DE 4.0 - Expansion of the False Creek Neighbourhood Energy Utility ("NEU")

IDEA Conference: Session 5B
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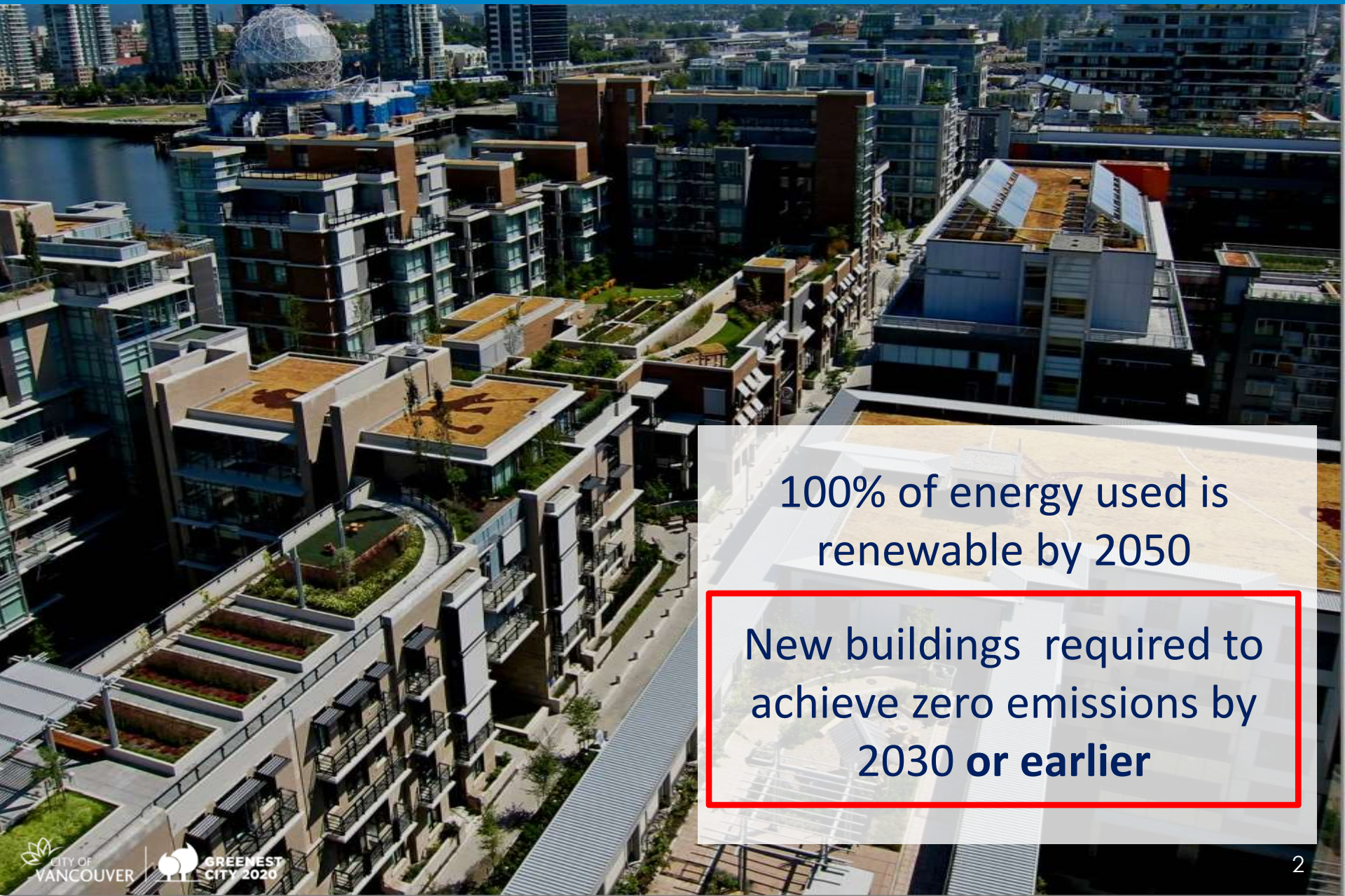
Renewable City Strategy – Approved in 2015



100% of energy used is renewable by 2050

New buildings required to achieve zero emissions by 2030 **or earlier**

Zero Emissions Building Plan – Approved in 2016

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High Performance Building

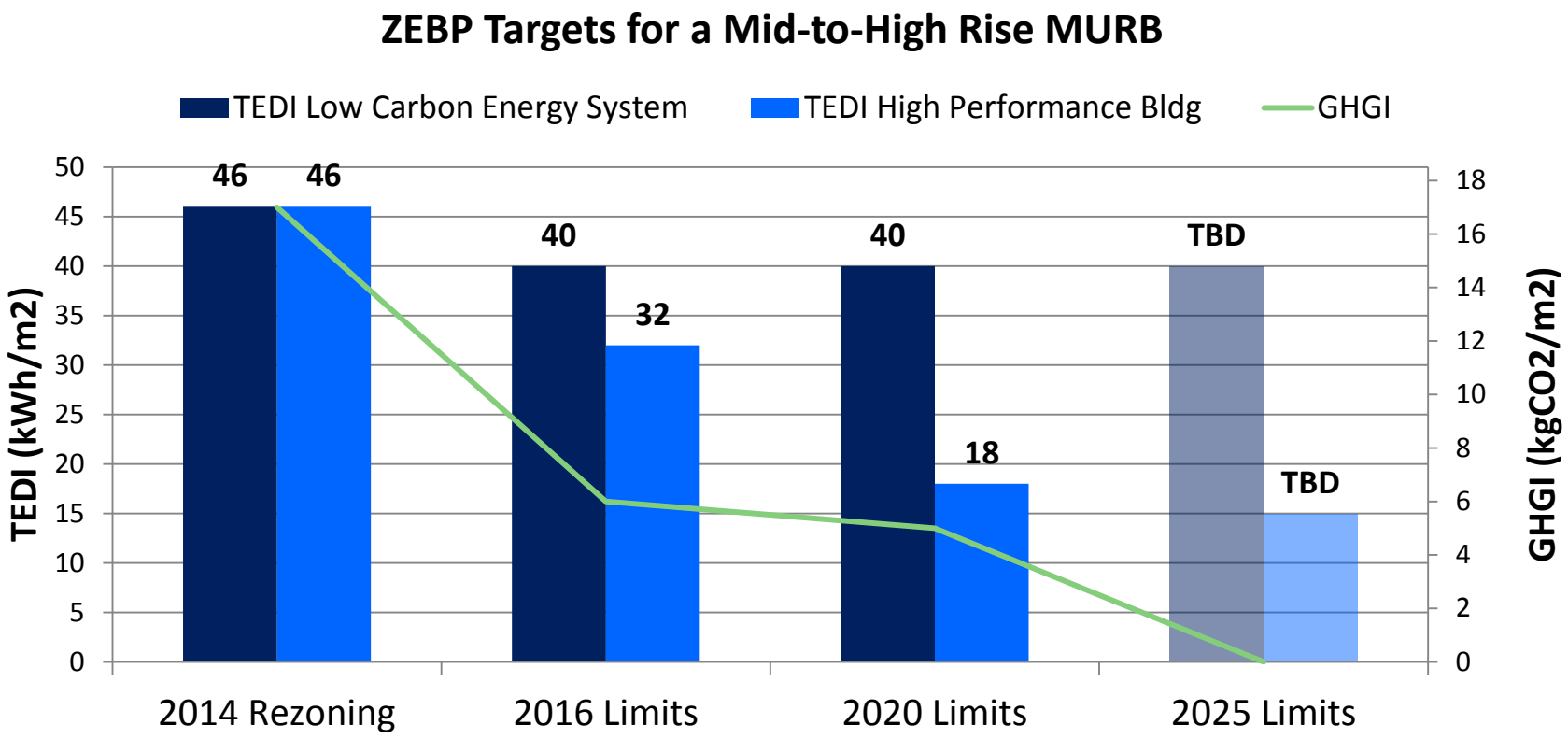
- GHG limit achieved by minimizing heat loss
- Enables simple heating system design

Low Carbon Energy System

- GHG limit achieved by combining efficiency with low carbon energy supply
- Uses advanced technologies

Zero Emissions Building Plan – Stepped Approach

- **Zero Emissions Building Plan** is a stepped approach to heat loss and energy use
- **Thermal energy demand intensity (TEDI) relaxation** for buildings connected to a City-recognized low carbon energy system



Vancouver – District Energy Priorities

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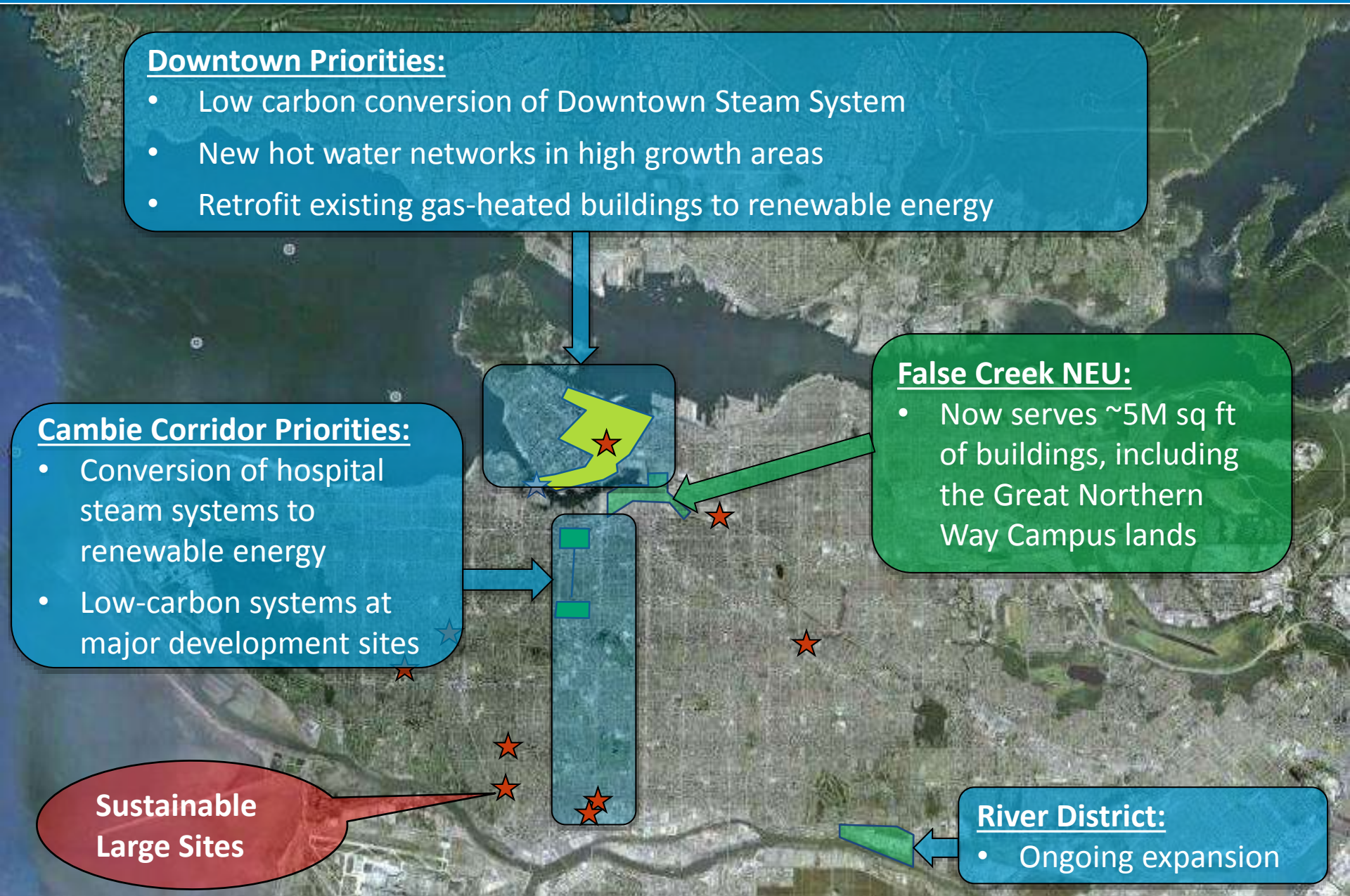

False Creek NEU Overview

- Supplies thermal energy for space heat & hot water
- Owned & operated by the City, with independent oversight by Expert Panel
- 70% of energy from renewable sources (waste heat recovered from sewage + bio-methane)
- Operating under a commercial utility model, delivering cost-effective renewable energy

NEU Development Timeline

2006: City Council decision to establish NEU

2010: NEU started operations

2014: Expansion to Great Northern Way Campus lands

2018: City Council approved major expansion plan

Environmental Benefits

- NEU provides City with direct control to achieve 100% renewable energy outcomes for pre-2030 buildings
- Enables recycling of waste heat and increases local supply of renewable energy
- Provides long-term flexibility to adapt to new technologies

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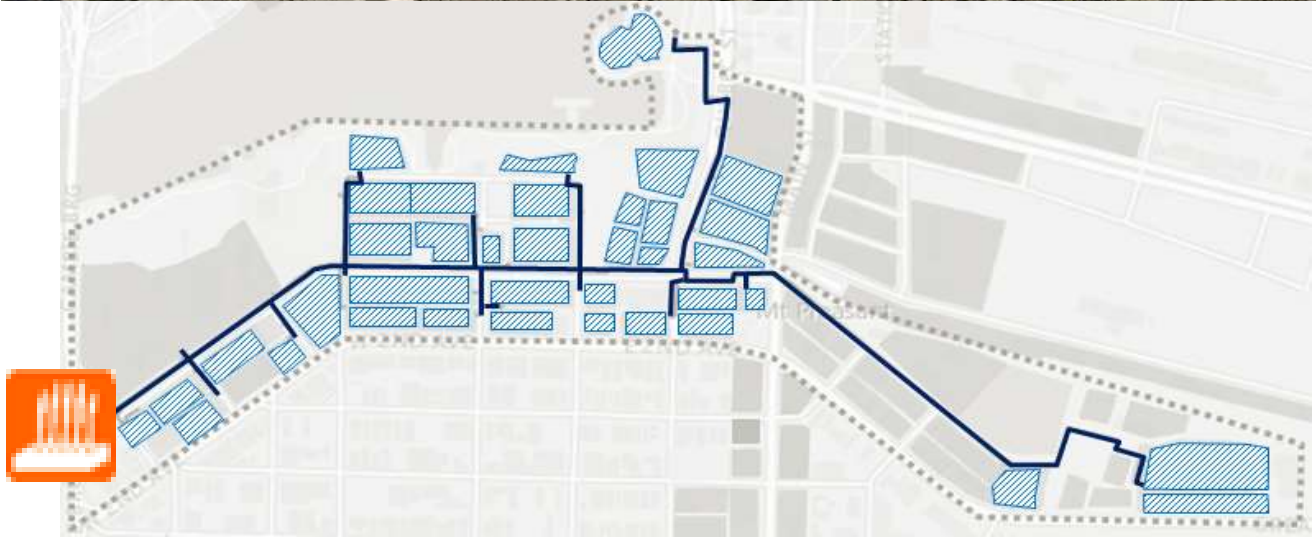
Developer Implications

- NEU provides simple approach to achieving green building policy GHG limits
- Construction cost and space savings, and increased architectural design flexibility
- Connecting to system is mandatory within designated area

End-User Benefits

- NEU connection helps to maximize roof-top amenity space
- Customers do not need to maintain and replace costly heat generation equipment
- Some buildings can sell waste heat back to the NEU

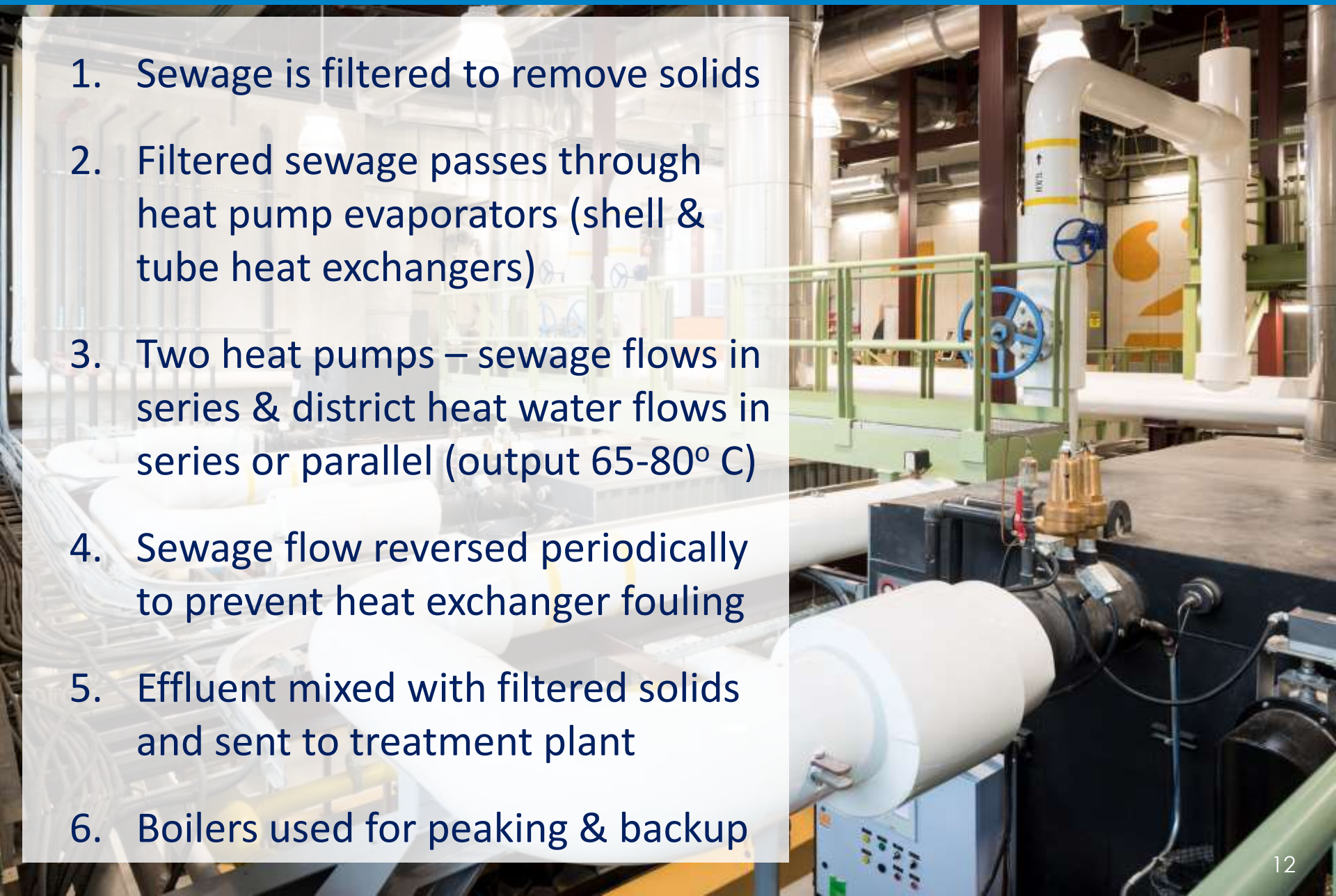
NEU Customer Base



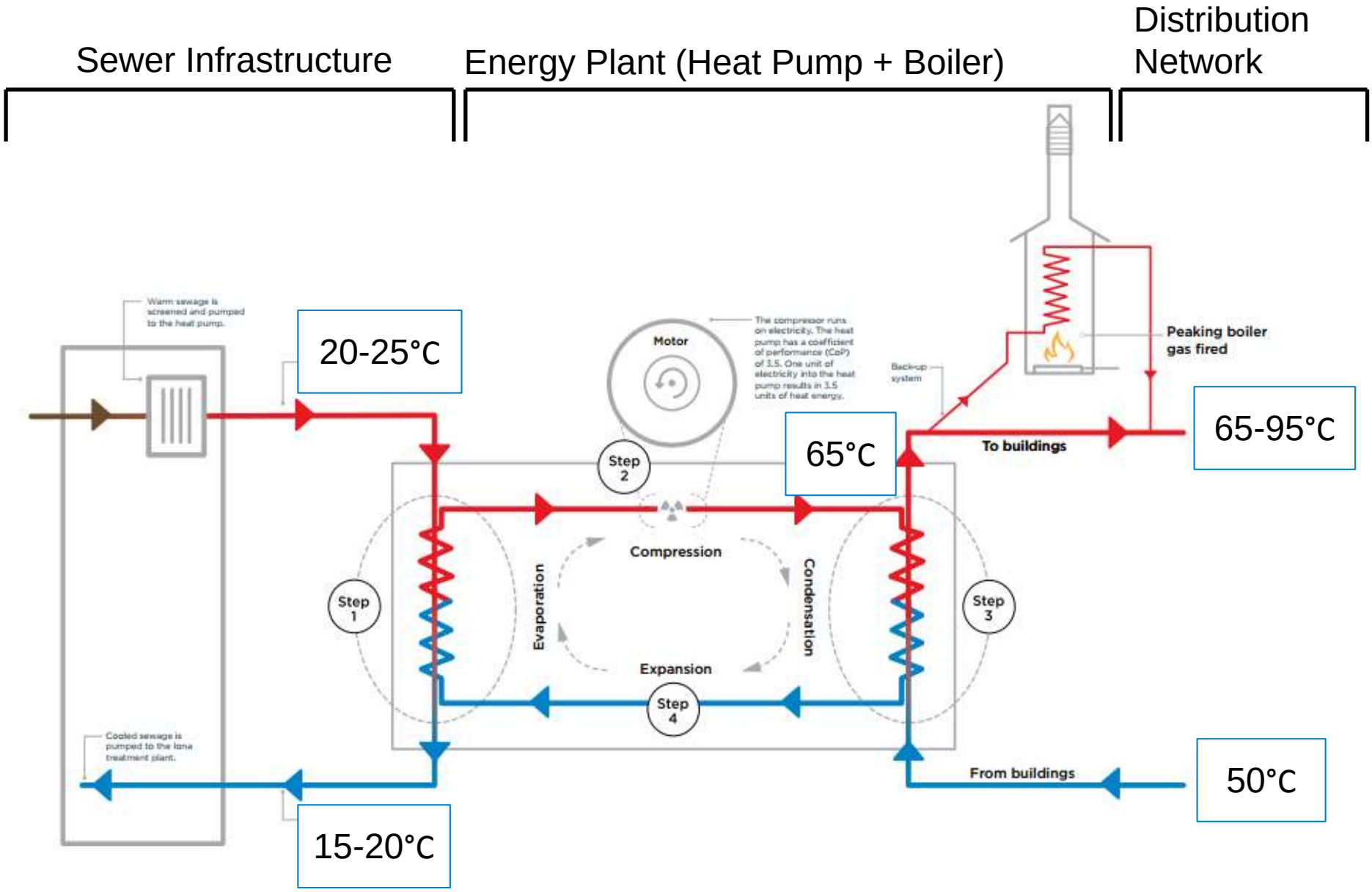
- **32** buildings
- **9** buildings in development
- Customer base has grown **300%** since 2010
- **5.2M sqft** of connected floor space

Sewage Heat Recovery - How it Works

1. Sewage is filtered to remove solids
2. Filtered sewage passes through heat pump evaporators (shell & tube heat exchangers)
3. Two heat pumps – sewage flows in series & district heat water flows in series or parallel (output 65-80^{o} C)
4. Sewage flow reversed periodically to prevent heat exchanger fouling
5. Effluent mixed with filtered solids and sent to treatment plant
6. Boilers used for peaking & backup



NEU Process Diagram



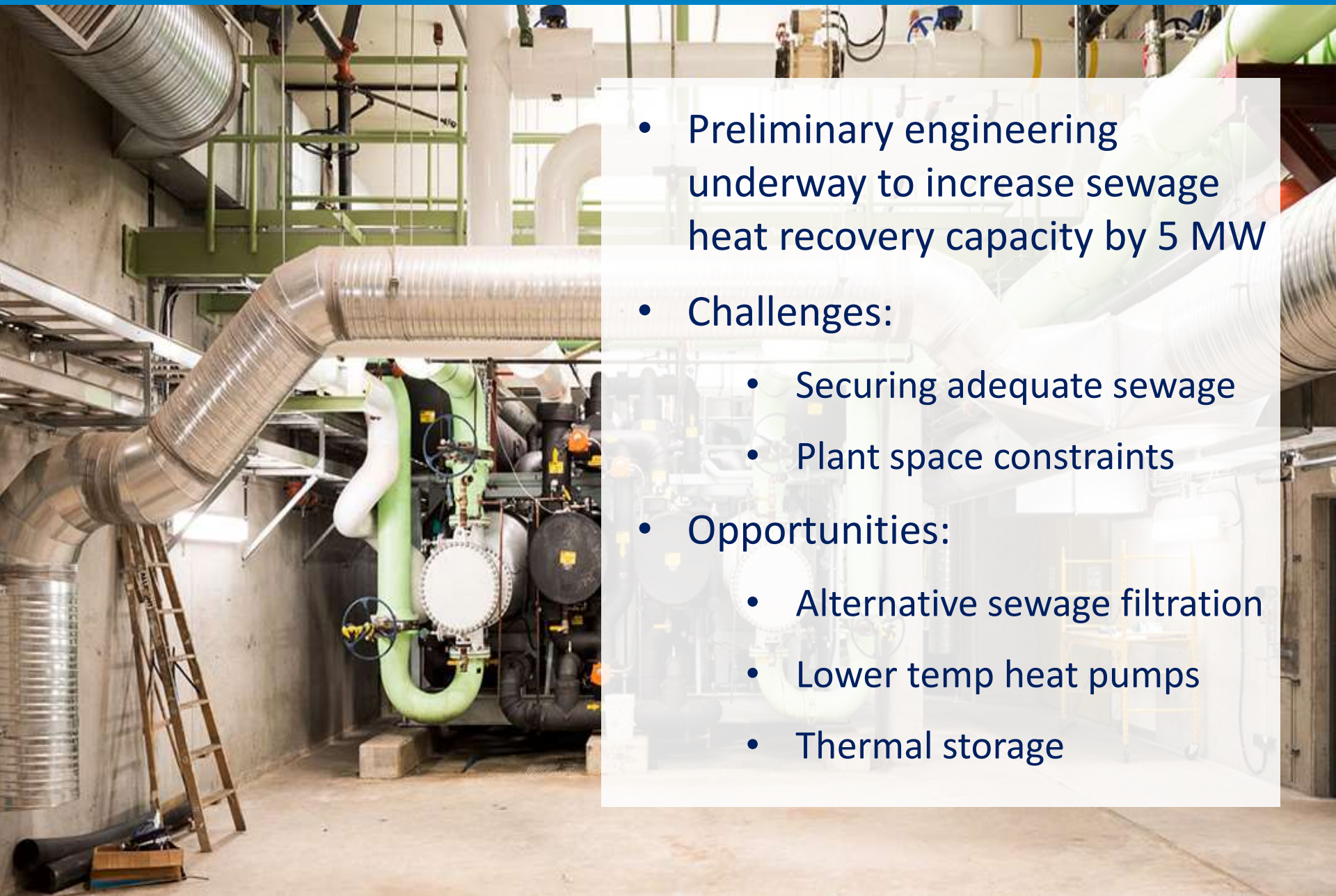
Distribution Pipe Network

- Two-pipe closed loop delivers thermal energy to customer buildings
- Supply: 65°C (95°C max), Return: 50°C
- Majority of pipe is steel, with PEX used on trial basis

Energy Transfer Stations

- Each building has an Energy Transfer Station, which houses two heat exchangers
- The heat exchangers transfer heat to the building's heating and hot water mechanical systems
- Automated controls and remote monitoring to ensure reliability
- Transitioning away from custom designed units for cost saving

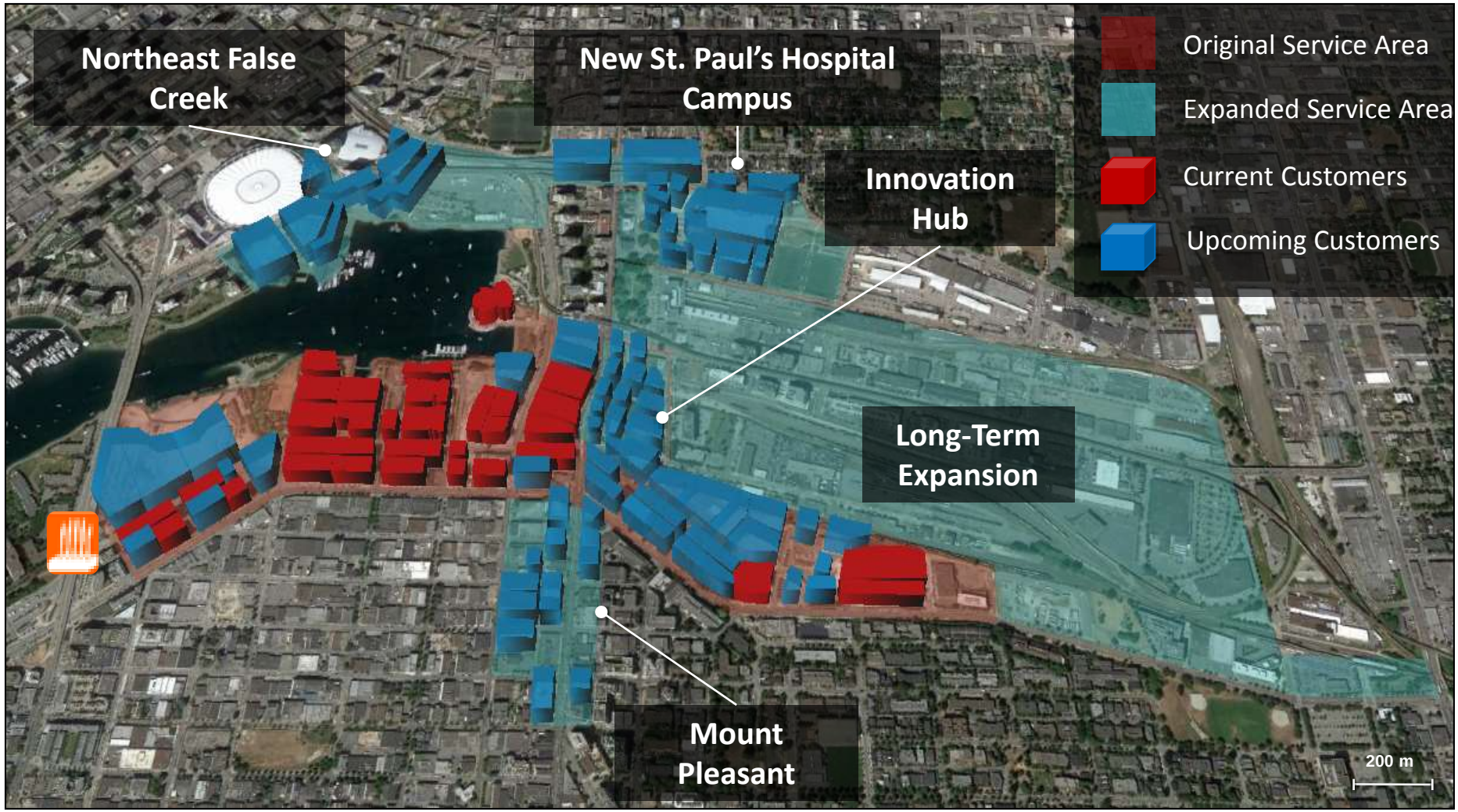
Sewage Heat Recovery Expansion



- Preliminary engineering underway to increase sewage heat recovery capacity by 5 MW
- Challenges:
  - Securing adequate sewage
  - Plant space constraints
- Opportunities:
  - Alternative sewage filtration
  - Lower temp heat pumps
  - Thermal storage

Major Expansion of the Service Area

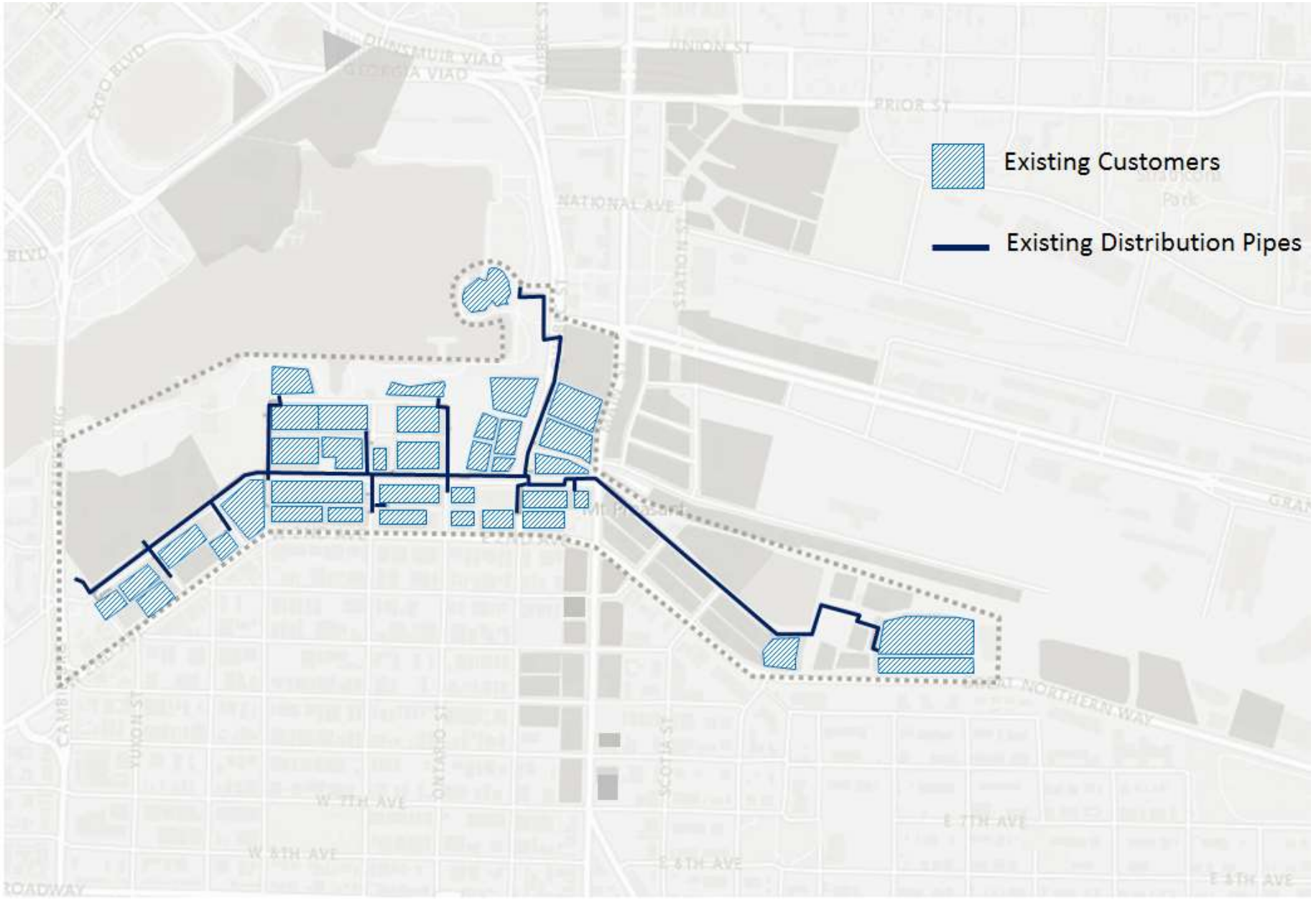
- In Feb 2018, City Council approved expansion plans to secure 100% renewable energy outcomes for ~22 million ft^2 of buildings



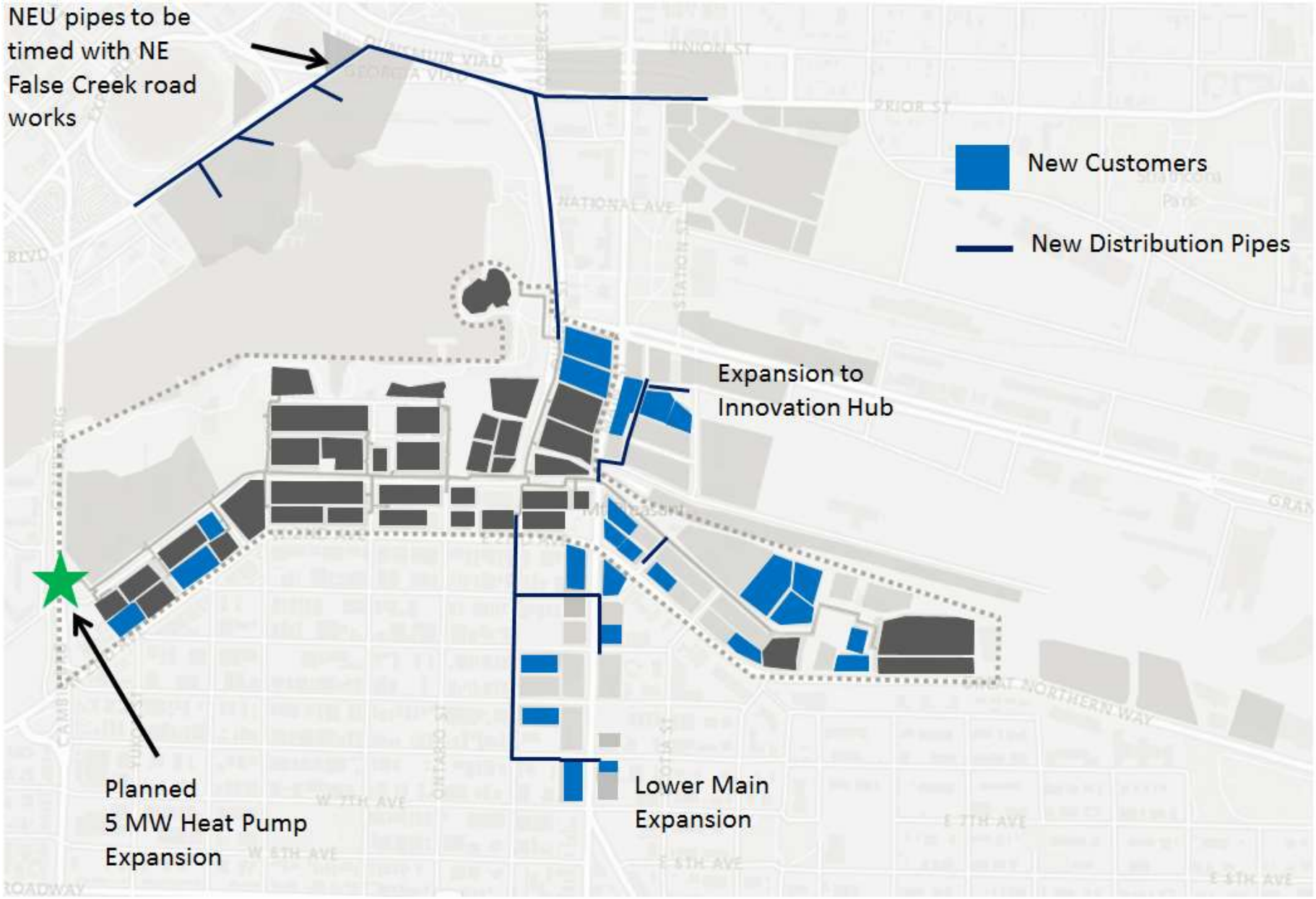
Role of the City

- Expansion plan is based on City ownership of the distribution network, and existing False Creek Energy Centre
- This maintains direct control to achieve GHG performance targets, without provincial regulation
- Flexibility for private sector investment in energy production

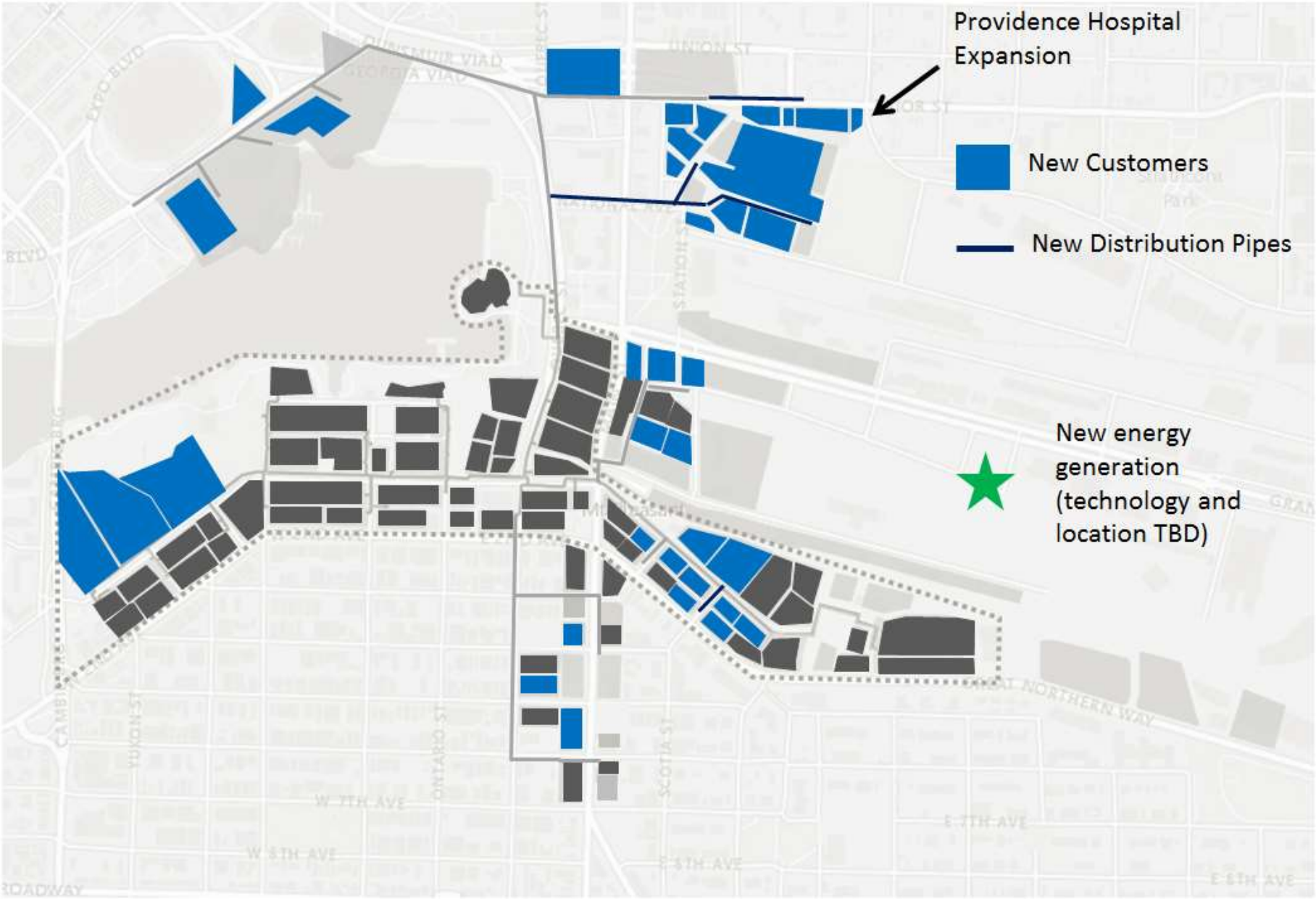
NEU Phasing: Current Status (to 2018)



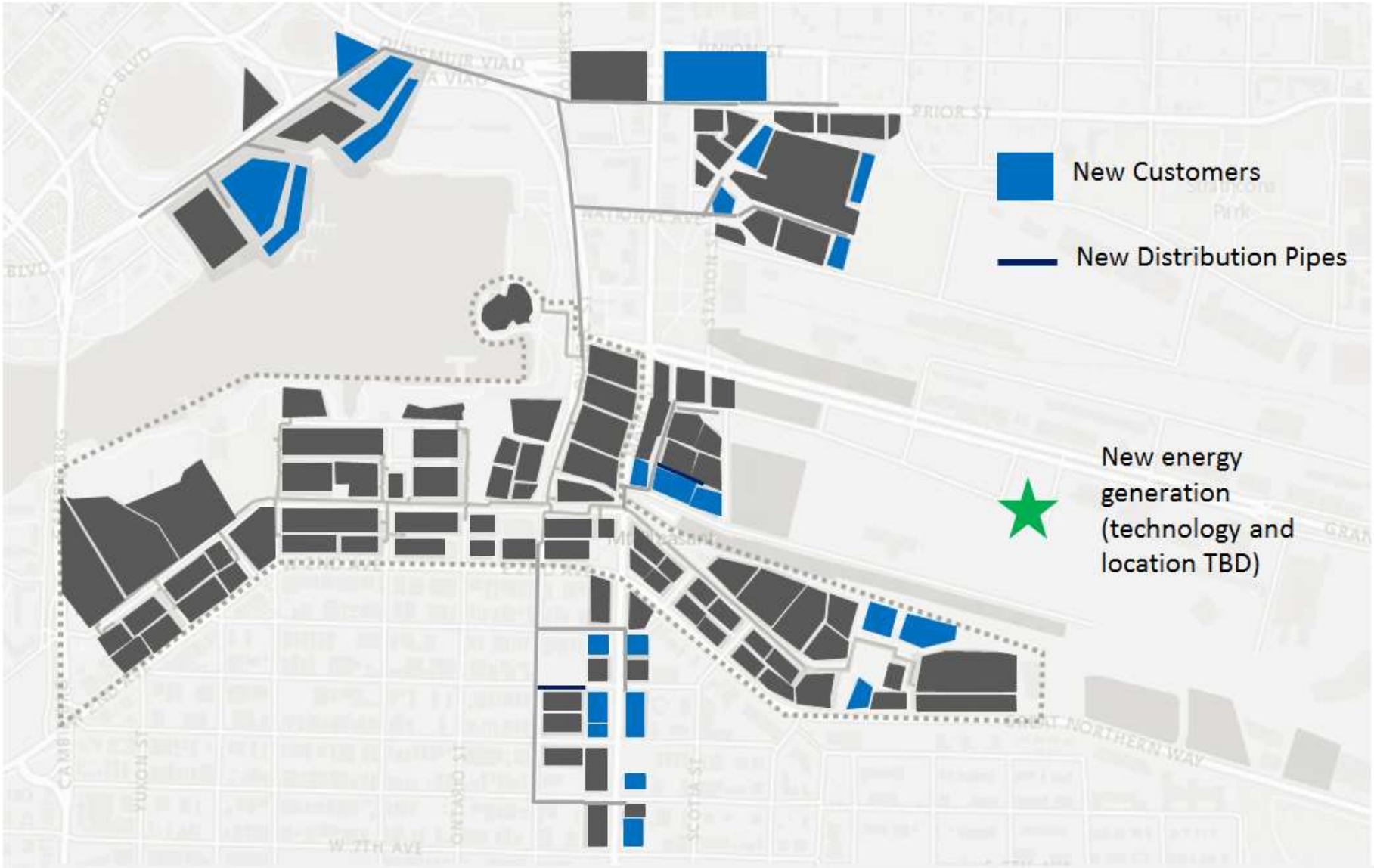
2019-2022 Capital Plan Forecast



2023-2026 Capital Plan Forecast

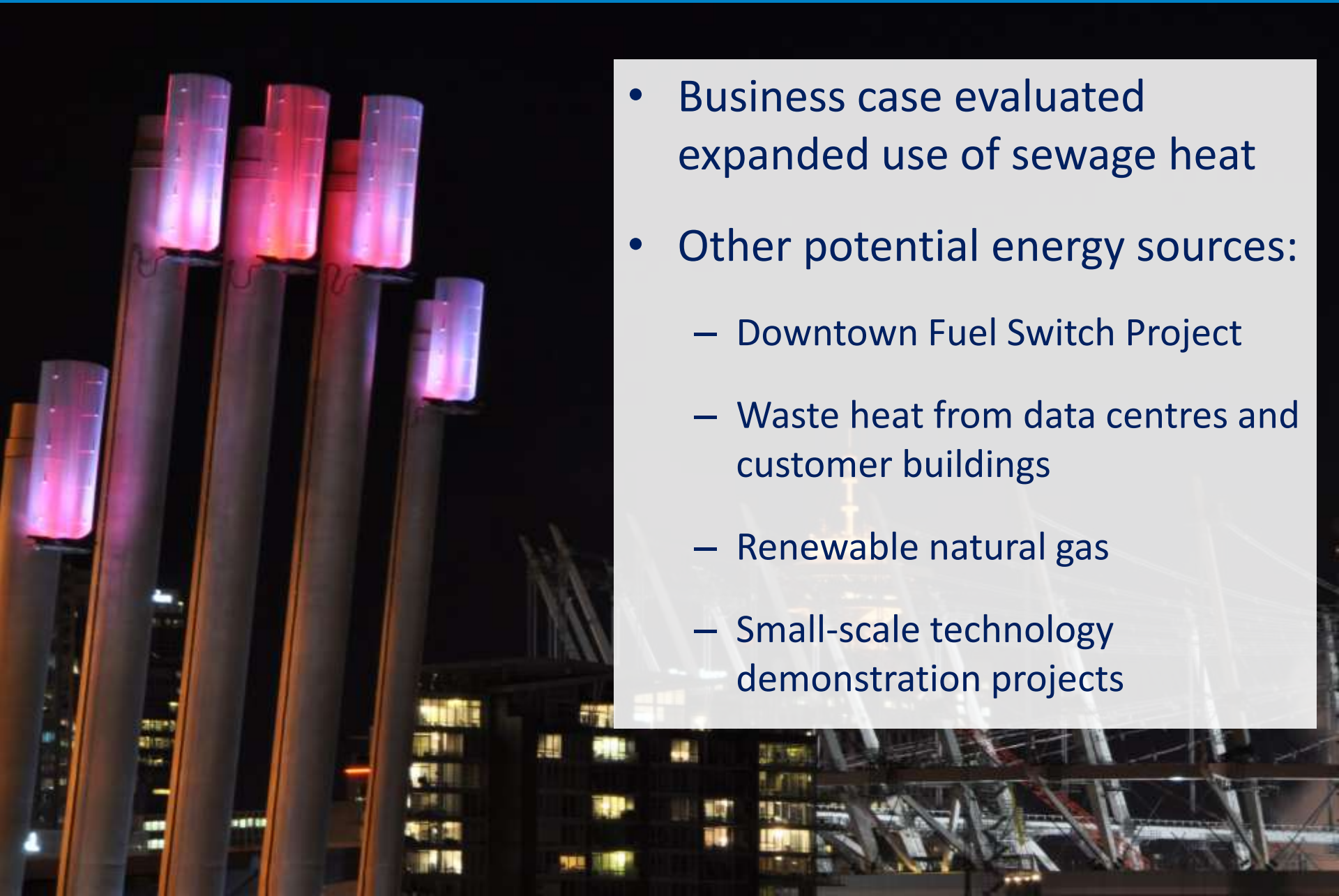


Forecast Growth Beyond 2026



NOTE: Sites that fall within expansion boundaries but not have not been included in phasing projections due to timing uncertainty will be assessed for connection on a case-by-case basis.

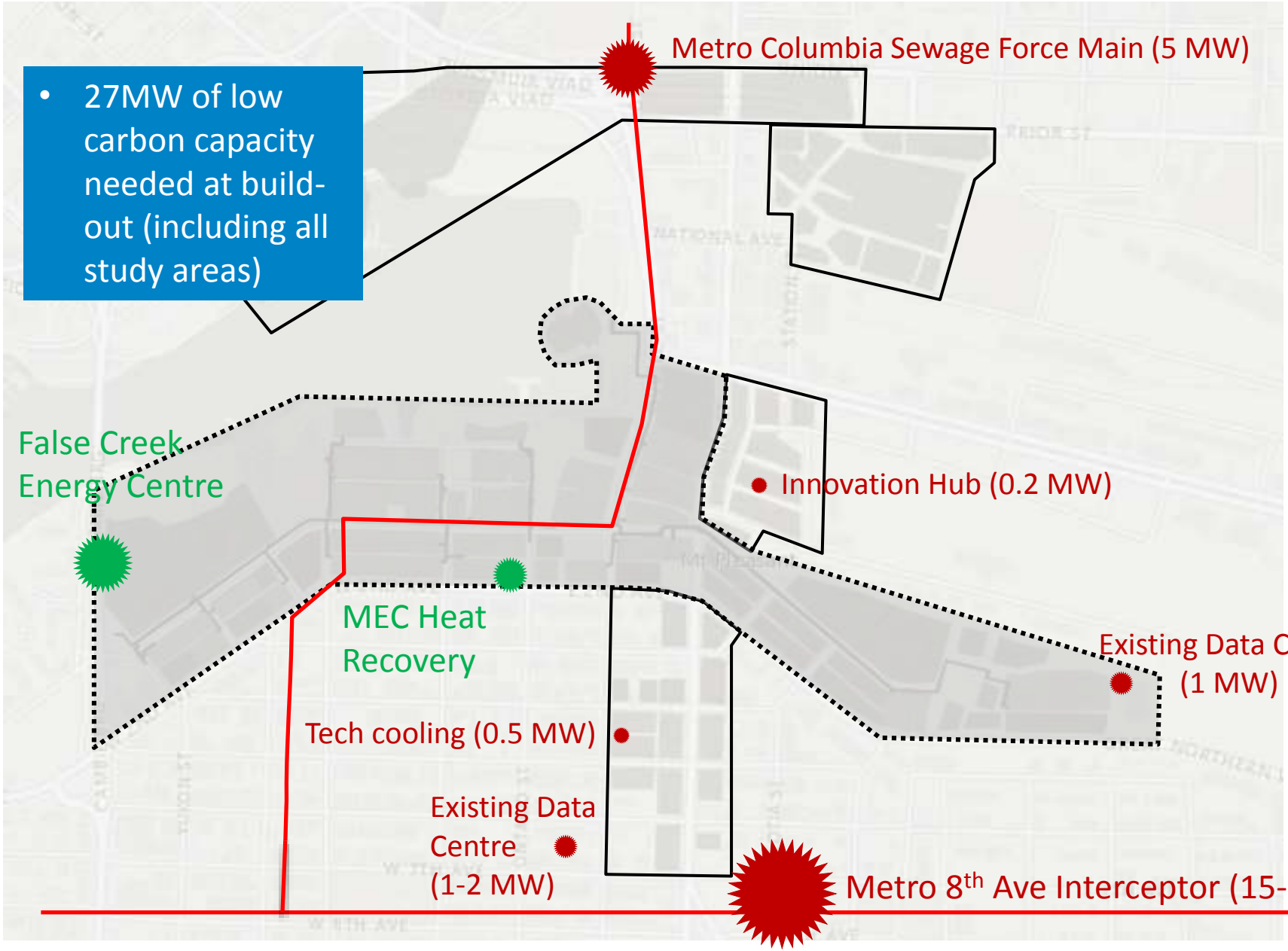
Energy Source Options for Expansions



- Business case evaluated expanded use of sewage heat
- Other potential energy sources:
  - Downtown Fuel Switch Project
  - Waste heat from data centres and customer buildings
  - Renewable natural gas
  - Small-scale technology demonstration projects

Waste Heat Opportunities

- 27MW of low carbon capacity needed at build-out (including all study areas)



Exploring Opportunities for Optimization

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KEY PRINCIPLES:

- Maximize energy efficiency and recovery of waste heat
- Preserve 100% renewable energy outcomes
- Achieve economic efficiency
- Maintain long-term technology flexibility
- Balance innovation and risk
- Maximize design flexibility and co-benefits for connected buildings

Key Optimization Areas

1. NEU Technology & System Design	• Explore lower temperature approaches for expansion areas to maximize efficiency & waste heat recovery potential
2. Design Requirements for Buildings	• Explore opportunities for increased flexibility in building-side mechanical design requirements
3. Sharing of Economic Benefits	• Connection fee to share economic benefits of connection between developers and utility customers

1. NEU Technology & System Design

Priority on maximizing use of local resources and unlocking waste heat recycling opportunities in the community

- **Example**: New MEC Store Waste Heat Recovery
  - Benefits include increased renewable energy generation, freeing valuable rooftop space for developer, and revenue stream for building owner
- **Study Underway**: Exploring potential for low temperature NEU zones to increase the amount of waste heat being recovered
  - Evaluate technical, cost, and servicing risks and benefits associated with discrete low temperature NEU zones
  - Includes consultation with development industry

1. NEU Technology & System Design (cont'd)

Operating temperature scenarios to be evaluated:

System Operating Temp	NEU Supply Temp (°C)	NEU Return Temp (°C)	Heating Equipment
Medium Temp (Current NEU)	65 *(max 95)*	50	Centralized
Low Temp	50 (max 60)	35	Centralized with some boosting required in buildings
Ambient Temp	25	20	Decentralized

2. Design Requirements for Buildings

Current customer building design requirements:

- **Restrictions**:
  - 100% of heat and hot water demand to be supplied by NEU with no building-side heat production equipment
  - Restrictions are in place to secure GHG outcomes and ensure cost-effective low carbon service
- **Exceptions allowed:**
  - Solar thermal panels
  - Equipment that recovers waste heat from refrigeration or cooling of the building

2. Design Requirements for Buildings (cont'd)

What we've been hearing from developers – a desire for more flexibility on:

- requirement for 100% energy supply by NEU
  - examples include exceptions for isolated or unoccupied spaces, hot water loads in office buildings, etc.

- the use of certain technologies that facilitate some on-site heat recovery
  - examples include distributed water-to-water heat pumps, and Variable Refrigerant Flow (VRF) systems which generate some heat from electricity

- Critical to maintain cost effectiveness and not jeopardize 100% renewable energy outcomes

3. Sharing of Economic Benefits

- Use of utility connection fees is a common practice (including district energy, other energy, water and sewer services)
- NEU provides construction cost savings through:
  - Eliminating the need for on-site renewable energy heat production
  - Flexibility on the building envelope through relaxed TEDI requirements
- Recovering a portion of this savings would result in lower rates for utility customers
- Different connection fee structures being explored – price per KW capacity appears to be the preferred approach for stakeholders

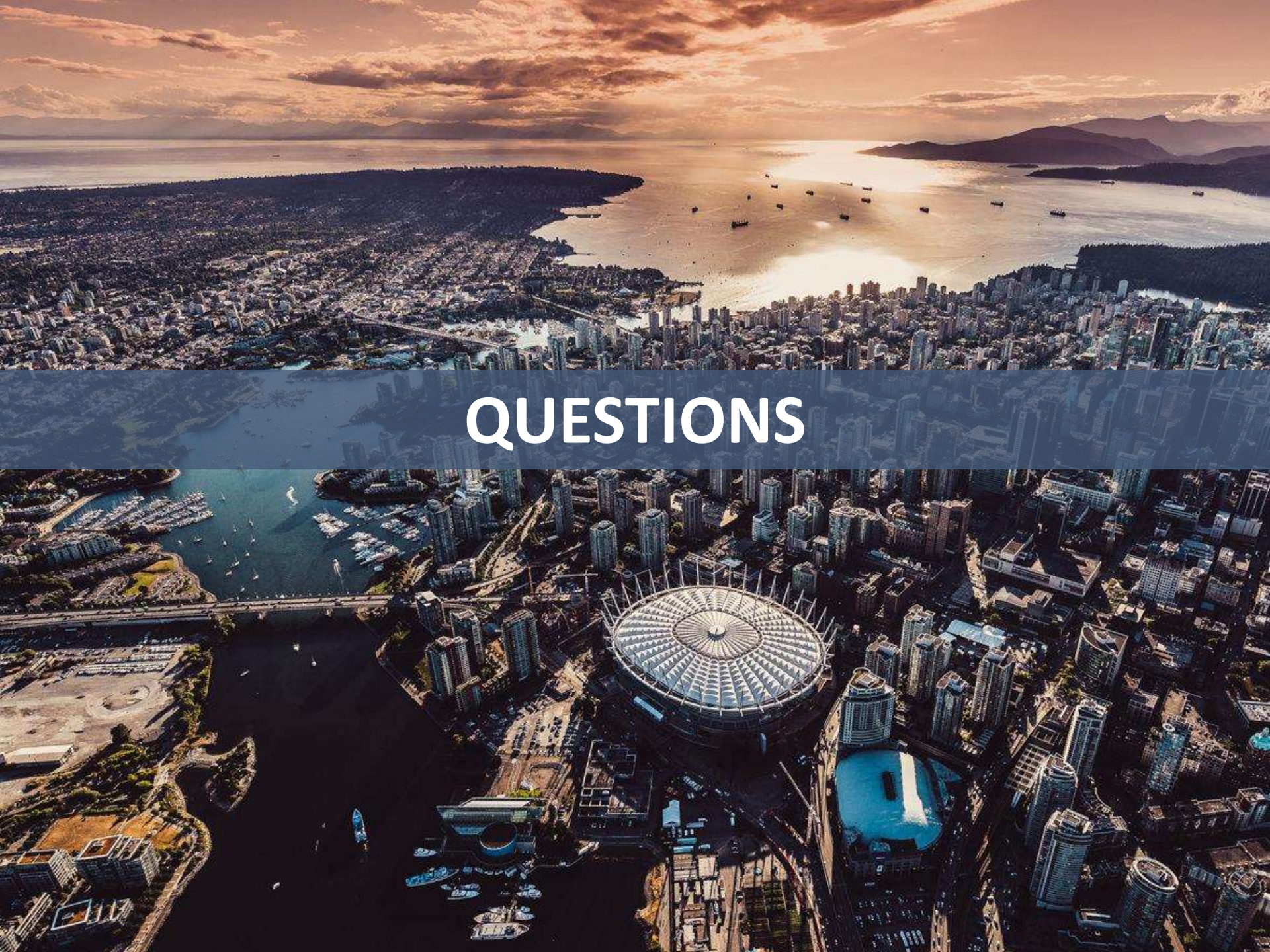
SUMMARY

The Zero Emissions Building Plan significantly lowers GHG emissions in new buildings. T**he NEU provides unique opportunities**:

1. **High level of City control to achieve Renewable City Strategy objectives** for pre-2030 buildings
2. **Ability to leverage resource recovery opportunities**, including sewage heat and other local waste sources
3. **A highly adaptable and resilient energy solution** for buildings

NEXT STEPS

- **Sewage Heat Expansion:**
  - Q4, 2018: initiate procurements (pending status of other low carbon options)
  - 2019 – 2020: detailed design and construction
- **Distribution System Expansion:**
  - **2019**: Mt Pleasant
  - **2020 - 2021:** NE False Creek and Innovation Hub
- **Technical Optimization Review:**
  - complete Q3 2018



QUESTIONS