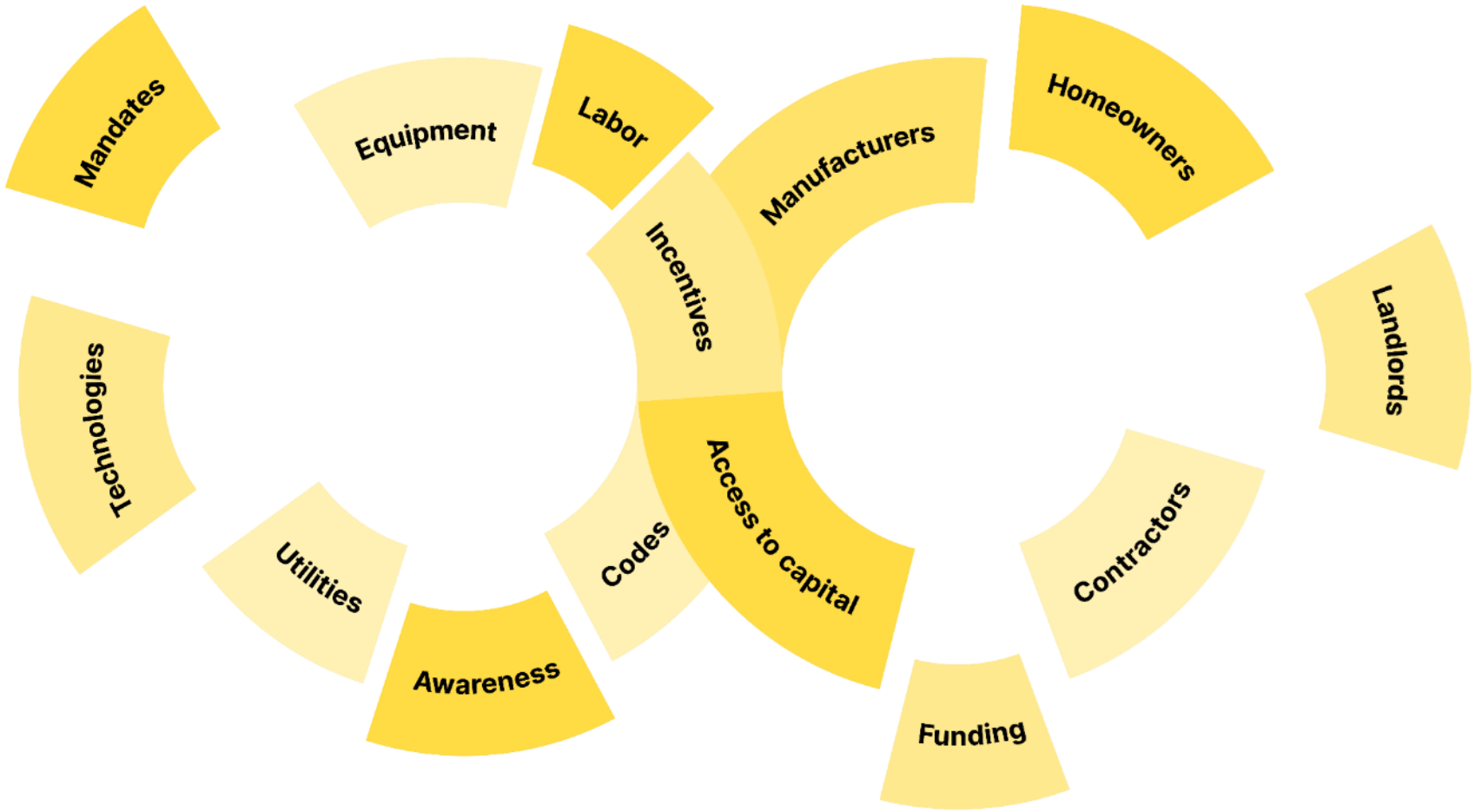
Ania Camargo, Thermal Networks Sr. Manager

BUILDING DECARBONIZATION COALITION

April 18, 2024

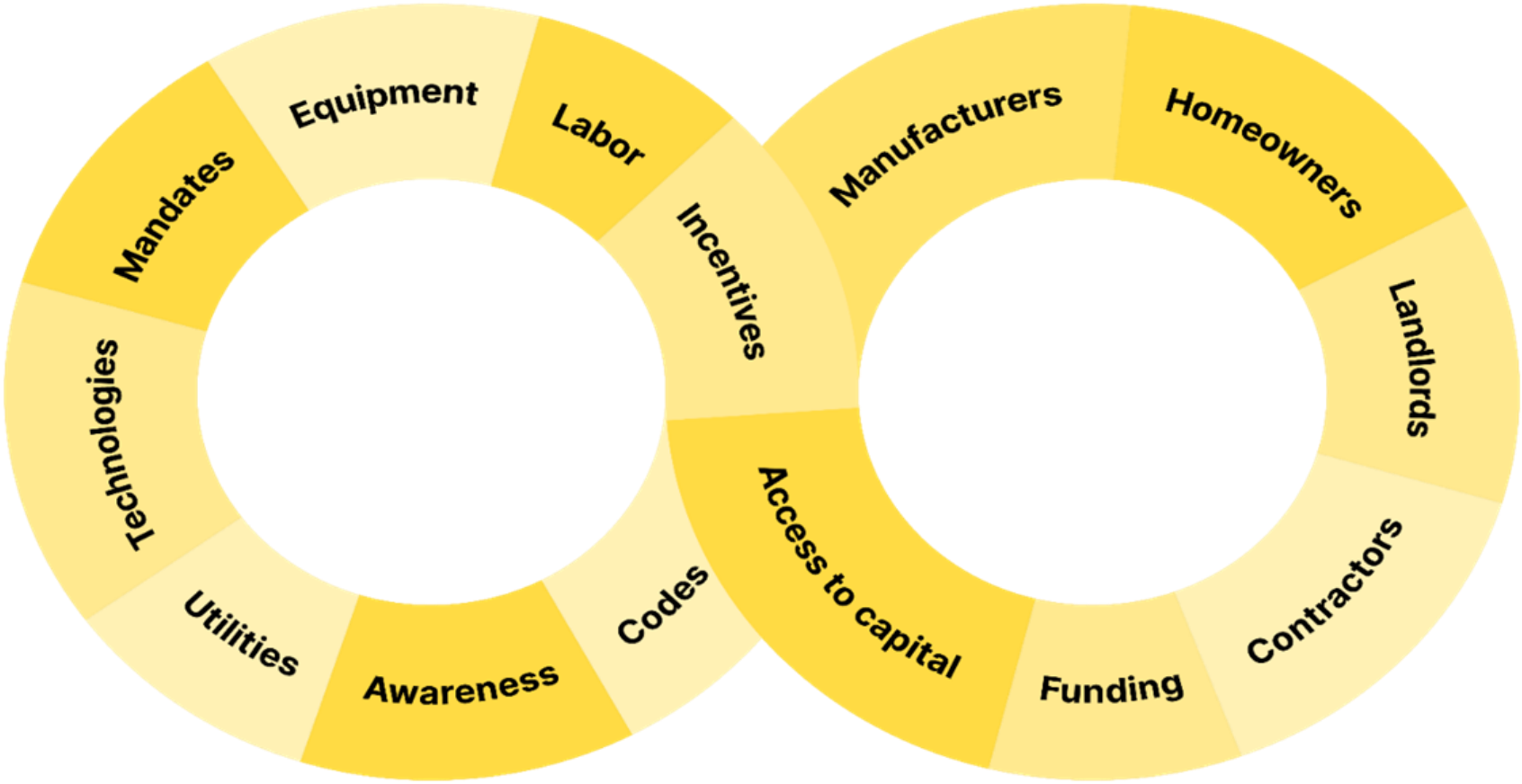
Our current approach to decarbonizing buildings is a mosaic of actors, decisions, and resources*



*This list is representative, not exhaustive; it includes tenants, community leaders, advocates, engineers, regulators, legislators, developers, builders, architects, training programs, education and awareness programs, local governments, customer service agents, and so on…

Unmanaged Transition, Increasing Gas Bills

We need a coordinated, scaled, and managed transition



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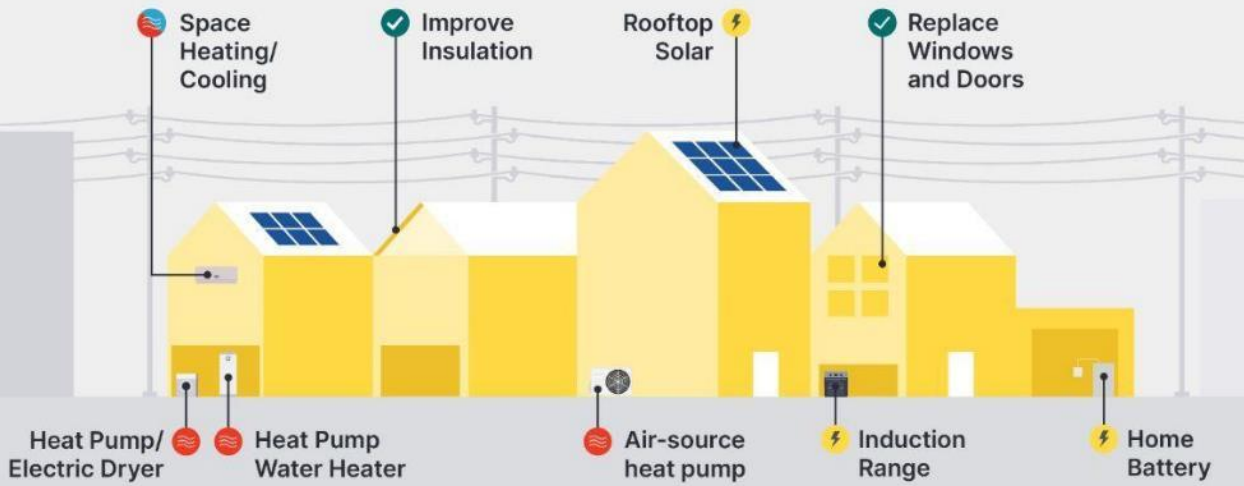
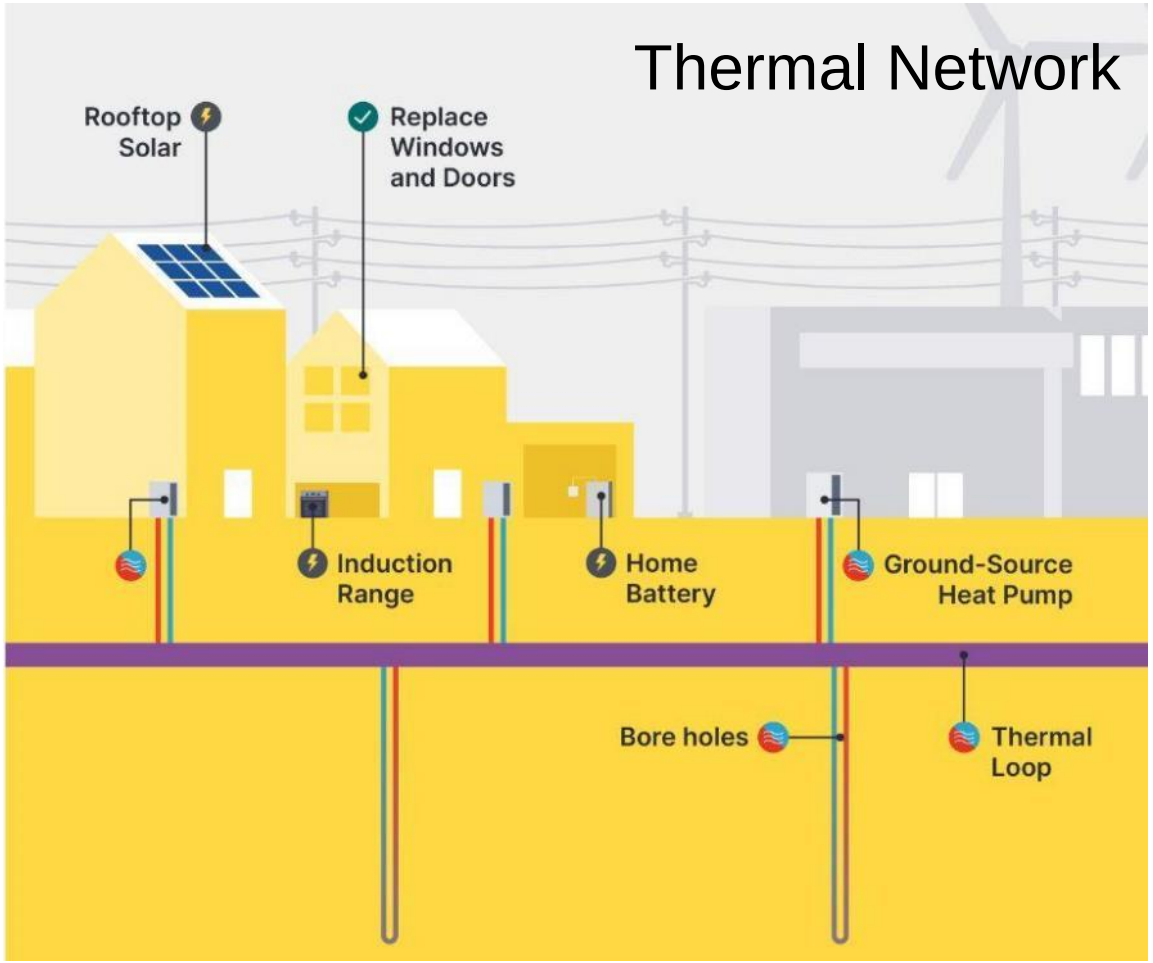
There are two primary pathways for achieving neighborhood decarbonization

Electric Network



Thermal Network



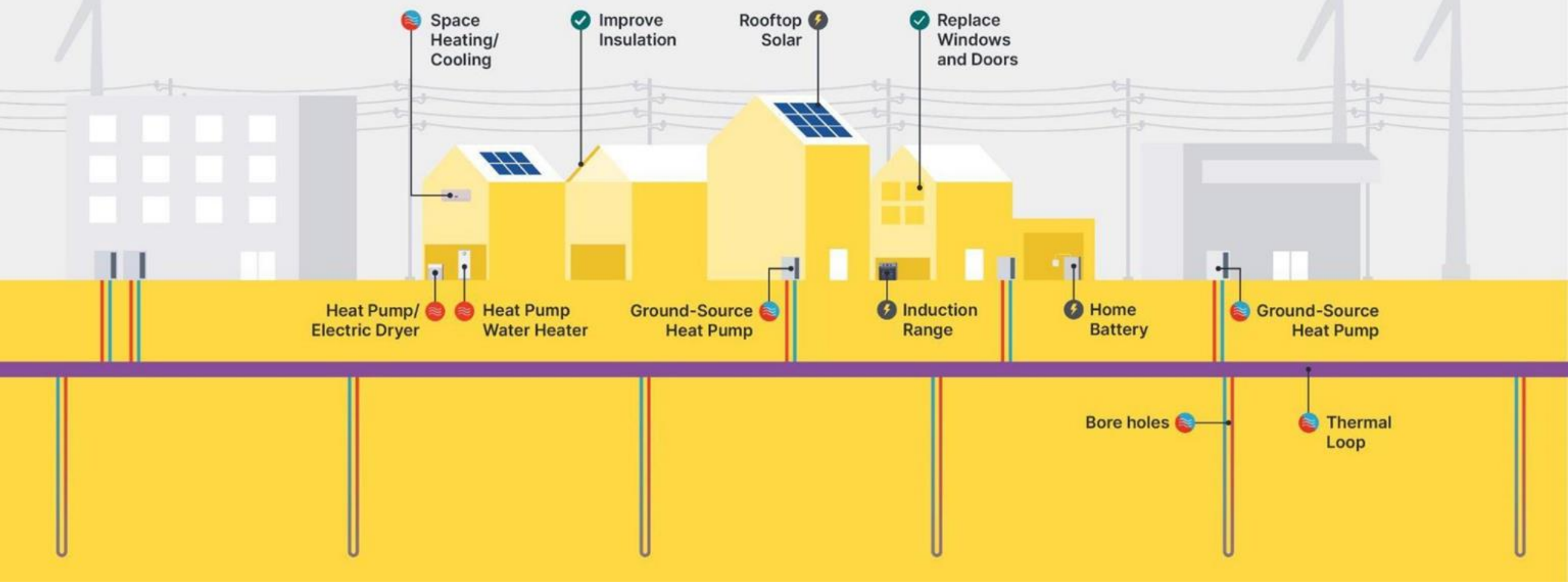
BDC

PG&E, Northern California

Pipe replacement/retirement	$1.2M	$20K
Customer electrification	-	$130K
Service retirement	-	$6K
TOTAL	**$1.2M**	**$156K**
	Status quo gas replacement	Electrification alternative

- Over 100 small-scale projects conducted to date
- Retired 22 miles of pipe
- 2 approaches:
  - Targeted Electrification
  - Zonal Electrification

Thermal Energy Network (TEN)



Thermal Energy Networks: Networked Geothermal

- Infrastructure in the street
- Single pipe
- Ambient temperature
- Heat pump in every building
- “Shallow” boreholes

Eversource: First Gas Utility Pilot in the US

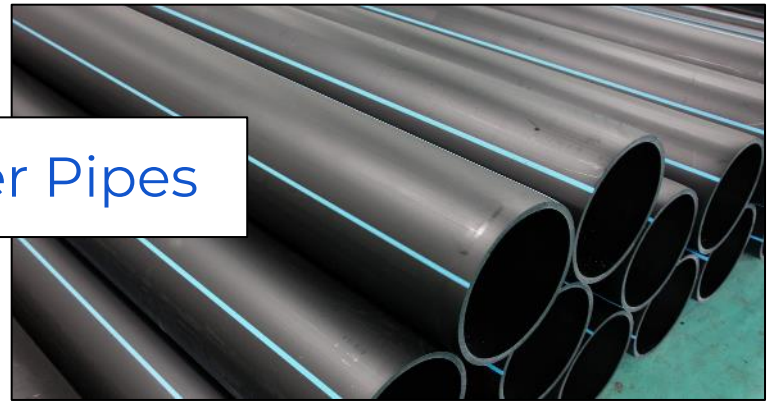
Eversource Pilot

- EJ community
- 37 Buildings, 140 customers
- Converting gas, oil and resistance electric
- Includes offices, businesses, households
- Cost of installation spread over all customers and time

Path for Gas Workers

Gas Pipes

Water Pipes



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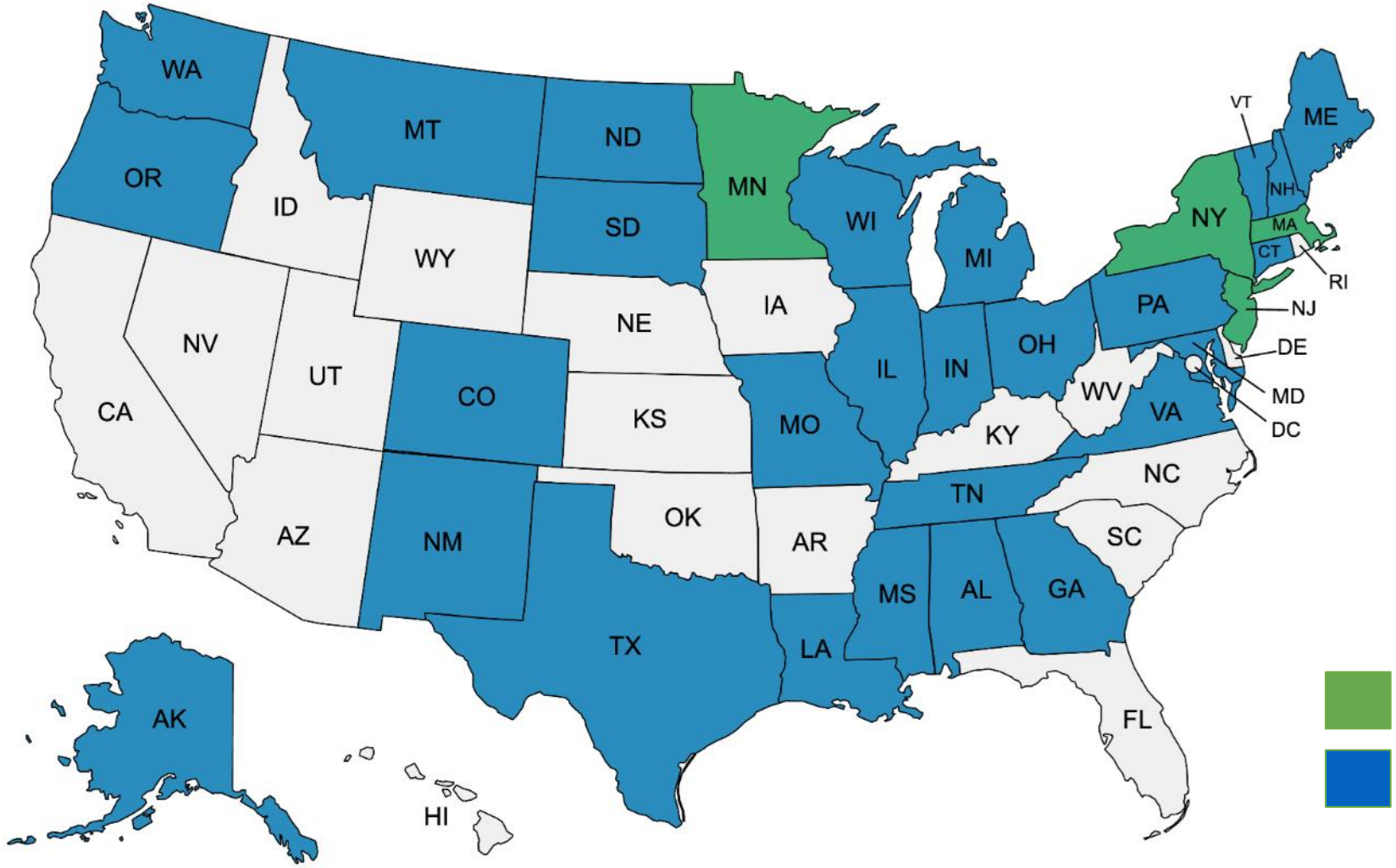
Utility Interest



Gas Utility Pilots

Utility NetGeo Coalition

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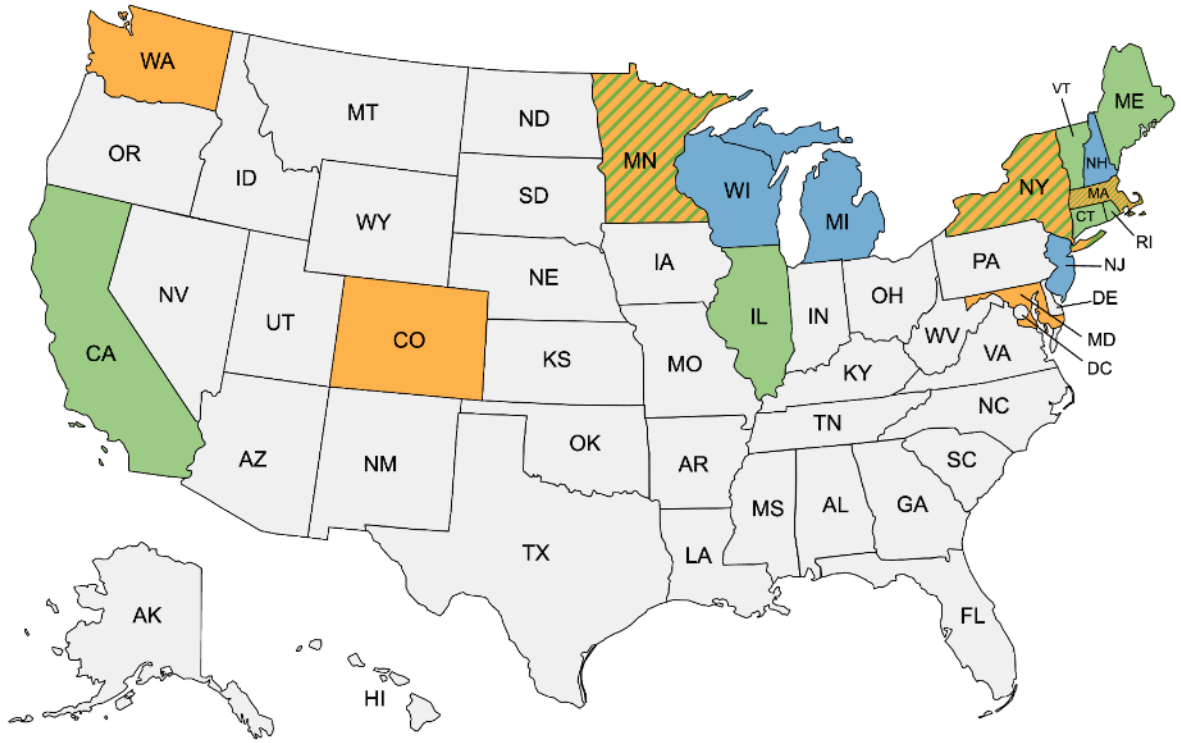
Thermal Network Legislation in US



Passed Legislation Filed Legislation Considering Legislation

Enabling Legislation:

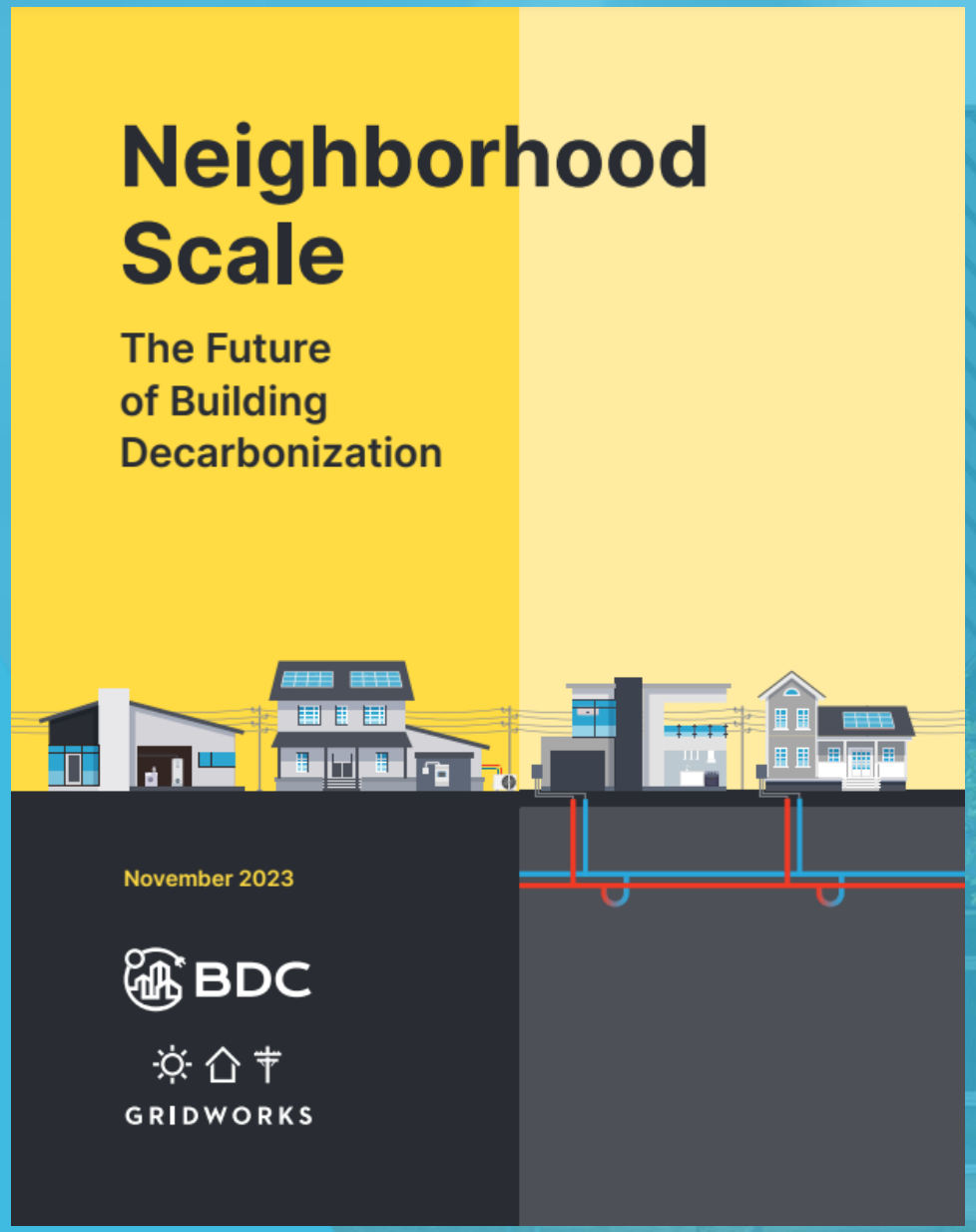
- Allow utilities to sell thermal energy
- Amend obligation to serve
- Allow pipe replacement funds for thermal networks
- Include labor transition
- Include equity priorities
- Joint gas and electric planning

Thank you!

BDC TENs Site

Neighborhood Scale White Paper

Reach out:
acamargo@buildingdecarb.org



Feel a new kind of energy.

Blatchford - District Energy Sharing System and Utility

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Christian Felske, Ph.D., P. Eng., City of Edmonton

Blatchford Renewable Energy

Edmonton

March, 2024

Once in a Lifetime Opportunity

Blatchford Renewable Energy

Edmonton

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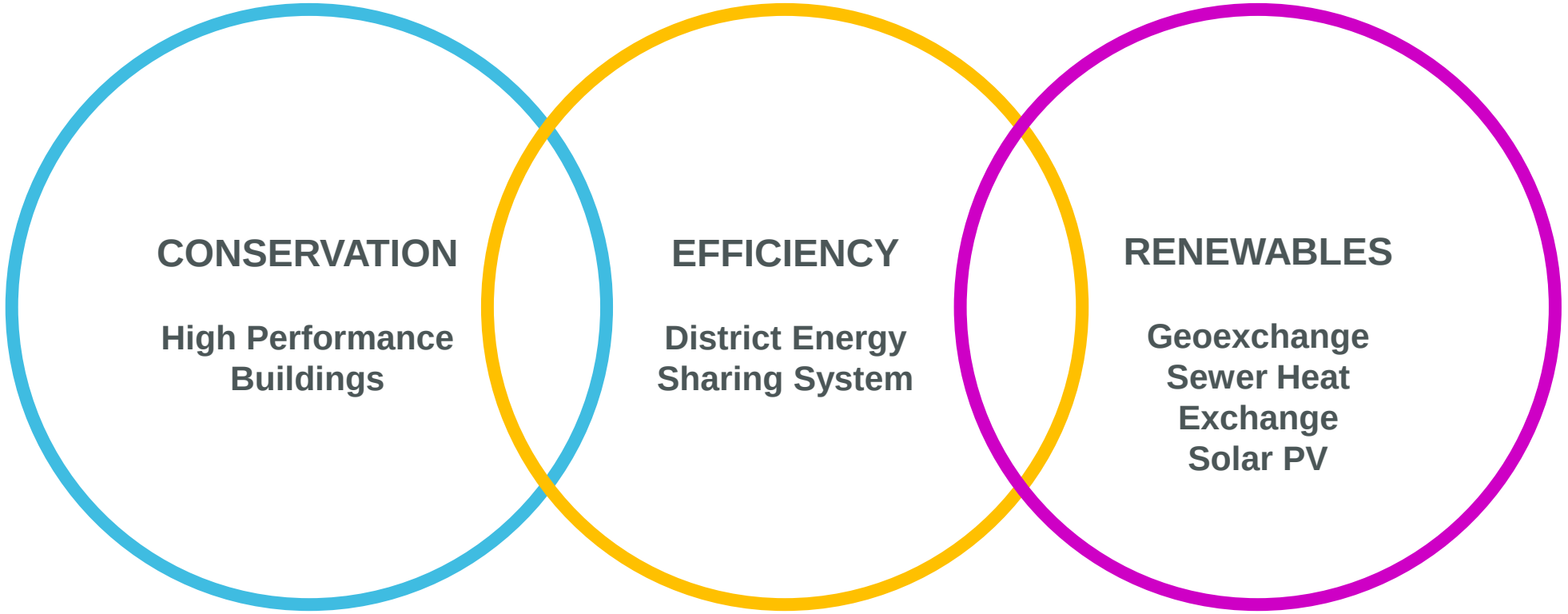
Community Energy Strategy



Blatchford Renewable Energy Utility

Blatchford Renewable Energy is a City of Edmonton utility that provides heating, cooling and hot water services to homes, businesses and schools in the Blatchford community.

Blatchford Renewable Energy

Edmonton

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Neighbourhood Plan

"A sustainable, net-zero carbon community powered by 100% renewable energy

BLATCHFORD REDEVELOPMENT (EDMONTON, AB)

- Expected 30,000 residents
- 1.5 million m^2 (16 million sq. ft.)
- Residential, commercial, institutional

DISTRICT ENERGY SHARING SYSTEM –
5^{TH} Generation Ambient DESS provides:

- Heating, cooling and domestic water heating

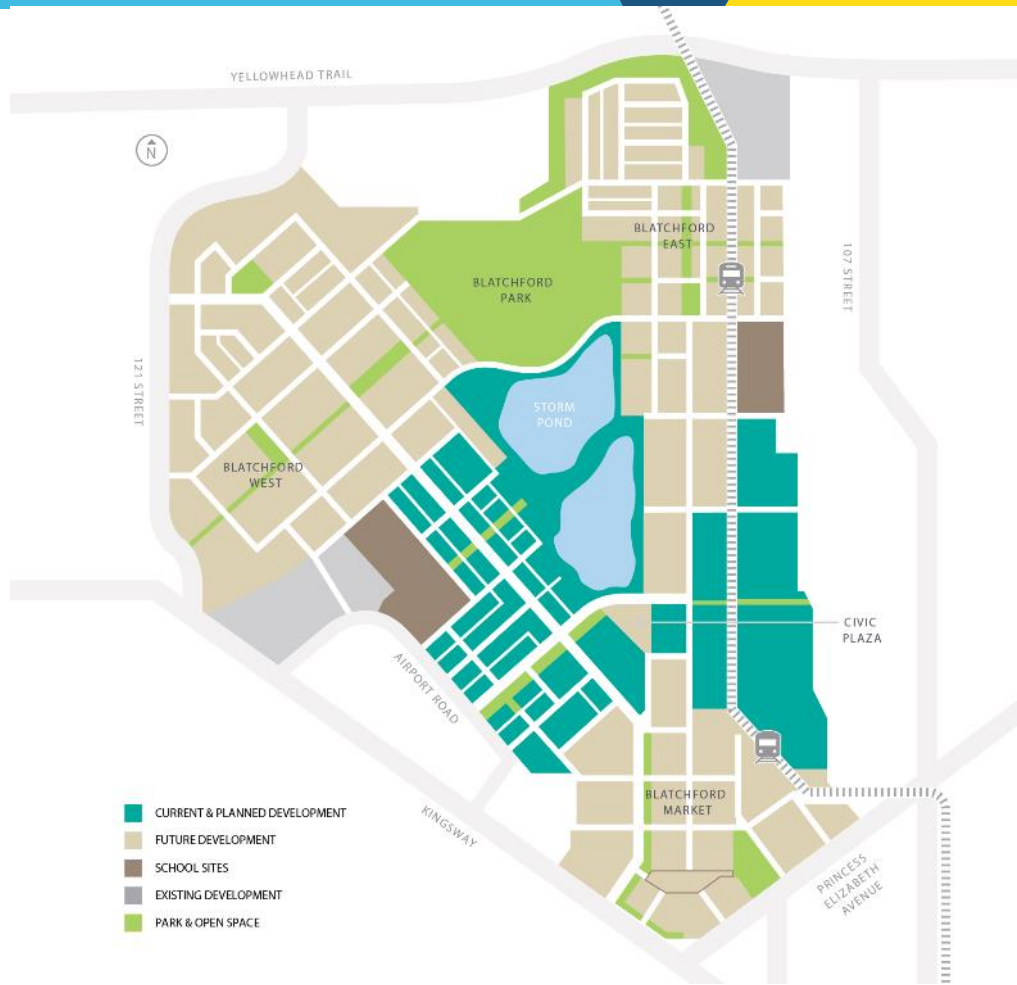
Future Heating Peak:
35 MW (119 MMbtu)
Future Cooling Peak:
46 MW (157 MMbtu)

ENERGY SOURCES

- Geo-exchange field
- Future sewer heat recovery
- Peaking boilers and cooling towers

ENERGY STORAGE

- Ground
- Distribution piping system



Blatchford Renewable Energy

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Geo-Exchange Field and Piping

Blatchford Renewable Energy

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Energy Centre One

Blatchford Renewable Energy

Edmonton

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Challenges and Opportunities

CHALLENGES

- Initial infrastructure costs
- Funding gap and need
- Market acceptance on the ground

OPPORTUNITIES

- Incorporation of new technologies
- Greenhouse gas reduction
- Leader in community led renewable energy generation
- Asset for a public-private partnership

Thank you!

BlatchfordEdmonton.ca

BlatchfordUtility.ca

Reach out at:
blatchfordutility@edmonton.ca

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Thermal Energy Networks Market Opportunities

Geothermal Energy-as-a-Service
for District Heating & Cooling

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Kareem Mirza, Chief Revenue Officer

subterra™ RENEWABLES

April 18, 2024

AGENDA

1. Subterra Renewables
2. Geothermal Exchange Systems/Thermal Energy Networks
3. District Geo - Accelerating a Path to Net-Zero
4. Case Study: Oberlin College, Ohio
5. Q&A

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Subterra Renewables: By the Numbers

Subterra is taking a driving role in addressing climate change and accelerating the transition to geothermal exchanges. The Company was recognized as Globe & Mail's Top Growing Companies in 2023 – as clean energy systems spread across urban centres.

+25
Years of Experience

+70
Drill Rigs in Modern Fleet

+250
Employees

+500
Projects Completed

+7.38M
Square Feet Enhanced

6,560
Units Optimized

+12.8M
Pounds of Greenhouse Gas Reduction

subterra RENEWABLES

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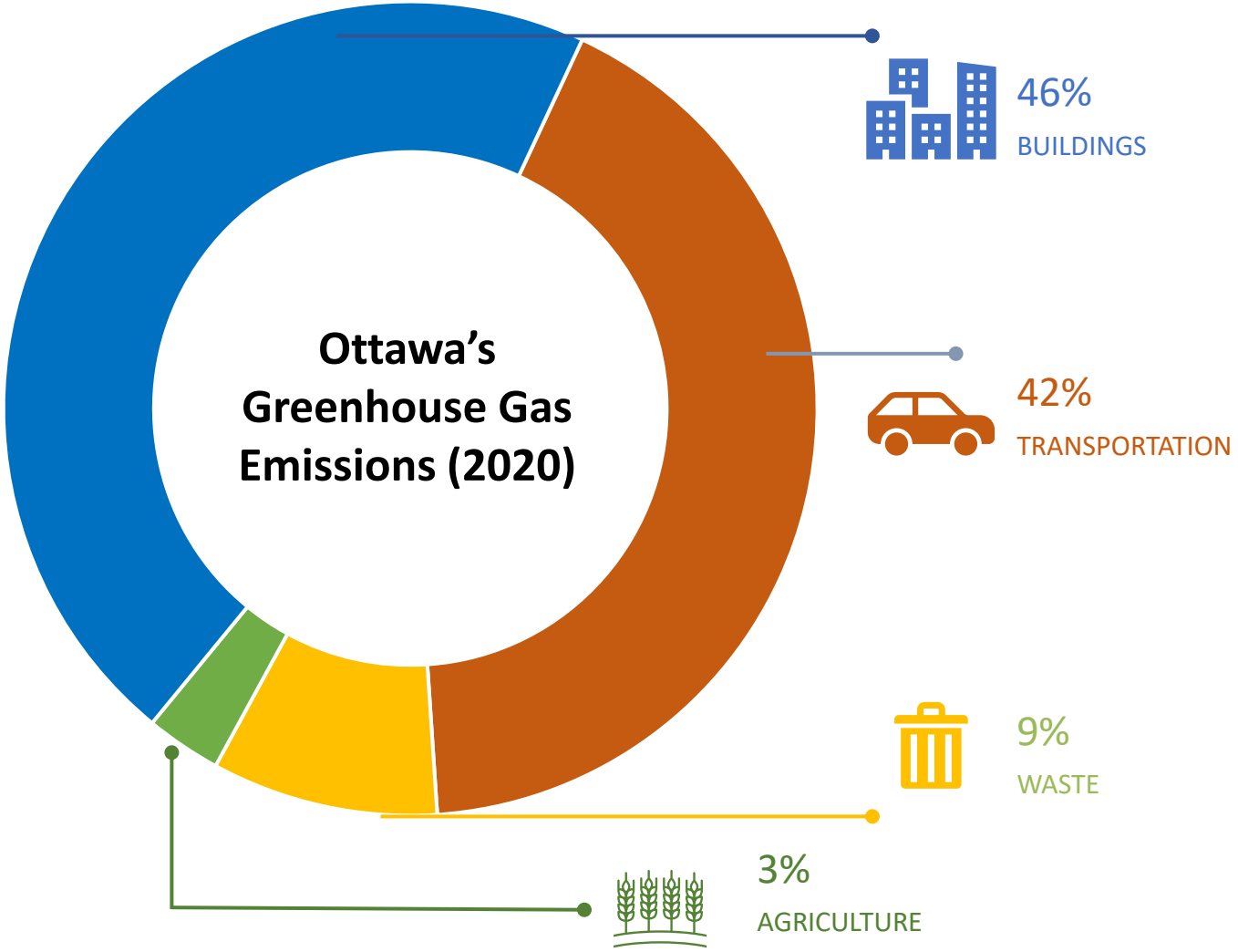
Carbon-Emitting Urban Sectors: Opportunity for Green Buildings



- **North American cities are studying carbon reduction strategies.**
- **We know that city buildings are one of the biggest contributors to greenhouse gas emissions.**
- **Ottawa's buildings account for close to 50% of its greenhouse gas emissions.**
- **Bigger cities like Toronto are closer to 60%, New York and Chicago are at upwards of 72%**

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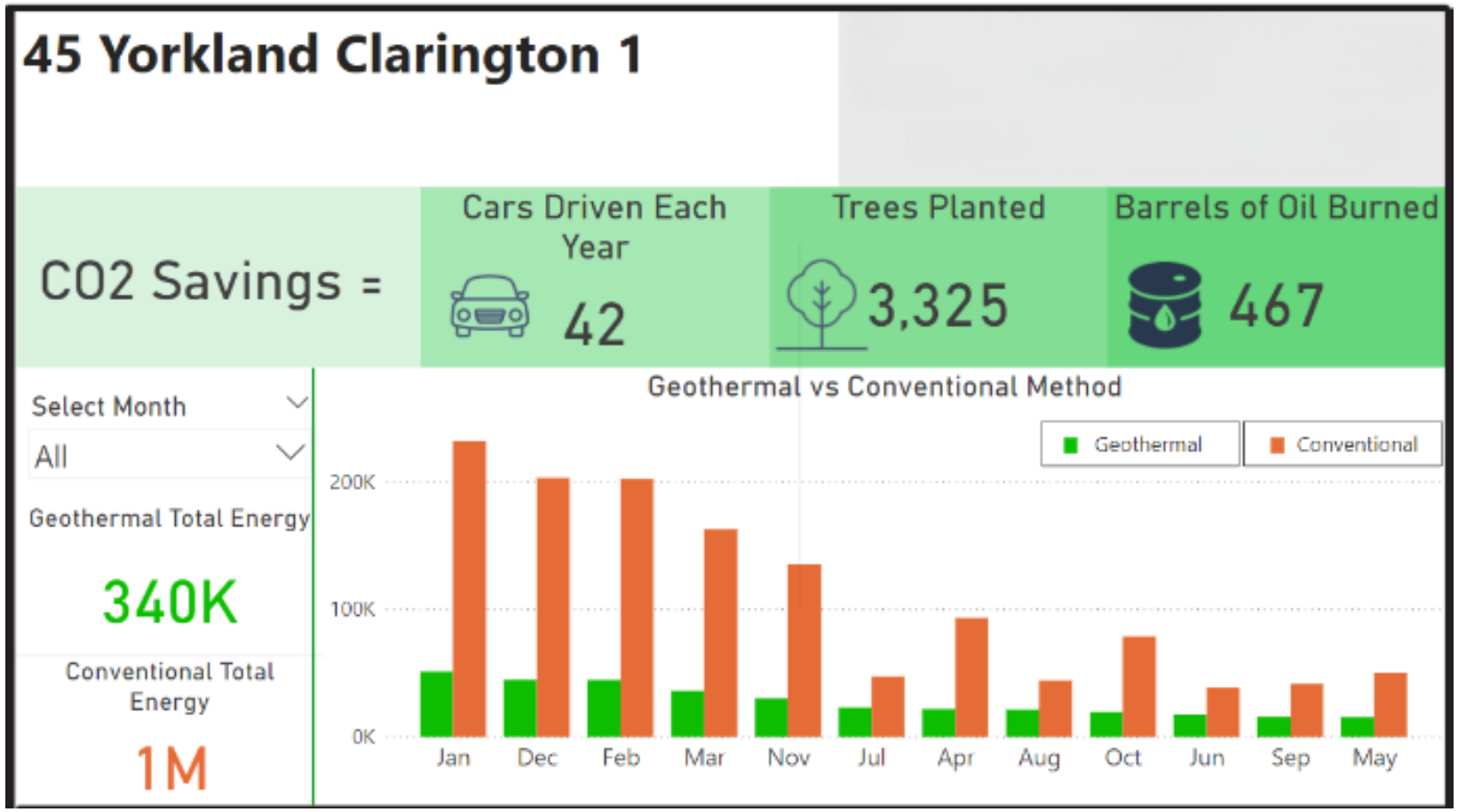
Geothermal Utility: Energy-as-a-Service Utility Reporting

ESG Dashboard Snapshot: Tracking carbon capture & savings in real time



- As part of Subterra's EAAS utility metrics monitoring, we track and report usage for each building and customer.
- We identify and work within client's ESG (Environment, Social & Governance) framework to ensure reporting data is timely and relevant for its sustainability reports.

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Drilling District Geo: How it Works
Case Study of Oberlin College

- **850 boreholes** at a depth of **600 ft.**
- Total vertical drilling to **510,000 linear feet**.
- The bore field is located under the future outdoor sports field, north of campus.
- This district system will heat and cool **55+ campus buildings**, reducing energy consumption by 30%, replacing century-old-fossil-fuel system.
- Project kicked off: **May 2023**

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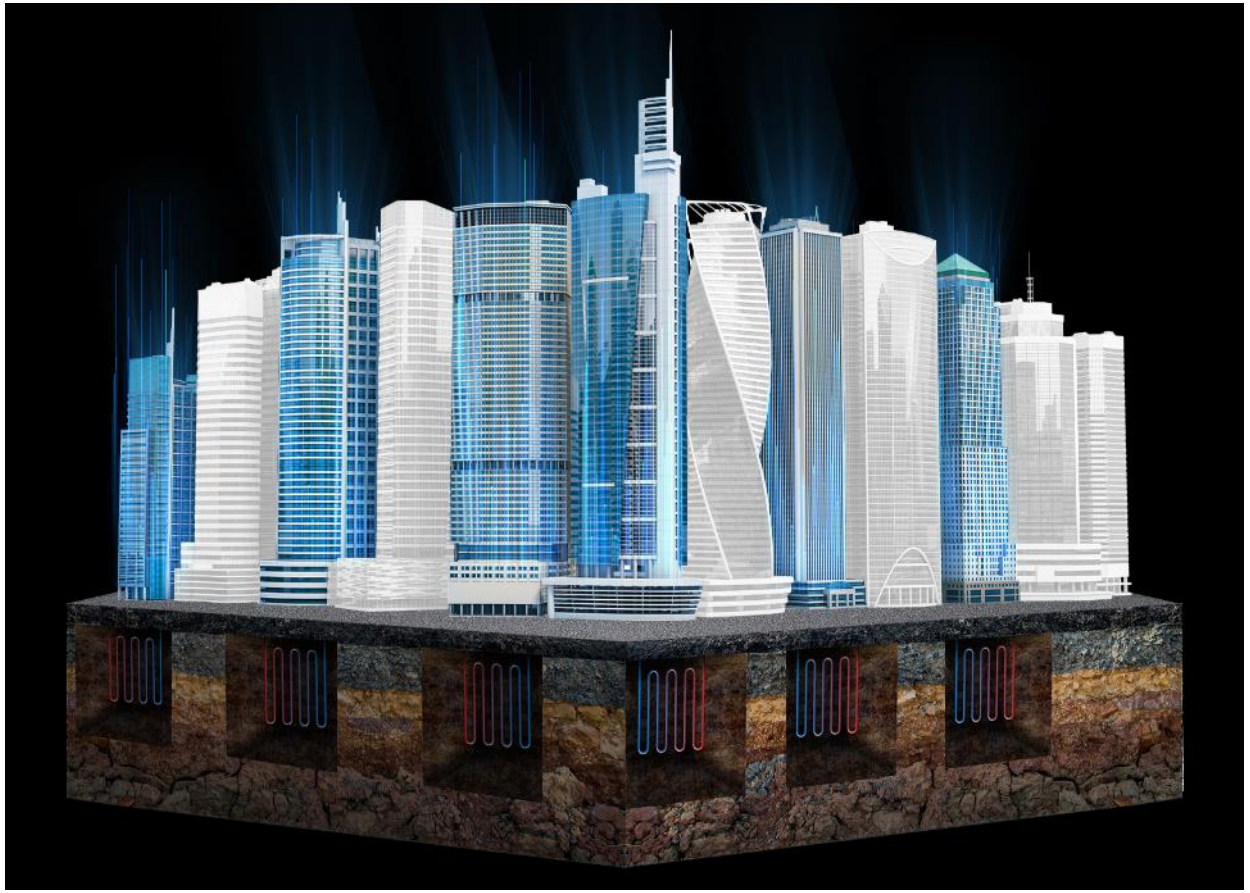
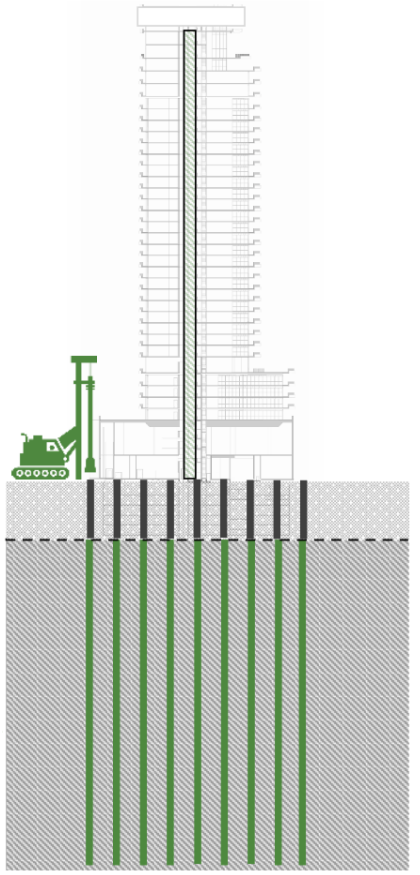
Thermal Loop Installation

- In urban centers where the project footprint is usually limited and may be difficult to access, vertical loops are often the most feasible installation option.
- The borehole depths usually range between 600 feet and 900 feet.



600′ to 900′ Depth of Ground Loops



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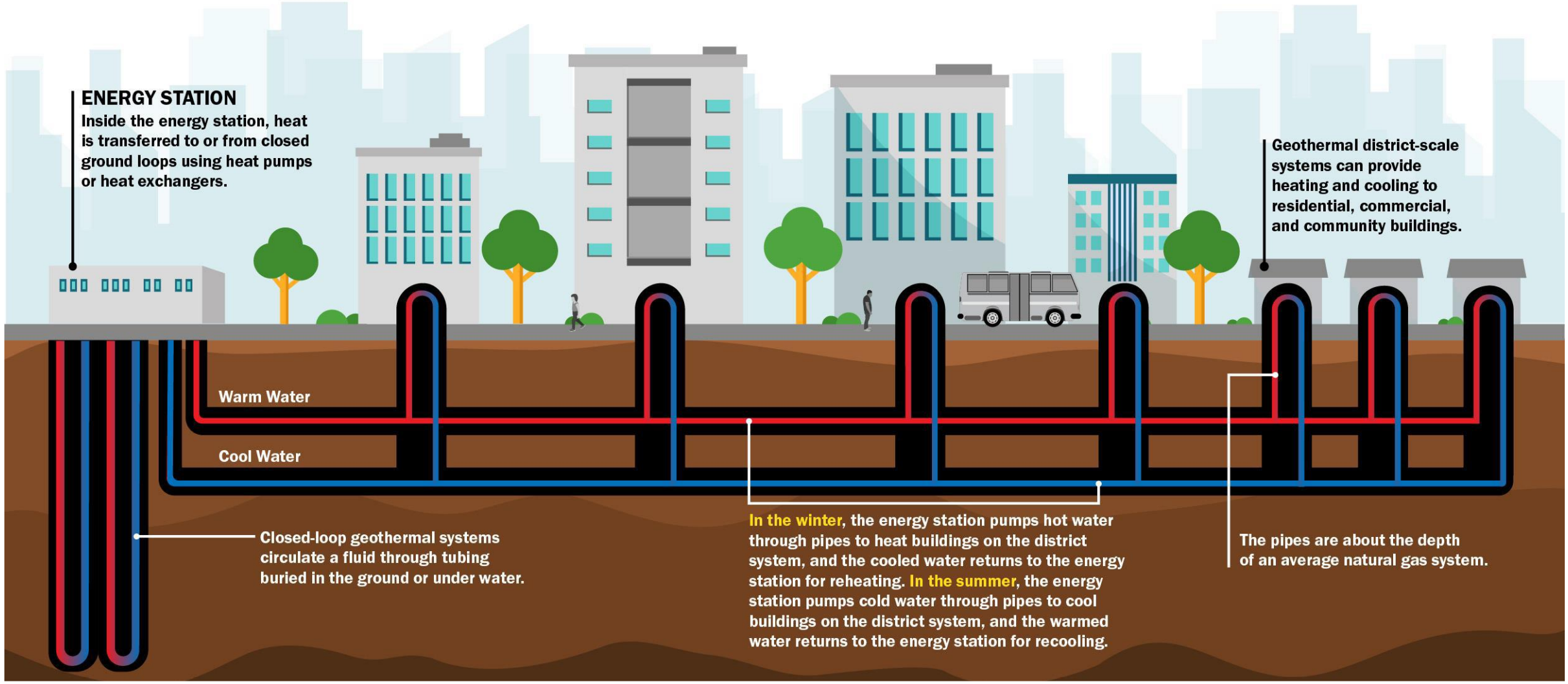
ENERGY STATION
Inside the energy station, heat is transferred to or from closed ground loops using heat pumps or heat exchangers.
Geothermal district-scale systems can provide heating and cooling to residential, commercial, and community buildings.
Warm Water
Cool Water
Closed-loop geothermal systems circulate a fluid through tubing buried in the ground or under water.
In the winter, the energy station pumps hot water through pipes to heat buildings on the district system, and the cooled water returns to the energy station for reheating. In the summer, the energy station pumps cold water through pipes to cool buildings on the district system, and the warmed water returns to the energy station for recooling.
The pipes are about the depth of an average natural gas system.

Can District Geothermal Networks Work in Other Parts of Ontario and Canada?

Yes! Many communities are undergoing feasibility studies

- Hangar District – Downsview
- Oakville
- Georgetown
- East Gwillimbury

Thank you!

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1-855-GEO-2050

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Workshop

NATIONAL BUILDING
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Moderator: Sachi Gibson

CANADIAN CLIMATE INSTITUTE | L'INSTITUT CLIMATIQUE DU CANADA

April 18, 2024

Thank you!

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