CITY OF VANCOUVER

**ADMINISTRATIVE REPORT**

| | |
|---|---|
| Report Date: | February 13, 2018 |
| Contact: | Chris Baber |
| Contact No.: | 604.871.6127 |
| RTS No.: | 12251 |
| VanRIMS No.: | 08-2000-20 |
| Meeting Date: | February 21, 2018 |

TO: Standing Committee on Policy and Strategic Priorities

FROM: General Manager of Engineering Services

SUBJECT: Expansion of the False Creek Neighbourhood Energy Utility ("NEU")

***RECOMMENDATION***

A. THAT Council adopt the NEU investment decision framework to guide NEU expansion into parts of Mount Pleasant, Northeast False Creek and the False Creek Flats, as outlined in this report, with funding subject to Council approval of future Capital Plans.

B. THAT staff bring proposed amendments to the Energy Utility System By-law 9552 forward to Council for enactment, expanding the service area to include parts of Mount Pleasant, Northeast False Creek and the False Creek Flats, as described in Figure 1 of this report.

***REPORT SUMMARY***

This report recommends a framework for expansion of the NEU service area to parts of Mount Pleasant, Northeast False Creek, and the False Creek Flats (including the Providence Hospital site). This aligns with previously approved community plans for these areas which require new building developments to utilize neighbourhood energy. The decision on NEU expansion is time sensitive, due to advancement of building development and infrastructure projects within the subject areas.

A comprehensive business case evaluation has determined that both NEU and non-NEU building approaches can achieve the current greenhouse gas emission limits set under the Zero Emissions Building Plan. While non-NEU building approaches do not require any direct City investment, the NEU provides the following unique benefits:

- it provides the City with direct control to secure 100% renewable energy target for connected buildings;

- it increases the local supply of renewable energy and reduces reliance on new renewable energy from more remote locations;
- the NEU provides long-term flexibility to adapt to new technologies; and
- it provides a renewable energy retrofit opportunity for existing gas-heated buildings.

Expansion of the NEU beyond the current service area will require a long-term capital investment in the range of $45-$93 million (2018$), subject to Council approval of future Capital Plans and the City receiving a financial return commensurate with a commercial utility model. While the expansion of the NEU is not without risk, the expansion framework incorporates flexibility in the future business model and mitigation strategies that staff believe will effectively manage risk. This includes a phased approach to expansion and a robust decision making framework to be applied prior to future infrastructure investment decisions that enables the City to adjust its approach over time, as needed.

***COUNCIL AUTHORITY/PREVIOUS DECISIONS***

In March 2006, Council approved the creation of the NEU to serve the Southeast False Creek Official Development Plan Area. In December 2006, Council approved a set of governance principles, including establishing the role of the City as owner and operator of the utility.

In June 2012, Council approved expansion of the NEU to the Great Northern Way Campus Lands and a southern portion of the False Creek Flats.

In October 2012, Council approved the Vancouver Neighbourhood Energy Strategy and Energy Centre Guidelines, with key actions including the low carbon conversions of existing steam heat systems and the deployment of new energy systems for high-density neighbourhoods.

In November 2015, Council approved the Renewable City Strategy, which sets the target for 100% of energy used within the City to be from renewable sources by 2050.

Between 2011 and 2017, Council approved various community plan policies that include criteria for developments to connect to a neighbourhood energy system in areas of Lower Main, the Mount Pleasant Digital District, the False Creek Flats and Northeast False Creek.

In July 2016, Council approved the Zero Emissions Building Plan, which established greenhouse gas ("GHG") and energy use limits for new buildings.

***REPORT***

***Background/Context***

Neighbourhood energy systems are shared infrastructure platforms which provide heating and/or cooling infrastructure for multiple buildings, and are most suitable in dense urban areas. They provide the utility business model and economy of scale necessary to make use of a variety of renewable energy resources that are often not available or affordable to implement in individual buildings. These district-wide systems are also capable of serving both new development and existing gas-heated buildings, and provide a flexible platform that can adapt to new technologies over time. Worldwide, neighbourhood energy systems are undergoing a renaissance in urban development as a result of growing concerns about climate

protection, energy security and resiliency.

Energy used by buildings generates 55% of Vancouver's total greenhouse gas emissions. Key priority areas of the Renewable City Strategy are to (1) improve the energy efficiency of buildings and to (2) increase the supply and use of renewable energy. Low carbon neighbourhood energy systems help to achieve both of these objectives in high density areas of the city.

The City-Owned NEU

The fundamental goal of the NEU is to minimize GHG emissions via a financially self-sustaining, commercially operated utility that delivers competitively priced energy services. Through its system efficiencies and by using sewage heat recovery as its low carbon energy source, the NEU provides substantial greenhouse gas emission reductions relative to traditional methods of providing heat and hot water. The current target for the NEU is to derive 70% of energy from renewable sources, such as sewage waste heat and renewable natural gas. The NEU began operation in January 2010, and since then has expanded its customer base by more than 300% serving new building developments in the Southeast False Creek and Great Northern Way Campus Lands areas.

The NEU is not regulated by the BC Utilities Commission ("BCUC"), and the City maintains direct control over investment decision making, rate setting and GHG performance targets. Given the City's dual role as owner and regulatory of the utility, Council established the Neighbourhood Energy Expert Panel to provide advice and input on issues including customer rate setting, policy and expansion opportunities. Appendix A provides additional details on the NEU's ownership model, governance and rate setting principles. Appendix B provides details on the NEU's levelized customer rate structure.

Downtown Neighbourhood Energy Status Update

In 2012, Council approved the Vancouver Neighbourhood Energy Strategy. Priorities for the Downtown area include (1) a renewable fuel switch for the privately owned Downtown steam heat system (the "Downtown Fuel Switch Project"), which provides heat to more than 200 large buildings and is one of the largest GHG reduction opportunities in the city, and (2) establishment of new low carbon neighbourhood energy systems in high-growth areas including Northeast False Creek.

- **Downtown Fuel Switch Project Update:**
    - Creative Energy Vancouver Platforms Inc. ("Creative Energy") has completed a feasibility study, which concluded that the Fuel Switch Project, utilizing clean local wood waste as a fuel, is a cost-effective approach for supplying renewable energy. However, due to current low natural gas and carbon prices, the project would be significantly more expensive than natural gas-fueled steam from the existing Creative Energy steam plant. Therefore, the study concluded that not enough of Creative Energy's customers would likely commit to buying energy from the project for it to proceed.

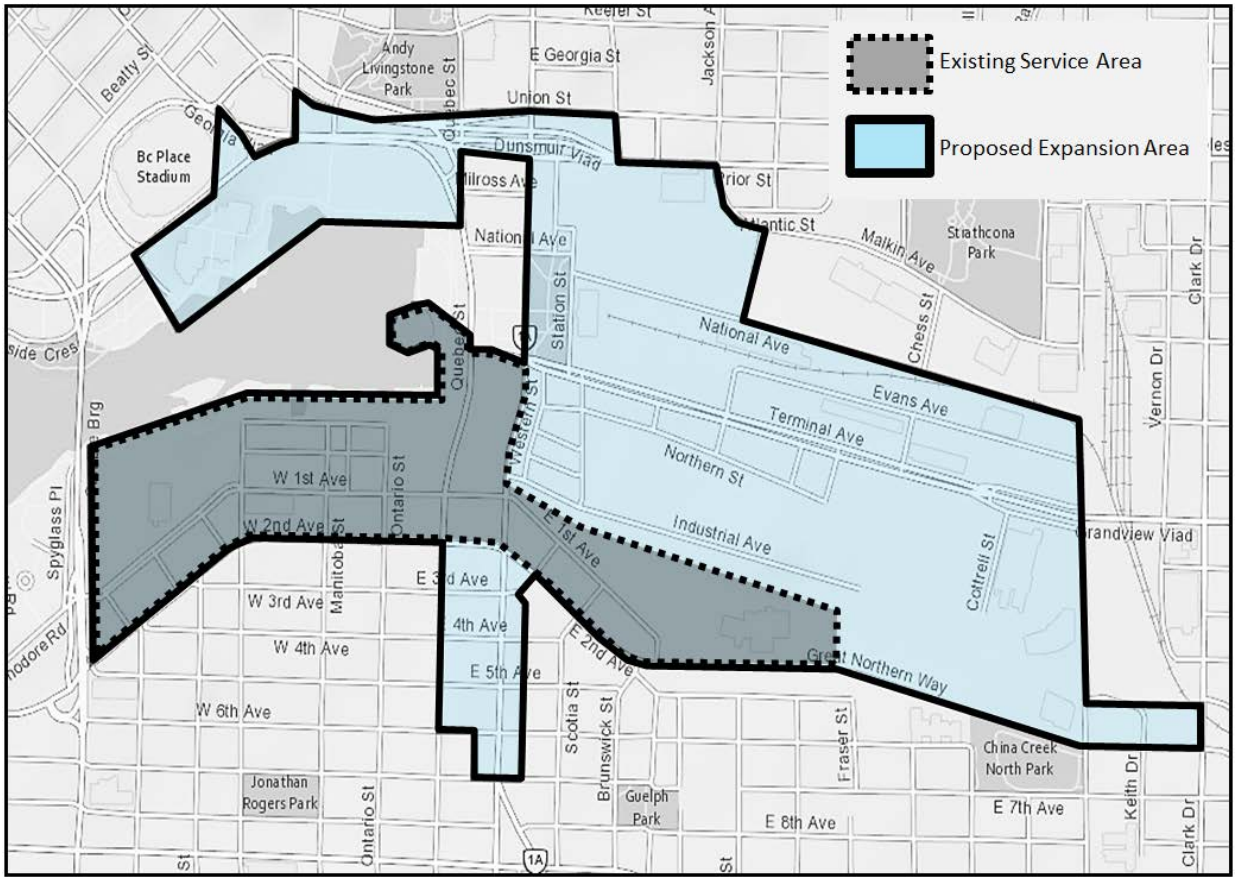
    - The City has entered into a non-binding Memorandum of Understanding with Creative Energy to clarify City support for the Fuel Switch Project and Creative Energy's commitments going forward. Creative Energy is now pursuing Provincial and Federal funding programs in an effort to improve the business case.

- **Northeast False Creek Update:**
  - Following a competitive procurement process, the City entered into an agreement with Creative Energy, for Creative Energy to design, build, finance, own and operate a new energy system to serve developments in Northeast False Creek. This system was to be regulated by the BC Utilities Commission ("BCUC"). To de-risk capital-intensive investments in energy infrastructure, the City committed to securing connection of new developments by way of a by-law.

  - The BCUC approved development of the energy system, but did not approve the agreement between Creative Energy and the City, out of concerns regarding mandating connections to a privately owned utility. Creative Energy does not have sufficient revenue security to proceed with investments in Northeast False Creek energy infrastructure.

This BCUC decision helped to provide clarity that the City should consider owning energy systems in areas where mandating connections is needed to secure customers and de-risk investments in energy infrastructure. Over the last year, a comprehensive business case analysis has evaluated potential expansion of the City-owned NEU to Northeast False Creek, the False Creek Flats, Lower Main and the Mount Pleasant Digital District. These areas are already subject to Council policy for new developments to utilize neighbourhood energy (see Figure 1).

**FIGURE 1. MAP OF PROPOSED EXPANSION AREAS**



***Strategic Analysis***

Staff have completed a business case analysis for expansion of the NEU, incorporating input from experts in the energy utility business sector, as well as input from the Neighbourhood Energy Expert Panel. Key objectives of the business case included:

1. understand infrastructure phasing requirements for expansion of the NEU, and

2. evaluate GHG, financial and customer implications associated with expansion, including project risks and mitigation strategies.

The business case analysis also included a comparison between NEU and non-NEU approaches for achieving low emissions buildings under the Zero Emissions Building Plan.

Guiding Principles for NEU Expansions

The expansion plan incorporates the following guiding principles, which are generally aligned with the original NEU governance principles that Council approved in 2006 (see Appendix A).

- **Renewable Energy**: the NEU will be used to accelerate 100% renewable energy outcomes for connected buildings, maximizing use of local resources like waste heat

- **Long-term Financial Viability**: expansions of the NEU must be financially viable, earning a return on investment commensurate with a commercial utility model

- **Customer Cost**: the NEU will provide a service that is cost competitive with other low carbon heating options available to customers

- **Resiliency**: the NEU will utilize a design approach that maximizes the reliability of the service and maintains the long-term flexibility to adapt to future technologies

- **Business Model**: to maintain control over GHG outcomes, the City will own the distribution system, with flexibility for private sector to own, operate and finance new energy centres

Phased Approach to Infrastructure Expansion

NEU infrastructure expansions would be timed with building development and major projects. This factors in an immediate investment required in time with Northeast False Creek roadworks, and NEU pipe connections to be ready in time for developments committed to using the system. The plan assumes City ownership and operations of heat distribution pipes and customer connections, while at the same time retaining long-term flexibility for future private sector investment in renewable energy production technologies.

The following maps demonstrate how the utility could grow over time, and are based on best available information on building developments and City infrastructure projects. Phasing is presented to align with future 4-year capital plan cycles, under which Council will make future investment decisions. Under this plan, the NEU customer base at build-out would grow from 758,000 square metres (8,160,000 square feet – existing service area) to approximately 2,100,000 square metres (22,600,000 square feet – including the expansion areas). These maps are based on the best available planning information at this time, and forecasts are subject to change with timing of future building developments and major road work projects.

**FIGURE 2. MAP OF 2018 NEU DISTRIBUTION SYSTEM AND CUSTOMERS**

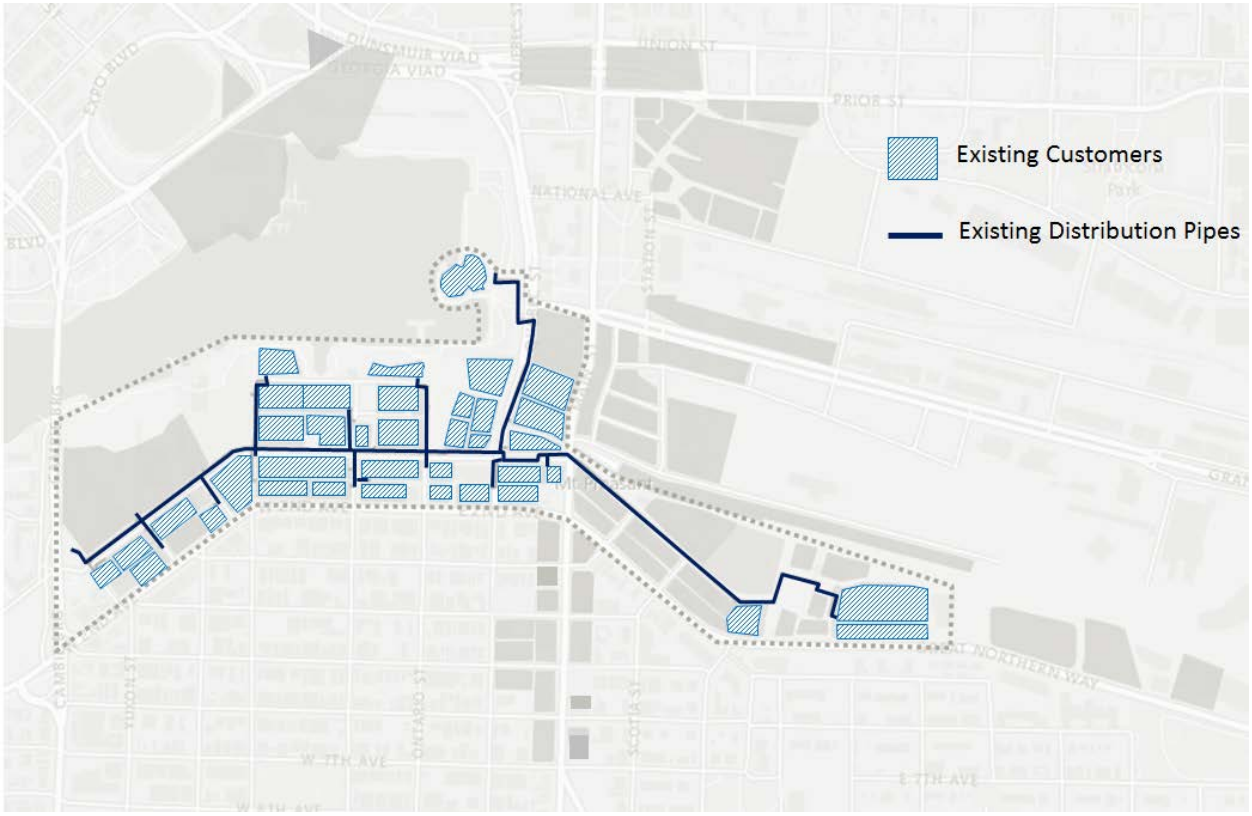



**FIGURE 3. MAP OF FORECAST 2019-2022 CAPITAL PLAN DISTRIBUTION SYSTEM AND CUSTOMERS**

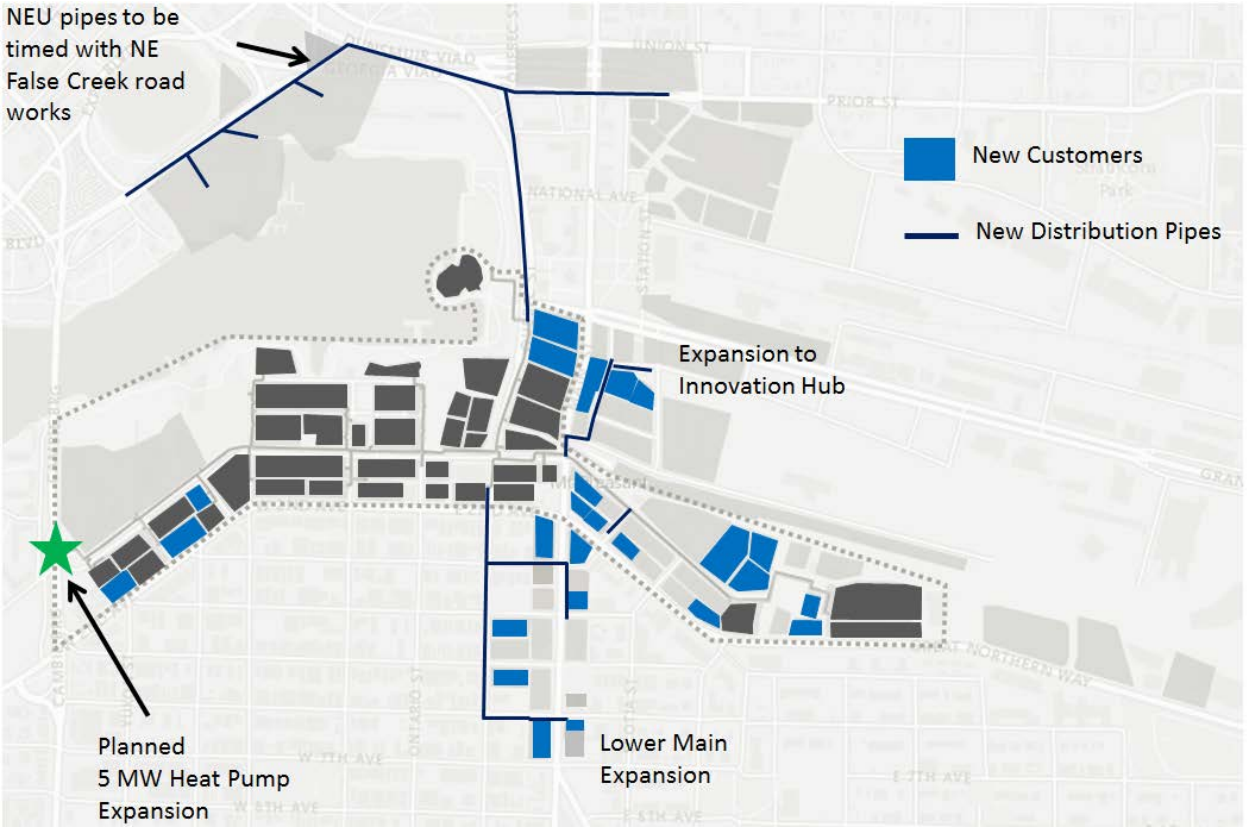


**FIGURE 4. MAP OF FORECAST 2023-2026 CAPITAL PLAN DISTRIBUTION SYSTEM AND CUSTOMERS**


**FIGURE 5. MAP OF ANTICIPATED NEU GROWTH BEYOND 2026***


**NOTE: some sites that fall within expansion boundaries have not been included in map phasing due to timing and energy demand uncertainty. These sites will be assessed for connection on a case-by-case basis.*

Heat Source Options for Expansion Areas

Rather than locking in decisions on future sources of renewable energy now, this plan preserves long-term flexibility to utilize a diverse range of technology options and resources. Potential future heat source options include:

- **Downtown Steam System Fuel Switch Project**: in the event that Creative Energy is able to secure sufficient support from senior levels of government, the Fuel Switch Project is a potential cost-effective source of renewable energy for the NEU.

- **Sewage Heat Recovery**: The NEU currently has 3 megawatts of sewage heat recovery capacity, which may increase to 8 megawatts over the next Capital Plan. Analysis of City and Metro Vancouver sewage infrastructure in the area indicates that, after this capacity increase, there will be approximately 15 megawatts of additional sewage waste heat available for recovery.

- **Other Sources of Waste Heat**: The NEU provides flexibility to recycle waste heat from sources such as building air conditioning, refrigeration and data centres. As an example, the new Mountain Equipment Co-op store in Southeast False Creek will sell waste heat from its air conditioning system back to the NEU.

- **Renewable Natural Gas**: To supplement heat recycled from sewage, the NEU currently uses renewable natural gas to help achieve its GHG target. Renewable natural gas, also called "bio-methane," is supplied by FortisBC, and is generated from agricultural, sewage treatment and food composting. In the future, renewable natural gas will also be supplied from the Vancouver Landfill.

- **Small-Scale Technology Demonstration Projects**: to support green economic development, the NEU platform also provides technology vendors with the opportunity to test and demonstrate pre-commercial technologies. An example of this is a sewage heat filtration system that is currently being piloted at the False Creek Energy Centre.

- **Back-up and Peaking Energy**: to ensure reliable energy services on the coldest days of the year, natural gas boilers and Creative Energy's system may be used for back-up and peaking energy. Both of these energy sources are compatible with the use of renewable natural gas. BC Hydro electricity is another potential long-term option.

The NEU expansion plan preserves long-term flexibility for private sector investment in new renewable energy production, which would reduce City financing requirements while at the same time facilitating green economic development.

***Implications/Related Issues/Risk (if applicable)***

***Financial***

NEU Infrastructure Capital Requirements

In addition to the $29 million required for expansion within the existing NEU service area, an investment in the range of $45-$93 million (2018$) is required over the next 12-20 years to expand the NEU service area to include Mount Pleasant, Northeast False Creek and the False Creek Flats (including City Innovation Hub and the Providence Hospital site).

Table 1 below summarizes potential capital requirements for the distribution system and energy centres beyond the current NEU service area, and the forecast levelized cost of service[1] to end users under three scenarios - base case, high cost and low cost – based on different expansion plan assumptions (see Appendix C).

**TABLE 1. SCENARIO ANALYSIS – CAPITAL INVESTMENT FOR NEU EXPANSION BEYOND CURRENT SERVICE AREA & LEVELIZED COSTS**

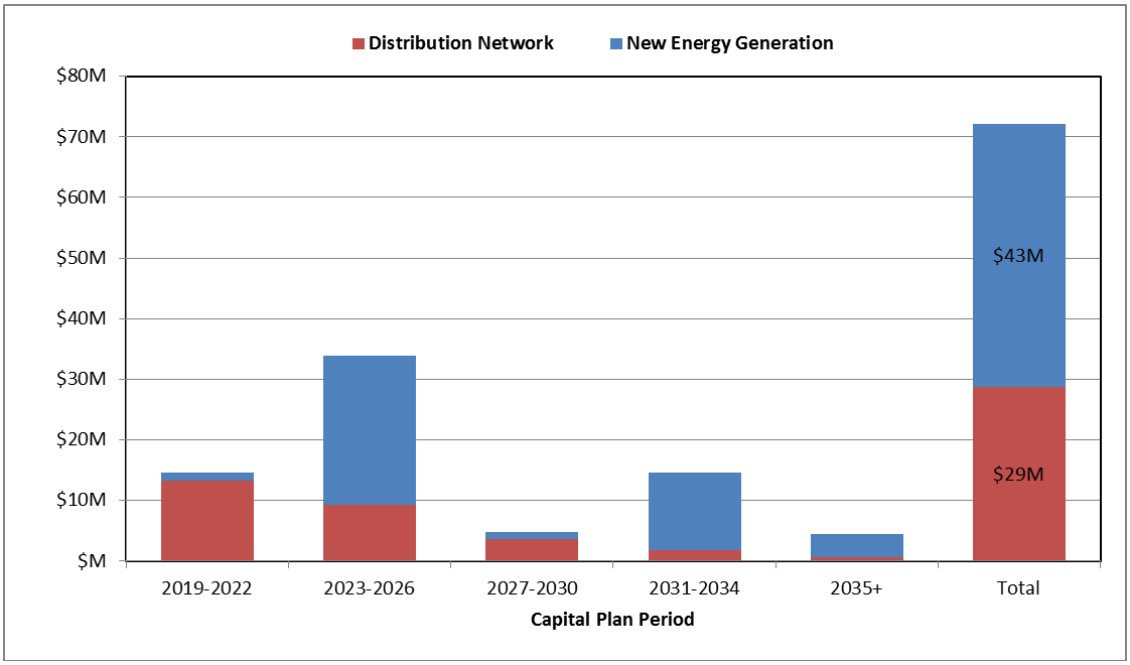
| Scenario | Total Capital Requirements to 2038, in 2018 $$ | Levelized Cost of Service to End User |
|---|---|---|
| **Forecast "Base Case" Scenario** | $29M – Distribution<br>$43M – Generation<br>**$72M - Total** | **$135 per MW-hr** |
| **High Cost Scenario** (30% increase in total capital costs, a 3 year delay in customer development, and a 6% borrowing rate) | $37M – Distribution<br>$56M – Generation<br>**$93M - Total** | $162 per MW-hr |
| **Low Cost Scenario** ($15M grant, a $200K customer connection fee, and a 4% borrowing rate) | $13M – Distribution<br>$32M – Generation<br>**$45M - Total** | $116 per MW-hr |

To support the NEU expansion plan beyond the current service area, the distribution system requires a capital investment in the range of $13 to $37 million (2018$), and new energy centres require a capital investment in the range of $32 to $56 million (2018$), totalling $45 to $93 million (2018$). The levelized cost of service to end users could range from $116 to $162 per MW-hr, in comparison to BC Hydro's cost of service for a residential building which could range from $155 to $190 per MW-hr depending on input assumptions.

Figure 6 below shows the capital investment profile under the base case scenario ($72 million in 2018$) by Capital Plan cycles. The City's future investment will be determined through the NEU expansion decision framework which, at each major investment decision point, considers the optimal NEU business, ownership and operating model with respect to energy generation and distribution; emerging technology and options to best achieve desired GHG outcomes; and funding availability in future Capital Plans.

**FIGURE 6. FORECAST BASE CASE INFRASTRUCTURE CAPITAL FOR EXPANSION AREAS (2018$)**

[1] The levelized cost of energy is a metric commonly used in the utility industry to evaluate the long-term cost of energy associated with various alternatives.




## NEU Expansion Investment Decision Framework

Table 2 below summarizes the analyses staff will undertake to guide major capital investment decisions, encompassing NEU business, ownership and operating model, technology options and the City's financial capacity.

**TABLE 2. INVESTMENT DECISION FRAMEWORK**

| Aspect of Evaluation | Analysis Required |
|---|---|
| **1. Options Analysis** | • Update evaluation of NEU alongside alternative options to achieve desired GHG outcomes |
| **2. Financial Analysis** | • Evaluate financial implications (fiscal capacity, NEU financial KPIs etc.) of continued operations and expansion |
| **3. Ownership Analysis** | • Evaluate City role with respect to ownership and operations of all or a portion of NEU infrastructure, including both existing infrastructure and future energy centres |
| **4. Risk Assessment** | • Update evaluation of risks using the City's standard risk assessment framework |

## Evaluation of Key Risks and Mitigation Strategies

Expansion of the existing NEU will have a number of benefits, and as well as risks to the City. In evaluating the option to expand the NEU, a risk analysis was completed and a number of existing and new mitigation strategies were developed to address these risks. Table 3 provides a summary of the key risks and existing and new mitigation strategies. NEU risks will change over time, and a comprehensive risk evaluation will be required prior to each major investment and funding decision by Council.

**TABLE 3. KEY RISKS AND MITIGATION STRATEGIES**

| Risks | Existing Mitigation Strategies | New Mitigation Strategies |
|---|---|---|
| • Pre-building of NEU infrastructure, in advance of customer revenues (e.g. Northeast False Creek NEU pipes)<br>• Long-term utility investments and new competing technologies<br>• Changes in capital and operating costs<br>• Operational risks<br>• Pre-commitment of NEU service to developers | • Mandatory connection by-law minimizes revenue risk<br>• NEU platform is adaptable to new technologies<br>• Annual updates to customer rates under a commercial utility financial model, with Expert Panel input<br>• Preserve future opportunity for the City to divest | • use a phased approach for infrastructure expansion, applying a robust decision making framework to guide future infrastructure investments and the role of the City<br>• Preserve flexibility for private sector investment in new energy centres<br>• Pursue applicable senior government funding programs<br>• Potential connection fee for developments to be explored |

### *Environmental*

The business case included an analysis comparing GHG and other environmental outcomes using the NEU to non-NEU approaches under the Zero Emissions Building Plan (see Table 4). Results are not presented for buildings rezoned under previous green building policies, which typically do not result in a comparable GHG performance outcome to the NEU.

**TABLE 4. COMPARISON OF ENVIRONMENTAL OUTCOMES BETWEEN NEU AND NON-NEU BUILDING**

| Criteria | NEU Connected Building | Low Emissions Building Without NEU Connection |
|---|---|---|
| **Near-term GHG performance** | 6kg of $CO_2$ per m2 floor area per year *(based on current NEU renewable energy target)* | 6kg of $CO_2$ per m2 floor area per year *(based on current Zero Emissions Building Plan GHG target)* |
| **Certainty over GHG outcomes** | Provides highest certainty over achieving GHG performance targets, based on demonstrated track record of the NEU's measured performance. Following construction, the City has an ongoing role in managing system to achieve targets | Provides moderate certainty over GHG outcomes, as requirements are based on modelled predictions, and actual GHG performance outcomes will not be measured until buildings are occupied. Following occupancy, the City has limited influence over operations, maintenance and equipment renewal decisions by building owners |

| | | |
|---|---|---|
| **City control to secure 100% renewable energy outcomes for buildings** | The NEU provides flexibility to adapt to new technologies, which allows the City to adjust the GHG performance target over time, enabling buildings constructed prior to 2030 to achieve the 100% renewable energy target without the need for future building retrofits | Achieving long-term 100% renewable target for pre-2030 buildings will require future building retrofits and associated costs to building owners. Securing the 100% renewable energy target is reliant on regulatory & incentive tools that do not exist today |
| **Contributing to City goal of increasing supply of local renewable energy** | Increases supply of local renewable energy through recovery of waste heat from sewage and cooling and use of other technologies | Long-term outcomes reliant on new supply of renewable energy from more remote locations |

The business case analysis demonstrates that both NEU and non-NEU approaches can cost-effectively achieve the current greenhouse gas emission limits set under the Zero Emissions Building Plan. While non-NEU building approaches do not require any direct City investment, the NEU provides the unique opportunity to rapidly reach the 100% renewable energy target for all buildings served by it, and increases local renewable energy supply through recycling of waste heat from sewage and other resources. This reduces reliance on new renewable energy from more remote locations and the associated ecological impacts. In addition to the items described above, the NEU also provides the long-term opportunity to retrofit existing gas-heated buildings to renewable energy.

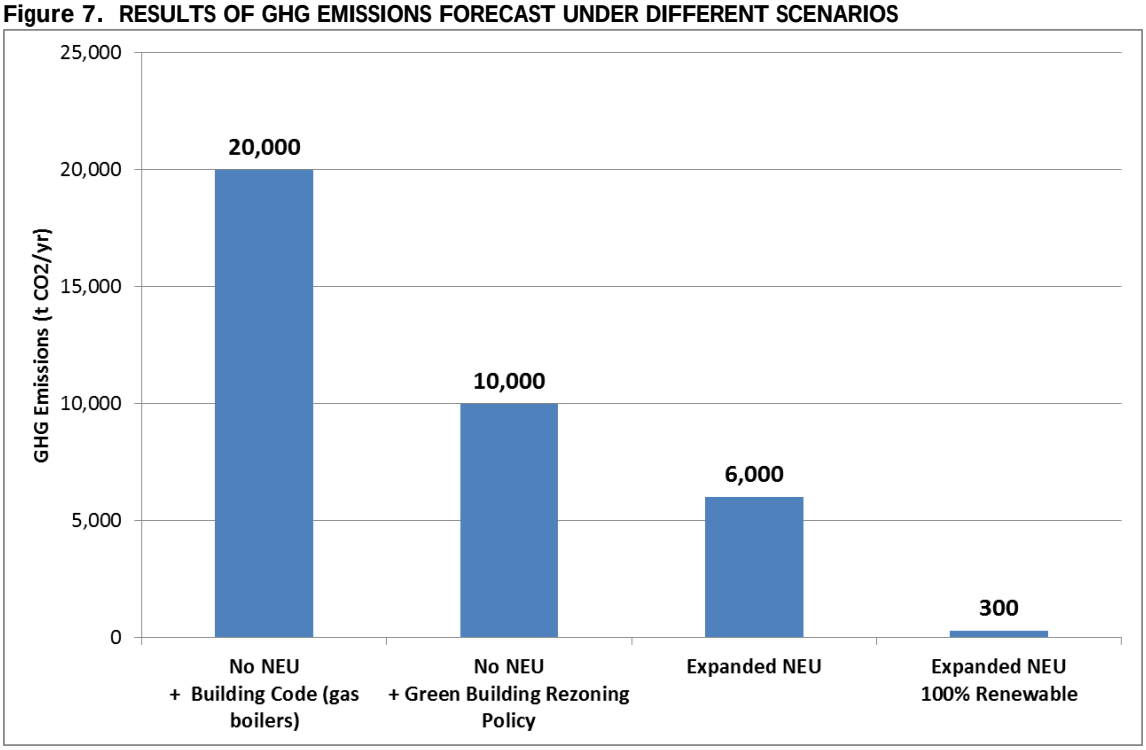
The cost per tonne of GHG savings resulting from the NEU ranges from $40 to $110 per tonne of CO2 eliminated, which is slightly lower than for a non-NEU connected low emissions building (see Appendix D for more info).

Figure 7 provides a forecast for GHG emissions under several different scenarios, for the expansion areas. The GHG reductions forecast do not include the existing NEU service area.

GHG savings for the expansion areas, at build-out, is approximately 4,000 tonnes of CO2 per year, compared to buildings that would otherwise be constructed with no NEU and would need to comply with applicable green building rezoning policies[2]. In a hypothetical case where buildings were simply constructed to comply with building code, the GHG benefit would increase to 14,000 tonnes CO2 at build-out. These estimates are based on the current 70% renewable energy target for the NEU and GHG emissions would be further lowered when transitioning to 100% renewable energy. Also, the above estimates are in addition to the forecast 10,000 tonnes CO2 per year savings for the existing NEU service area at build-out.

[2] Buildings with rezoning applications filed on or after May 2017 are required to meet the GHG performance targets associated with the Zero Emissions Building Plan, and sites with earlier rezoning applications are assumed to achieve less stringent standards. This estimate also factors in the proposed St. Paul's Hospital, which is early in the development process and has a high degree of uncertainty regarding GHG emissions with or without an NEU connection.

**Figure 7. RESULTS OF GHG EMISSIONS FORECAST UNDER DIFFERENT SCENARIOS**




Beyond the renewable energy and greenhouse gas emissions benefits, the NEU also provides environmental co-benefits:

- the recovery of waste heat from building air conditioning systems also provides a modest reduction in potable water use compared to conventional evaporative cooling systems (e.g. the recovery of waste heat from the new Mountain Equipment Co-op store in Southeast False Creek will reduce water consumption by approximately 1 million litres annually); and

- the NEU allows buildings to avoid the need to locate heating equipment on roof-tops, leaving more space for green roofs which help to reduce rainwater run-off and the heat island effect.

***Utility Customer Implications***

Appendix D provides a comparison between a building heated with the NEU versus a low emissions building constructed without an NEU. For a residential or office high rise building, factoring in construction, maintenance, utility fees and equipment renewal costs, connecting to an NEU results in a comparable cost to meet the Zero Emissions Building Plan energy efficiency and GHG limits. This is based on analysis that indicates that NEU customer rates, factoring in the expansion areas, would not differ significantly from rates as forecast for the current NEU area. The NEU also provides the following benefits to customers:

- up-front construction cost savings for buildings, and increased architectural design flexibility;

- customers do not need to maintain and replace heat generation equipment; and

- buildings that have significant air conditioning use (e.g. an office building) have the opportunity to sell waste heat back to the utility.

The Energy Utility System By-law 9552 sets technical requirements for buildings connecting to the NEU, terms of service, customer fees, and the geographical areas subject to the mandatory connection provisions of the by-law. Subject to Council approval of this report, staff will be reporting back with recommendations for amendments to the Energy Utility System Bylaw 9552 that will:

1. expand the geographical area subject to the By-law (see map Figure 1);

2. adjust, where appropriate, technical requirements for buildings connecting to the system, to ensure that requirements remain aligned with current building practices, increase building design flexibility for developers, and maximize the ability to recycle waste heat from buildings; and

3. establish amounts of connection fees if appropriate.

Staff have had preliminary discussions with the development industry, including the Urban Development Institute and other landowner representatives. Subject to Council approval of the recommendations in this report, staff will enter into detailed consultations with development industry representatives regarding items 2 and 3 above.

### *Next Steps*

Subject to Council approval of the recommendations in this report, Staff will proceed with the next steps generally as described in Table 5.

**TABLE 5. IMMEDIATE NEXT STEPS**

| Activity | Forecast Timing |
|---|---|
| Council decision on enactment of an amendment to the Energy Utility System By-law to expand the service area of the NEU | Q1, 2018 |
| Consultation with development industry, including landowner representatives regarding NEU and building technical design and related Energy Utility System By-law amendments | Q1 – Q2, 2018 |
| Council decision on amendments to the Energy Utility System By-law to adjust technical requirements for customer buildings and NEU connection fees | Q3, 2018 |

***CONCLUSION***

Staff recommend a framework to guide future expansion of the NEU to parts of Mount Pleasant, Northeast False Creek, and the False Creek Flats. For buildings constructed prior to 2030, the NEU provides an effective tool to secure 100% renewable energy outcomes, and enables the recycling of waste heat that cannot happen without a district-scale solution. In addition, the utility provides a resilient solution for heat and hot water in buildings, with a flexible infrastructure platform that can adapt to a wide range of renewable energy technologies.

* * * * *

# APPENDIX A
# FALSE CREEK NEIGHBOURHOOD ENERGY UTILITY
# OWNERSHIP MODEL, GOVERNANCE AND RATE-SETTING PRINCIPLES
# APPROVED BY CITY COUNCIL IN DECEMBER 2006

### *Approved Ownership and Operating Model*

On December 14, 2006, Council assessed various ownership and operating options for the NEU, and approved the continued ownership and operation of the NEU by the City, with the following conditions:

- That the NEU be integrated into the Engineering Services Department.
- That the ongoing governance, operational and financial responsibilities related to the NEU be shared by the General Manager of Engineering Services and the Director of Finance.
- That the merits of continued ownership be reviewed before any significant expansion of the NEU, and, in any event, within three years of the commencement of commercial operations.

### *Approved Governance Principles*

At that same time, Council approved the following governance principles for the NEU:

1. That the NEU will seek to minimise greenhouse gas emissions, consistent with the directions established in the Community Climate Change Action Plan.
2. That the NEU will be operated to ensure long-term financial viability based on a commercial model.
3. That the NEU will strive to establish and maintain customer rates that are competitive with the long-term capital and operating costs of other heating options available to customers.
4. That the City, where feasible, will support the development and demonstration of flexible, innovative and local technologies through the NEU.
5. That the City will consider and evaluate the potential to expand the NEU to other neighbourhoods and developments, with the merits and feasibility of each expansion phase to be determined separately.

### *Approved Rate-Setting Principles*

Council also adopted the following eight principles, to be applied to setting rates and terms of service for NEU customers:

1. That NEU rates are structured so as to recover the following costs incurred by the City, based on forecasted costs:
    i. all direct operating costs associated with the NEU,

ii. all debt service and repayment costs associated with the NEU,

iii. the share of City administrative overheads that are attributable to the NEU,

iv. property taxes and/or payments-in-lieu of property taxes, as appropriate,

v. a reserve fund for NEU rate stabilization,

vi. an appropriate level of compensation for the risks and liabilities assumed by the City associated with the ownership and operation of the NEU, and

vii. credits for any benefits provided by the NEU to City taxpayers (e.g., contribution to corporate GHG reductions goals), as determined by Council.

2. That NEU rates fairly apportion the aforementioned costs among customers of the NEU.

3. That NEU rates be understandable to customers, practical and cost-effective to implement.

4. That at least two separate rate classes (commercial and residential) be established to distinguish different types of NEU customers, with rates reflecting each class's proportional contribution to total costs.

5. That, where feasible, NEU rates provide price signals that encourage energy conservation by NEU customers.

6. That the methodology for calculating NEU rates provide year-to-year rate stability for NEU customers to the greatest extent possible.

7. That the methodology for calculating NEU rates provide year-to-year revenue stability for the City to the greatest extent possible, and include the use of a rate stabilization reserve similar to that used by the City for other utility operations.

8. That rates be updated by Council annually based on forecasted costs, and adjusted to reflect any deviation from target levels of reserves, with annual rate changes requiring review and approval by Council followed by enactment of the necessary amendments to the NEU by-law.

# APPENDIX B
# FALSE CREEK NEIGHBOURHOOD ENERGY UTILITY
# LEVELIZED CUSTOMER RATE STRUCTURE AND FINANCIAL KEY PERFORMANCE INDICATORS

SEFC NEU customer rates are comprised of two components: a Fixed Capacity Levy (related to the fixed capital and operating costs associated with the NEU) and a Variable Energy Use Charge (related to customers' actual energy consumption). To ensure fair and appropriate rates, all annual rate changes are reviewed by the independent Expert Panel.

To provide competitive and stable rates for the SEFC NEU customers, rates are established based on a levelized rate approach. As illustrated in Figure 1 below, rates are set to *under-recover* annual costs in the early years of the NEU's operation when the customer base is small, and to gradually recover past costs and a modest return on investment when the customer base is fully established. This approach ensures that infrastructure costs are more equitably distributed between the initial customers and those who connect in later years. If the levelized rate approach were not taken, customer rates would have to be set much higher in the early years of operation.

The levelized rate approach is commonly used by privately owned utilities regulated by the BC Utilities Commission ("BCUC"), including the SFU's UniverCity Energy system, the River District Energy system and the new UBC neighbourhood system.

**FIGURE 1: LEVELIZED RATE APPROACH**

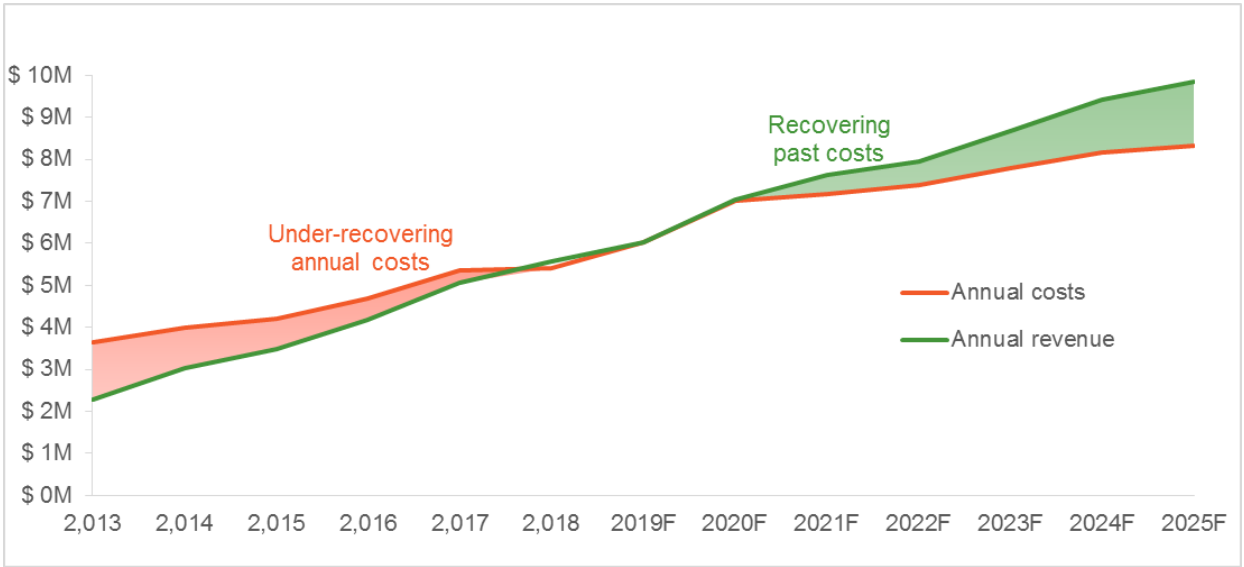
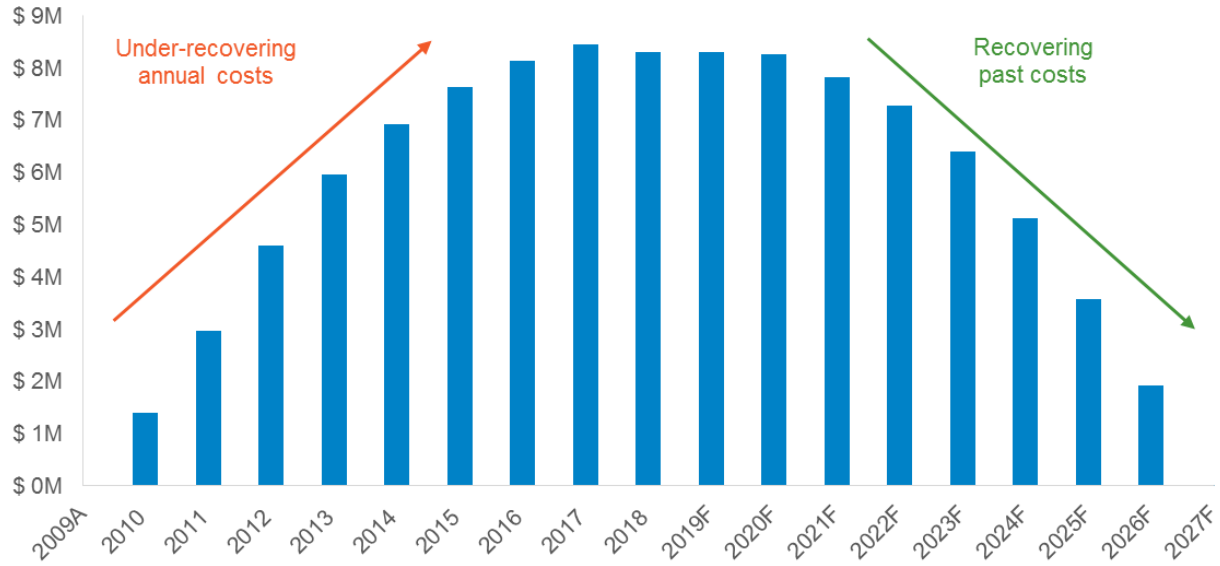


**FIGURE 2: CUMULATIVE BALANCE OF UNDER-RECOVERED COSTS UNDER LEVELIZED RATE APPROACH**




To ensure that the cumulative balance of under-recovered costs (Figure 2) can be recovered within a reasonable timeframe without impacting the stability and competitiveness of the customer rates, the levelized rate approach contemplates annual rate increases that include two components: an inflationary increase and a Rate Escalation Factor.

The Rate Escalation Factor is applied to customer rates above annual inflation to gradually increase rates over time to ensure all of the NEU's revenue requirements are met over the long-term. Using this approach enables the NEU to maintain rates that are stable, affordable and appropriate for new utilities with large upfront capital investments.

## Key Performance Indicators & Targets

To provide greater clarity for future rate setting under the levelized rate approach, in 2015, Council adopted the following KPIs and targets in 2015:

***KPI #1: Maximum balance of under-recovered costs*** – The target for the maximum balance of under-recovered costs shall not exceed $9 million which allows for variation in the timing of development coming on stream.

***KPI#2: Maximum timeline for recovery of all costs*** – The target for recovery of all costs be within 25 years (2034) to match the original term of the levelized rate approach.

***KPI#3: Application of Rate Escalation Factor*** – The Rate Escalation Factor be applied until the year that annual revenues exceed annual costs.

***KPI#4: Competitive rates*** – Council policy requires that the NEU "*strives to establish and maintain customer rates that are competitive with the long-term capital and operating costs of other heating options available to customers.*" When the NEU started operation in 2010, a target was set to limit its rates to no greater than a 10% premium above the BC Hydro rate, which remains current.

# APPENDIX C
# RESULTS OF SENSITIVITY ANALYSIS ON KEY PRO FORMA ASSUMPTIONS

As part of the business case evaluation, a range of sensitivity analysis was completed in order to quantify potential risk associated with changes to key pro forma input assumptions. A key input assumption is defined as an assumption that carries a significant impact on the results of the financial analysis. The key financial output considered for the sensitivity analysis is the levelized cost of energy ($/MWh), which is an industry standard evaluative metric used to guide utility business case analysis and decision making. Table 1 describes the key input assumptions used for the sensitivity analysis.

**TABLE 1. KEY INPUTS EVALUATED IN PRO FORMA SENSITIVITY ANALYSIS**

| Input | Sensitivity Description |
|---|---|
| Capital Cost | Sensitivity assumes a 30% increase in total capital expenditures beyond current estimates. This scenario models unforeseen capital cost overruns and unexpected costs beyond the contingency included in cost estimates. |
| Development Schedule | The current approach to NEU infrastructure development is on a "just-in-time" basis, though delays in new building construction presents the risk of delayed revenues. This sensitivity evaluates a 3-year halt in all development activity beginning in 2022, a crucial year for infrastructure development. This sensitivity assumes that energy generation infrastructure is still constructed despite the slowdown. |
| Energy Demand | Energy demand assumptions were based on the new Zero Emissions Building Plan policies. However, until these buildings are constructed there is some uncertainty on how they will actually perform. This sensitivity assumes a reduction in forecast energy demand of 20% for all new buildings coming online later than 2020. The sensitivity analysis doesn't consider a scenario where energy demand is higher than forecast (which base on input from experts is a more likely scenario), because such an outcome would result in a lower levelized unit cost of energy supply. |
| Connection Fee | The current NEU rate structure does not include a connection fee. A scenario was considered where the NEU implemented a $200,000 fee per building to cover capital cost connecting to the NEU. The use of connection fees is a common practice within the utility industry, and the amount of the connection fee analyzed in this sensitivity is less than the anticipated cost savings to developers through connecting to the NEU. |
| Grant Funding | Factoring in the significant GHG emission reductions and innovative features of the NEU, there is the potential that NEU Expansion would qualify for Federal and Provincial funding programs. This scenario assumes a $15 M grant. |
| Cost Recovery Model | The current financial model of the NEU includes a 10% return on equity, commensurate with a commercial utility, to justify the capital expenditure to taxpayers. This scenario assumes no return on equity premium and an NEU that limits revenues collected to cost recovery (i.e. financing costs equivalent to the forecast City debt rate). |
| Interest Rates | The current forecast City borrowing rate is 4% and the NEU utilizes 5% rate in the financial pro forma model. Based on the professional opinion of Finance staff, it is unlikely that the borrowing rate would increase beyond 6% so the 6% was utilized as a worst case scenario to model the effects of interest rate increases. |
| Return on Equity | To evaluate the impact of a commercial pre-tax return on equity the assumed return on equity rate is increased from 10% to 12%. |

The impacts of the sensitivity analysis on the NEU levelized cost of energy are shown in Figure 1 and impacts to capital cost are shown in Figure 2.

**FIGURE 1. RESULTS OF SENSITIVITY ANALYSIS**

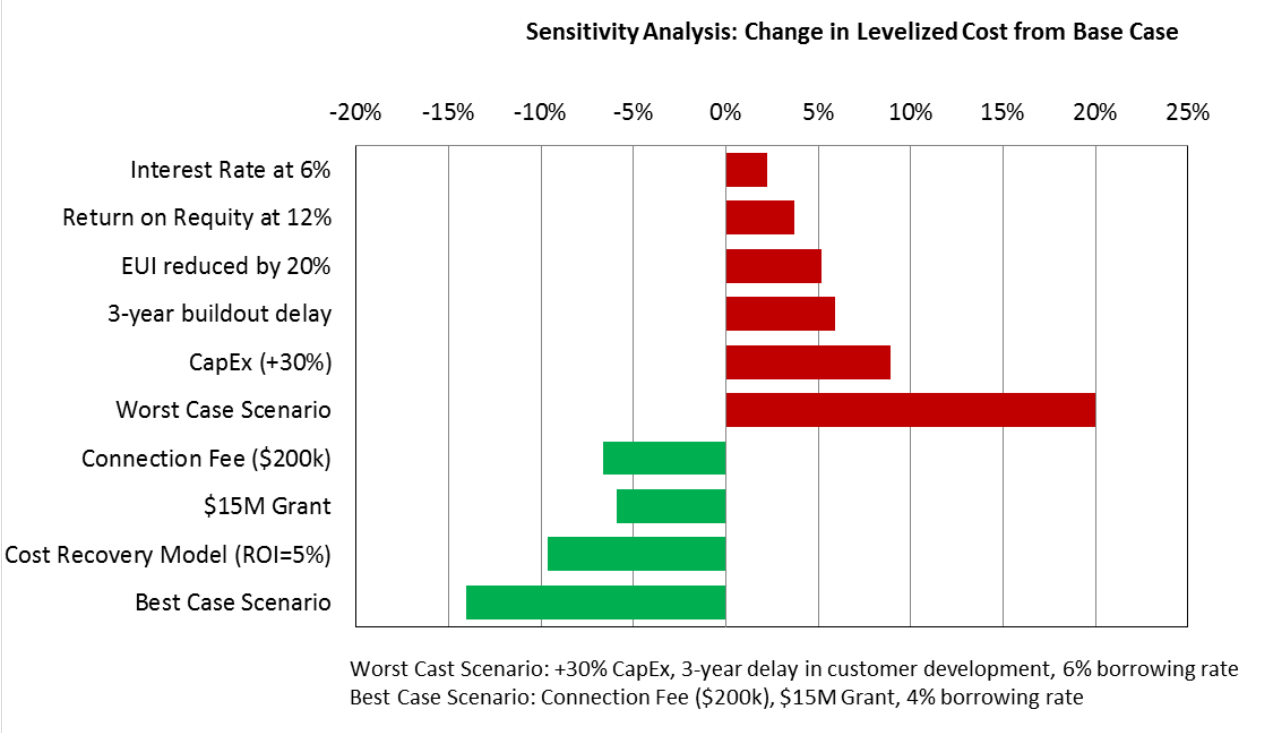
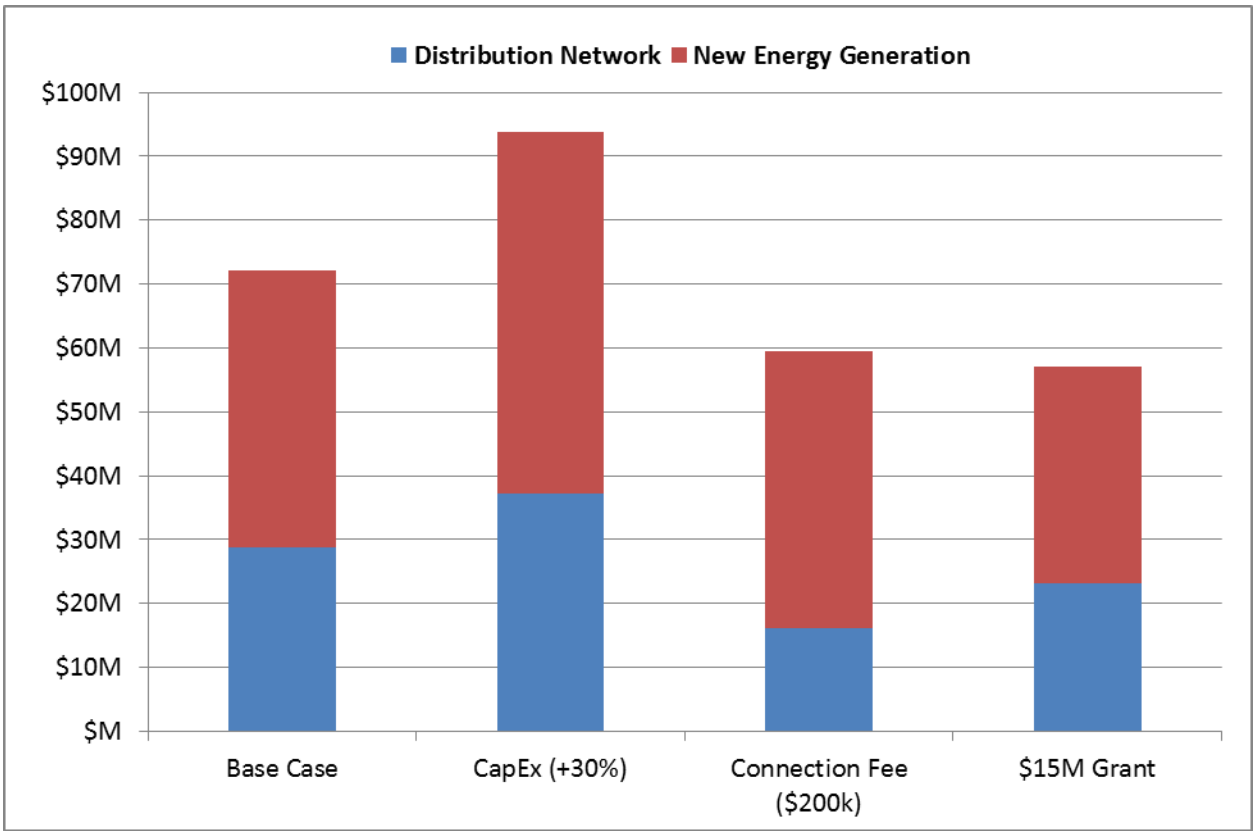



**FIGURE 2. RESULTS OF SENSITIVITY ANALYSIS - CAPITAL COST FORECAST FOR NEU EXPANSION AREAS**




The results of the sensitivity analysis demonstrate a moderate (<20%) level of sensitivity for all assessed factors. A key performance indicator for the NEU is to maintain customer rates that do not exceed the effective rate of BC Hydro residential electricity. Current NEU rates are 12% lower than the forecast BC Hydro effective rate for April 1, 2018, so a 10% rate increase would still allow the NEU to comply with this established key performance indicator.

# APPENDIX D
# COMPARISON BETWEEN NEU CONNECTED BUILDING AND LOW EMISSIONS BUILDING NOT CONNECTED TO NEU

The NEU expansion business case analysis included a quantitative and qualitative comparison between a building connected to the NEU, and a low emissions building without an NEU.

## Alternative Approaches for Low Emissions Buildings

This analysis compares alternative approaches to the NEU for achieving low emissions buildings rezoned under the Zero Emissions Building Plan, for a residential and commercial buildings.

Results are not presented for buildings rezoned under previous green building policies, as such buildings do not provide a comparable GHG performance outcome to the NEU. This analysis considered the specific types of residential and commercial buildings anticipated to be constructed to comply with area plans under the Zero Emissions Building Plan, plus specific design requirements for the area (e.g. Northeast False Creek buildings require cooling to be compatible with entertainment district).

Both NEU-connected and non-NEU-connected alternatives are assumed to have equivalent short-term GHG performance outcomes in accordance with current Zero Emissions Building Plan GHG performance targets. Under the Zero Emissions Building Plan rezoning policy, buildings not connected to a low-carbon energy system are required to make additional improvements to their building envelope and ventilation systems to reduce heating demand and energy use. The building and energy system assumptions used for each alternative, according to building type, are summarized in the Table 1 below.

It is important to note that GHG performance requirements only apply to those sites with rezoning applications filed after May 2017. The expansion areas do include a number of pre-May 2017 sites that will be developed to earlier standards, generally resulting in an increased GHG output for these buildings if developed with a stand-alone heating system.

**TABLE 1: SUMMARY OF BUILDING DESIGN ASSUMPTIONS FOR ALTERNATIVE APPROACHES**

| Building Component | NEU Connected – *Residential & Commercial* | Low Emissions Building – *Residential* | Low Emissions Building – *Commercial* |
|---|---|---|---|
| **Space Heat Production Equipment** | Heat exchanger, connected to NEU | Air-source heat pumps and gas-fired boilers | Air-source heat pumps and gas-fired boilers |
| **Domestic Hot Water Production Equipment** | Heat exchanger, connected to low-carbon NEU | Pre-heating from air-source heat pumps, with a gas-fired hot water tank | Pre-heating from air-source heat pumps, with a gas-fired hot water tank |
| **Envelope Effective $R_{SI}$-Value** | 7 | 9 (improved insulation or reduced thermal bridging) | 12.3 |
| **Balcony Thermal Breaks** | No | No | No |
| **Window to Wall Ratio** | 50% | 50% | 60% |

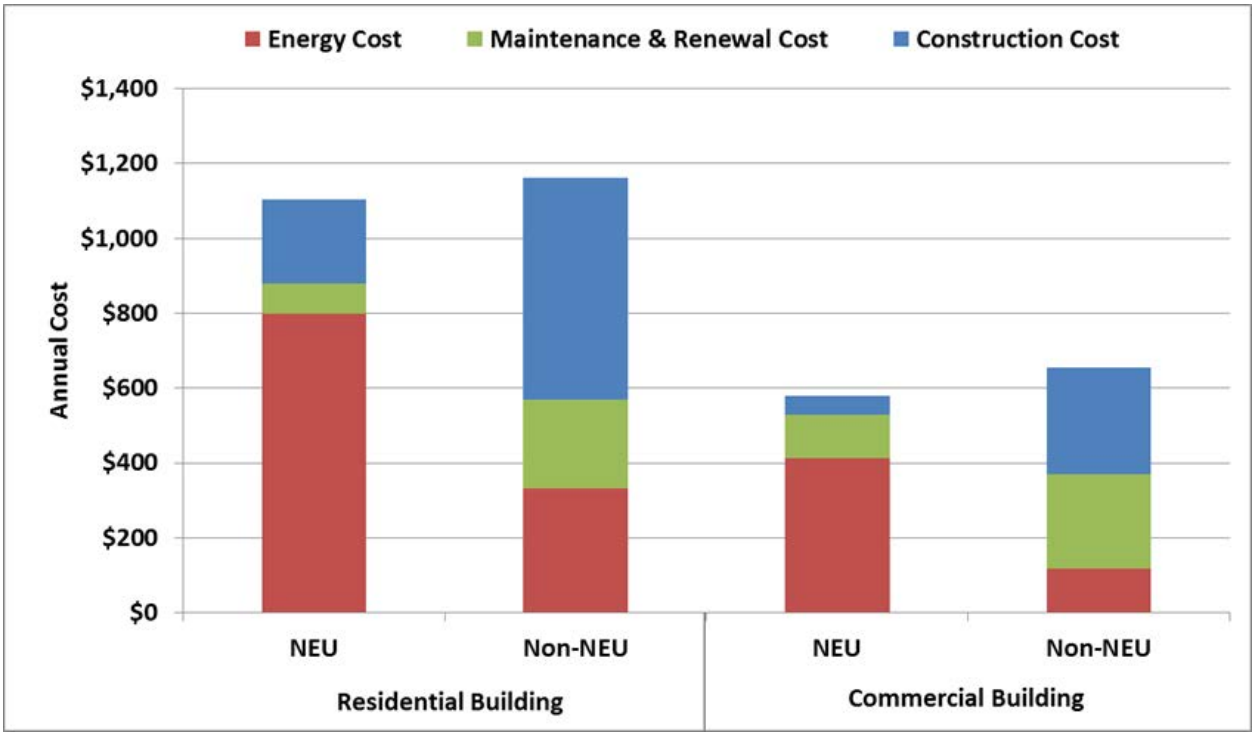
| | | | |
|---|---|---|---|
| **Window $U_{SI}$-Value** | 0.36, double-pane low-e aluminum frame | 0.36, double-pane low-e aluminum frame | 0.23 triple glazing – curtain wall |
| **Heat Recovery Ventilation Efficiency** | 52% | 65% | 65% |

## Evaluation Results

Based on the above assumptions, construction, maintenance/renewal costs and energy costs were calculated for each option and building type. Results are based on an 80m$^2$ (860 sq ft) residential and commercial unit are presented in Figure 1. Energy and maintenance costs are based on a 30-year levelized rate, while the construction costs are annualized over 30-years at a 5% interest rate. Using a levelized rate approach enables the accounting of full life-cyle costs, including construction, operation, maintenance and renewal. It is important to note that levelized costs are not to be confused with today's costs.

For both commercial and residential buildings, the overall annual costs are comparable between the two options with slightly lower costs for the NEU approach. While the overall costs are similar, the allocation of costs between construction, maintenance/renewal and energy are different between an NEU-connected and non-NEU building.

**FIGURE 1: 30-YEAR LEVELIZED ANNUAL COST FOR A 80M$^2$ RESIDENTIAL AND COMMERCIAL UNIT**

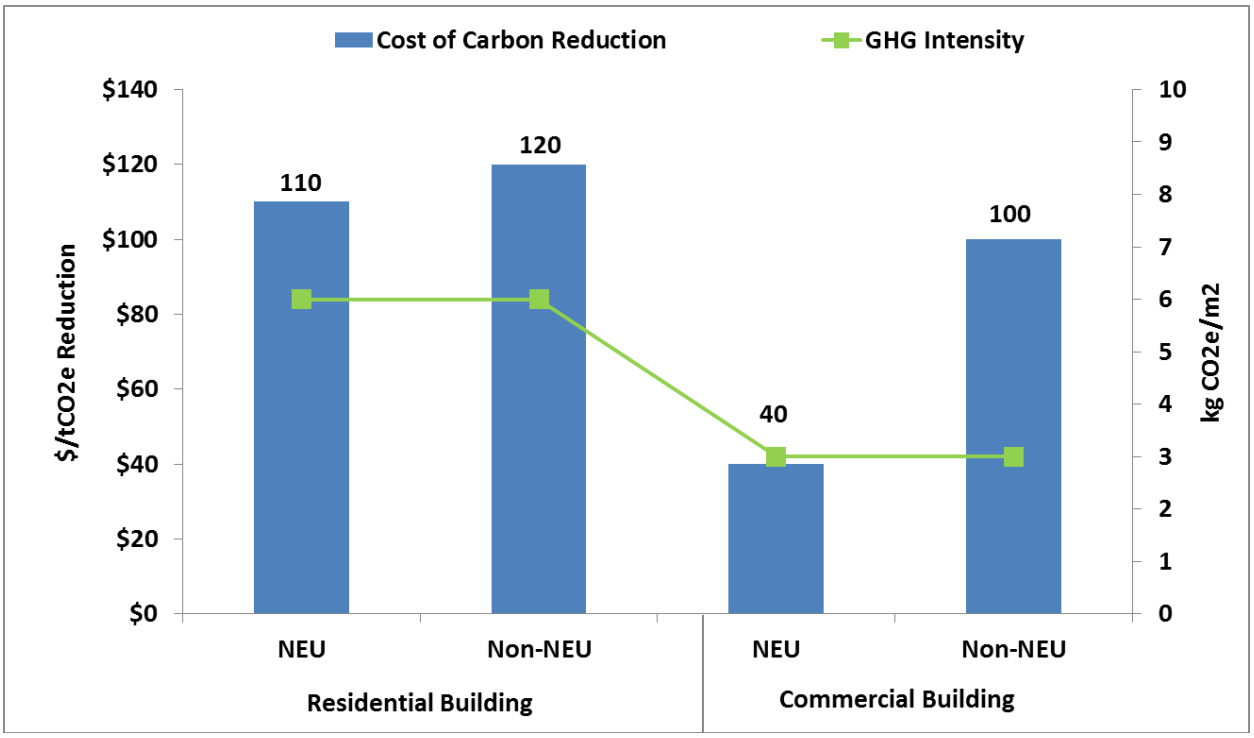



Connection to the NEU provides significant construction cost savings to new developments connecting to the system. Based on this finding, the potential for a service connection fee is to be explored to evaluate the opportunity for residents and tenants to benefit from a portion of these cost savings.

Another metric evaluated is the cost of carbon reduction. As per Figure 1, the base case was assumed to be a building constructed to achieve the 2014 Vancouver Building Code, which

would typically use natural gas boilers (lowest cost approach). For residential buildings, the cost of carbon reduction for an NEU connected building was found to be slightly lower than a non-NEU low emissions building. For commercial buildings the NEU approach is significantly lower. However, this is a bit misleading as both the volume of $CO_2$ reductions and incremental lifecycle costs were modest, meaning small differences in performance between NEU and Non-NEU resulted in larger discrepancies.

**FIGURE 2: COST OF CARBON REDUCTION COMPARED TO A BUILDING CONSTRUCTED TO THE 2014 VANCOUVER BUILDING CODE**




The benefits and risks for NEU-connected and non-NEU low emissions buildings are summarized in Table 2 below.

**TABLE 2. QUALITATIVE COMPARISON BETWEEN NEU AND NON-NEU CONNECTED BUILDING**

| Criteria | NEU Connected Building | Low Emissions Building Without NEU Connection |
|---|---|---|
| **Near-term GHG performance** | 6kg of CO2 per m2 of floor area per year, based on current NEU renewable energy target | 6kg of CO2 per m2 of floor area per year, based on current Zero Emissions Building Plan GHG performance requirement |

| | | |
|---|---|---|
| **Certainty over GHG outcomes** | Provides highest certainty over achieving GHG performance targets, based on demonstrated track record of the NEU and the City's ongoing role in managing system to achieve targets | Provides moderate amount of certainty over GHG outcomes, but actual GHG performance outcomes will not be understood for 5 to 7 years (factoring in time for buildings to be developed and be operational for sufficient amount of time). Following construction, the City has limited influence over operations, maintenance and equipment renewal decisions by building owners |
| **City control to secure 100% renewable energy outcomes** | The NEU provides technological flexibility which allows the City may adjust GHG performance target of NEU over time, enabling buildings constructed prior to 2030 to achieve 100% renewable energy target without the need for costly and disruptive building retrofits | Achieving long-term 100% renewable target for pre-2030 buildings will be challenging due to need for future building retrofits and associated costs/ disruptions to building owners. Also reliant on regulatory/ incentive tools that do not exist today |
| **Contributing to Renewable City Strategy goal of increasing local renewable energy production** | Increases supply of local renewable energy through recovery of waste heat from sewage and cooling and use of other technologies | More reliant on imported renewable energy from more geographically remote locations |
| **Customer cost** | Slightly lower (see Figure 1) | Slightly higher (see Figure 1) |
| **Other Benefits** | • Provides retrofit opportunity for existing gas-heated buildings to switch to renewable energy<br>• Frees up space that would otherwise be used for heating equipment in customer buildings, including space for green roofs<br>• Provides greater architectural design flexibility for developers | • Minimal financial risk to the City<br>• Provides developers with option to choose other energy system solutions |
| **Other Risks** | • Changes magnitude of NEU risk exposure to City<br>• Requires ongoing staff and Council resources for management of NEU | • Cost impact to residents when expensive heat generation equipment when it reaches end of service life. May result in less expensive and more GHG intensive replacement solutions |

The alternatives analysis illustrates that both NEU and non-NEU approaches can cost-effectively achieve the current GHG targets set under the Zero Emissions Building Plan. However, the NEU provides the unique opportunity of being able to quickly reach the 100% renewable energy target for all buildings served by it, and increase the recycling of waste heat and local supply of renewable energy. The NEU also provides a unique retrofit opportunity for existing gas-heated buildings. However, the NEU does carry a significant degree of financial investment and risk for the City, which needs to be carefully managed.