# CPCN APPLICATION

FOR

THE UNIVERSITY OF BRITISH COLUMBIA

NEIGHBOURHOOD DISTRICT ENERGY SYSTEM PROJECT

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Prepared by Corix Utilities Inc.

August 8, 2014

Building a World of Sustainable Communities

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## NEIGHBOURHOOD DISTRICT ENERGY SYSTEM PROJECT

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| **DATE:** | AUGUST 8, 2014 |

CORIX Utilities

Building a World of Sustainable Communities

# TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... 1

1 PROJECT INTRODUCTION ..... 5

1.1 APPLICANT ..... 5
1.1.1 Name, Address and Nature of Business ..... 5

1.2 FINANCIAL AND TECHNICAL CAPACITY ..... 9
1.2.1 Financial Capacity ..... 9
1.2.2 Technical Capacity ..... 9
1.2.3 Name, Title and Address of Contact ..... 10
1.2.4 Name and Address of Legal Counsel ..... 10
1.2.5 Project Team Organizational Chart ..... 10

1.3 REGULATORY PROCESS ..... 11

2 PROJECT NEED, ALTERNATIVES AND JUSTIFICATION ..... 13

2.1 PROJECT HISTORY AND NEED ..... 13

2.2 SCREENING OF ALTERNATIVE TECHNOLOGIES ..... 14

2.3 THE SUSTAINABILITY OF WASTE HEAT FROM TRIUMF ..... 14

2.4 PROJECT BUILD-OUT SCHEDULE, LOAD ANALYSIS AND ENERGY DEMAND FORECAST 15
2.4.1 Project Build-out Schedule ..... 16
2.4.2 Energy Use Intensity (EUI) ..... 17
2.4.3 Load Analysis ..... 18

2.5 SUMMARY OF PREFERRED ALTERNATIVE ..... 19
2.5.1 Phase 1: Project Plan and Description for Current CPCN Filing (2014-2024) ..... 19
2.5.2 Phase 2: Long Term Project Plan ..... 19

2.6 FINANCIAL MODELING AND INPUTS ..... 20
2.6.1 Capital Costs ..... 22
2.6.2 Operating Costs ..... 27

2.7 DEBT AND EQUITY FINANCING ..... 30
2.7.1 Depreciation and Amortization ..... 31

2.8 INCOME TAXES ..... 33

2.9 INDICATIVE REVENUE REQUIREMENTS ..... 33

2.10 LEVELIZED RATE PROPOSAL ..... 36
2.10.1 Fixed and Variable Charges ..... 41
2.10.2 Financial Projections ..... 42
2.10.3 Sensitivity Analysis ..... 43

2.11 PROJECT ALTERNATIVES COMPARISON ..... 43

3 CONSULTATION ..... 44

3.1 FIRST NATIONS CONSULTATION ..... 44

3.2 PUBLIC CONSULTATION ..... 44

4 PROJECT DESCRIPTION ..... 47

4.1 OVERALL PROJECT PLAN ..... 47

4.2 PHASE 1 PROJECT PLAN ..... 48

4.2.1 Phase 1 Phasing ..... 49

4.3 PHASE 1 SYSTEM COMPONENTS ..... 50

4.3.1 Temporary Energy Centres ..... 50

4.3.2 Distribution Piping ..... 50

4.3.3 Energy Transfer Stations ..... 51

4.3.4 Nodal Energy Centre/Energy Transfer Stations ..... 51

4.4 IMPLEMENTATION SCHEDULE ..... 52

4.4.1 Construction Issues and Public Works ..... 52

4.5 HUMAN RESOURCES REQUIREMENT ..... 52

4.6 RISK ANALYSIS ..... 53

4.6.1 Development Risk ..... 53

4.7 PHYSICAL, BIOLOGICAL AND SOCIAL IMPACTS ..... 55

4.8 CUSTOMERS ..... 56

4.9 PERMITS AND APPROVALS ..... 57

5 PROJECT COSTS ..... 58

5.1 CAPITAL COST ASSUMPTIONS ..... 58

5.1.1 Capital Cost Estimate ..... 58

6 PROVINCIAL GOVERNMENT ENERGY OBJECTIVES AND POLICY CONSIDERATIONS ..... 62

7 NEW SERVICE AREAS ..... 63

APPENDIX ONE: DRAWINGS ..... 64

APPENDIX TWO: PRE-FEASIBILITY STUDY AND FEASIBILITY STUDY ..... 65

APPENDIX THREE: PUBLIC CONSULTATION OPEN HOUSE AND FEEDBACK ..... 66

APPENDIX FOUR: PUBLIC CONSULTATION SUMMARY REPORTS ..... 67

APPENDIX FIVE: UNA BOARD PRESENTATION ..... 68

APPENDIX SIX: PROCESS SCHEMATIC ..... 69

APPENDIX SEVEN: UBC DISTRICT ENERGY COMPATIBILITY GUIDE ..... 70

**APPENDIX EIGHT: 2014-2015 PROJECT SCHEDULE ..... 71**

**APPENDIX NINE: UBC TRIUMF LETTER OF INTENT ..... 72**

**APPENDIX TEN: INFRASTRUCTURE AGREEMENT ..... 73**

## LIST OF FIGURES

Figure 1: Proposed NDES Service Area ..... 1
Figure 2: NDES Project Plan ..... 2
Figure 3: NDES Phase 1 Project Plan ..... 3
Figure 4: Ownership Structure Organizational Chart ..... 5
Figure 5: Proposed NDES Service Area ..... 8
Figure 6: Project Team Organizational Chart ..... 11
Figure 7: Anticipated Phase 1 Developments Timeline ..... 16
Figure 8: Escalation Factors ..... 22
Figure 9: Incremental Capital Costs (2014$) ..... 23
Figure 10: Cumulative Capital Costs (2014$) ..... 24
Figure 11: Carbon (GHG) Emissions Profile ..... 25
Figure 12: Fuel Costs (nominal $) ..... 28
Figure 13: Plant in Service Coast Compared to Rate Base (nominal $) ..... 32
Figure 14: Connection Credit Account Compared Rate Base (nominal $) ..... 32
Figure 15: Revenue Requirement (nominal $) ..... 34
Figure 16: NDES vs. ADES Annual Revenue Requirement (nominal $) ..... 35
Figure 17: Allocation of Property, Plant and Equipment NBV between NDES and ADES ..... 35
Figure 18: NDES vs. ADES Share of Fuel Costs (%) ..... 36
Figure 19: Annual Consumption (MWh) ..... 37
Figure 20: NDES Annual Revenue Requirement per MWH (nominal $) ..... 37
Figure 21: NDES Annual Rate per MWh (nominal $) ..... 38
Figure 22: NDES Residential Deferral Account Compared to Rate Base (nominal $) to Rate Base (nominal $) ..... 39
Figure 23: 30-year NPV Levelized NDES Coat vs. Competitive Carbon Neutral Benchmark ..... 40
Figure 24: Monthly In-Suite Heating Bill ..... 41
Figure 25: Project Plan Phasing ..... 48
Figure 26: Phase 1 Project Plan Summary ..... 49
Figure 27: Initial Development Schedule ..... 52
Figure 28: GHG Emissions Profile ..... 56
Figure 29: Geographic Area ..... 57

## LIST OF TABLES

Table 1: Projected Building Gross Floor Area ($m^2$) - Full Build Out ..... 17
Table 2: EUI Summary ..... 17
Table 3: Energy Use Intensity Benchmark Data ..... 18
Table 4: Expected Load Forecast Summary ..... 19
Table 5: Escalation: Facts and Assumptions ..... 21
Table 6: Connected Floor Area ..... 22
Table 7: Incremental Capital Cost (thousands, 2014$) ..... 23
Table 8: Cumulative Capital Costs (thousands, 2014$) ..... 23
Table 9: Connection Credit Scenarios ..... 26
Table 10: Connection Credit ..... 26
Table 11: Plant in Service (thousands, nominal $) ..... 27
Table 12: Fuel Prices (nominal $) ..... 27
Table 13: Fuel Consumption ..... 28
Table 14: Fuel Costs (nominal $) ..... 28

Table 15: Direct Operating Costs (nominal $)..... 28
Table 16: Indirect Operating Costs (nominal $)..... 29
Table 17: Indirect Costs: Facts and Assumptions..... 29
Table 18: Balance Sheet (thousands, nominal $)..... 31
Table 19: Financing, Depreciation and Tax Assumptions..... 31
Table 20: Revenue Requirements (thousands, nominal $)..... 33
Table 21: NDES Rate Design..... 38
Table 22: Residential Rate Design: Facts and Assumptions..... 41
Table 23: Statement of Earnings..... 42
Table 24: Cash Flow..... 42
Table 25: Sensitivities..... 43
Table 26: System Components Summary and Ownership..... 48
Table 27: Project Capital Cost and Budget..... 61

# EXECUTIVE SUMMARY

Corix Multi-Utility Services Inc. ("CMUS") is seeking a Certificate of Public Convenience and Necessity ("CPCN") to construct and operate Phase 1 of the University of British Columbia ("UBC") Neighbourhood District Energy System ("NDES") to serve new developments at UBC. Hereafter, CMUS will be referred to as Corix. *Figure 1: Proposed NDES Service Area* depicts the proposed NDES service area.

To facilitate the start of initial construction of the NDES in early 2015, at this time Corix is requesting expedited Commission approval for Phase 1 (the first 10 years of the model) of the NDES as described in this application, including an indicative financial model showing current cost assumptions, revenue requirements, rate design and rates. Corix will be filing a revised financial model, revenue requirement and rate application in the spring of 2015. Corix is however seeking Commission approval in principle of the Carbon Emissions Rider and the Connection Credit and the Residential Deferral Account based on a levelized rate approach as described below and elsewhere in this application.

## Project Plan

**Figure 1: Proposed NDES Service Area**

The purpose of the UBC NDES is to provide a thermal energy solution that supports UBC's institutional and neighbourhood GHG reduction targets, in addition to the community and provincial energy sustainability objectives for the new development areas. To achieve this, the project plan outlines how the NDES development is contemplated to be implemented in two phases with the goal to efficiently match capital investment with neighbourhood development. Phase 1, the project for this application, is approximately the first 10 years of operation and provides service for Wesbrook Place and initial loads in the Acadia East and Block F neighbourhoods.

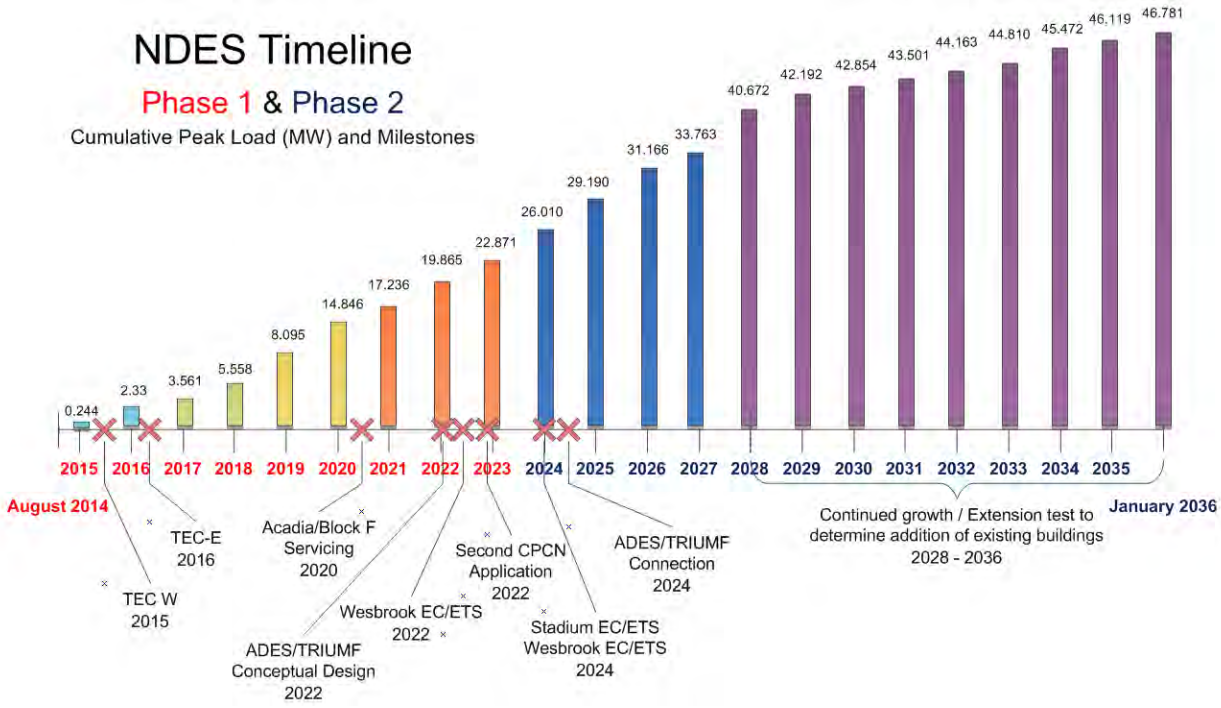
Phase 2 is currently contemplated to occur in 2024 when thermal load can support the installation of the alternate energy source, which is likely to be the utilization of waste heat from TRIUMF cooling towers. UBC has a Letter of Intent (LOI) with TRIUMF supporting the project.

The trigger to initiate Phase 2 of the NDES is either or both of the following events:

- the interconnection of the Wesbrook portion of the NDES and the ADES; and/or
- the connection of a permanent CEP to an Alternate Energy Source

Phase 2 of the NDES Project Plan outlines the interconnection of Wesbrook Place, Stadium Road, the ADES and Acadia/Block F with a main trunk supply-return pipeline. A permanent Central Energy Plant (CEP) will be constructed to the south of Wesbrook Place, as close as possible to the TRIUMF research facility. *Figure 2: NDES Project Plan* outlines the overall Project Plan.

**Figure 2: NDES Project Plan**




There are two unique features proposed for the NDES that provide long term benefits to NDES customers. The first is the Carbon Emissions Rider. It is proposed that during Phase 1, Corix will collect, in rates, a temporary rider called the Carbon Emissions Rider of $25 / tonne of GHG emissions. The rider is intended to ensure that initial customers served by temporary natural gas boilers contribute to the cost of future Alternate Energy Sources and to help mitigate potential changes in rates with the implementation of the Alternate Energy Sources. It is also intended to ensure that Corix has appropriate incentives to implement low carbon energy sources in the event natural gas prices stay low.

The second unique feature is the Connection Credit, which is proposed to ensure that early low-rise buildings in Wesbrook Place have the required hydronic systems to connect to the NDES. Securing these loads will result in lower rates for all customers, even after taking into account the Connection Credit. The Connection Credit is designed to reflect the incremental cost of in-suite hydronic heating systems, over electric baseboard heating, and decline over time, as it is expected that hydronic building systems will become standard as developers innovate and building codes evolve, thereby eliminating the premium. The Connection Credit is anticipated to be in place until 2021.

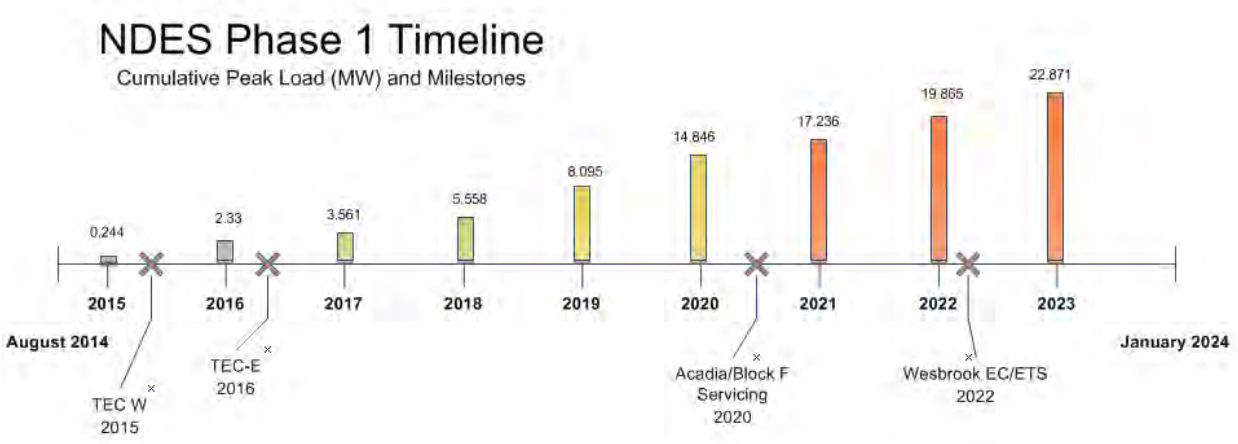
When the community is built out, the NDES is projected to reduce annual GHG emissions by approximately 64% and electricity by 40% relative to benchmark approaches to heating and domestic hot water production to multi-family residential buildings in Vancouver. The project aligns with UBC's Sustainability Initiative,

UTown@UBC Community Energy and Emissions Plan (CEEP) and the Provincial Government's green energy objectives under the *2007 BC Energy Plan* and the *Clean Energy Act*.

**Phase 1- Current CPCN Application**

Phase 1, the project outlined in this CPCN application, is approximately the first 10 years of operation and provides service for Wesbrook Place and initial loads in the Acadia East and Block F neighbourhoods. Corix is currently seeking a CPCN for the first 10 years of the project plan including indicative projected rate base, indicative revenue requirements, indicative rates, revenue deficiency deferral account (referred to as Residential Deferral Account in indicative model), connection credit and GHG emission rider associated with this phase. During Phase 1 two temporary energy centres (TECs), potentially a component of the nodal Wesbrook Energy Centre/ETS, distribution piping systems and energy transfer stations will be constructed to serve the initial development parcels in the Wesbrook Place neighbourhood. Natural gas will be the interim fuel source and the first building called Prodigy will require service in June of 2015. Acadia East and Block F will likely be served by purchased energy from the UBC Academic District Energy System. *Figure 3: NDES Phase 1 Project Plan* outlines the timeline for Phase 1.

**Figure 3: NDES Phase 1 Project Plan**




By submitting this application to the BCUC, Corix applies for:

1. A Certificate of Public Convenience and Necessity under Sections 45 of the Utilities Commission Act (the "Act") for the construction and operation for Phase 1 of the proposed community-based district energy system at UBC, Vancouver BC
2. Approval under section 45(vii) of the Infrastructure Agreement between Corix and UBC, including endorsement of the proposed project plan.
3. Approval under sections 45 (i),56, 60 and 61 of the Act of the revenue requirements, rate design and rates as described in the application (a revised financial model showing final revenue requirements, rate design and rates will be filed in the spring of 2015):
   a. The indicative rate base as provided in Section 2.7 of the Application.
   b. The indicative revenue requirement as provided in Section 2.9 and consistent with the recent Commission decision in the Phase 2 Generic Cost of Capital proceeding applicable to small thermal energy utilities:
      i. A deemed capital structure of 57.5% debt and 42.5% equity;
      ii. Long term debt financing costs estimated at 4.0%;
      iii. A return on equity (ROE) 9.5%, which is based on the current low risk benchmark equity return plus 75 basis points to account for the additional risk related to the development of the small scale alternative energy utility;

iv. Operating costs as provided in Section 2.6.2; and
v. The proposed 10-year levelized rate structure through which the company defers a portion of its annual revenue requirements in the early stages of development in order to provide affordable rates for customers.

c. Approval of the accounting treatment of the following:
i. A revenue deficiency deferral account which is used to record those portions of revenue requirements which are not recovered in the early stages of development, with the goal of complete recovery of the funds over the 20-year period; and
ii. The proposed Connection Credit for low rise buildings connected prior to 2021
iii. The Carbon Emission Rider; and
iv. The indicative rate design as provided in Section 2.10 of the Application

This application was developed in accordance with the *2010 CPCN Application Guidelines.* Corix would be the utility services provider responsible for system operations and maintenance, emergency response, and billing and customer care functions. The indicative rates were developed using a cost of service model and financial structure consistent with that implemented by other regulated utilities in British Columbia. Final rate design and rates will be submitted early in 2015 when construction for Prodigy service is completed. This will include the installation of the first temporary energy center, plus distribution piping and the ETS to serve the building.

**Section 1** – "Project Introduction" provides information about Corix, its technical and financial capacity, the proposed project team and an overview of the regulatory process proposed for this project.

**Section 2** – "Project Need, Alternatives and Justification" includes information about the project, its purpose, the feasibility study (including UBC's feasibility study evaluating thermal energy alternatives) and the results of the financial and technical analysis of the selected technical concept compared with business as usual.

**Section 3** – "Consultation" focuses on the public consultation process conducted to date. Samples of related material developed for the consultation process are included in Appendices 3 and 4.

**Section 4** – "Project Description" provides a detailed technical description of the project and an overview of the project implementation process.

**Section 5** - "Project Costs" - in addition to the summary of the project costs provided in Section 3, this section includes a more detailed breakdown of the capital costs and an overview of the assumptions as developed during the feasibility assessment process.

**Section 6** – "Provincial Government Energy Objectives and Policy Considerations" – addresses British Columbia's Energy Objectives and the project's impact on the environment.

**Section 7** – "New Service Areas" includes information about the operations and maintenance, customer service and the proposed role of the new neighbourhood energy utility.

# 1 PROJECT INTRODUCTION

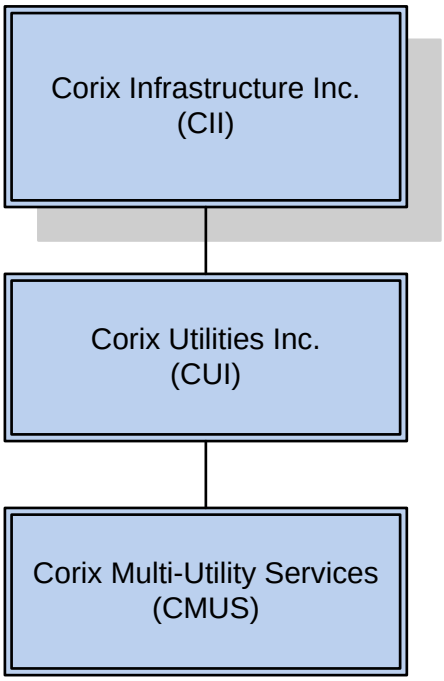
## 1.1 APPLICANT

### 1.1.1 Name, Address and Nature of Business

Corix Multi-Utility Services Inc. (CMUS), a subsidiary of Corix Inc., will develop, implement and own the Neighbourhood District Energy System (NDES) that will provide thermal energy to the University of British Columbia's new development areas at its Vancouver campus.

The ownership structure of Corix Multi-Utility Services with Corix is depicted in *Figure 4: Ownership Structure Organizational Chart*.

**Figure 4: Ownership Structure Organizational Chart**




#### Corix

Corix is a fully integrated, leading provider of utility infrastructure solutions, including energy, water and wastewater projects. The Corix team has extensive experience and expertise in the development of sustainable District Energy Utilities across North America and includes local experience at UniverCity in Burnaby, BC. Corix's portfolio includes system ownership, operations and management services, water product distribution and other utility services.

#### University of British Columbia

Established in 1908, the University of British Columbia (UBC) is one of Canada's leading research universities and is consistently ranked among the top 40 in the world. UBC is located on two campuses, an Okanagan campus in Kelowna, and a Vancouver Campus at Point Grey (referred to here as UBC's Vancouver campus, or the Campus).

UBC Properties Investments Ltd. (referred to here as UBC Properties Trust) was created in 1988 as a wholly owned subsidiary of UBC and the sole trustee of the UBC Properties Trust. The Trust's beneficiaries are UBC and the UBC Foundation. Its mission is to acquire, develop and manage real estate assets for the benefit of its beneficiaries. Over the years, the role of UBC Properties Trust has evolved to include management of many aspects of UBC's real estate assets, including servicing and marketing lands for residential development, and developing faculty and staff rental housing.

UBC's Vancouver campus is located within the boundaries of Metro Vancouver. However, its land use and planning regime is governed by Part 10 of the Municipalities Enabling and Validating Act (No. 3) [SBC 2001] Ch. 44 (MEVA), which provides for the Minister to adopt a Land Use Plan and that for so long as the Land Use Plan is in effect, the Metro Vancouver's land use bylaws (and in particular, zoning bylaws) do not apply to the Campus. Rather, UBC's Board of Governors must ensure that all:

(a) agreements entered into by the University,
(b) rules, resolutions or similar authorities issued or adopted by the Board of Governors,
(c) permits, licences or similar authorities issued or adopted by the University under an authority referred to in paragraph (b), and
(d) land development undertaken or authorized by the Board of Governors,

are consistent with the Land Use Plan.

The Land Use Plan is akin to an official community plan adopted by a local government pursuant to the Local Government Act. The Land Use Plan divides the Campus into "academic", "green academic" and "residential community" areas. Lands designated as "residential community" are to provide a range of rental and long-term lease housing to the broader community (non-institutional housing). The "residential community" areas are divided into Neighbourhood Housing Areas, which are reserved for the creation of a vibrant residential community with related retail and office areas.

The UBC Board of Governors applies the general land use policies of the Land Use Plan by adopting a Neighbourhood Plan for each Neighbourhood Housing Area.

Currently, the Land Use Plan designates seven Neighbourhood Housing Areas. Four have been built out (Hampton Place, Chancellor Place, Hawthorne Place and East Campus). Wesbrook Place is currently being developed. Stadium and Acadia East are reserved for future development.

When completed, Wesbrook Place will be the largest Neighbourhood on UBC's Vancouver Campus. Over 12,500 students, faculty, staff, parents, alumni and members of the general public will live here in a mix of townhouses and apartments. Neighbourhood plans will be prepared for the future Acadia East and Stadium Road Neighbourhoods. Within the Acadia East neighbourhood, there are two precincts: the Acadia West Precinct has been designated for University purposes, namely student family housing, and Acadia East precinct will be designated to provide housing to the broader community. In this document, the Wesbrook Place, Acadia East, East Campus and Stadium Road Neighbourhoods will be referred to collectively as the Development Areas.

The land within each Development Area is owned in fee simple by UBC. UBC Properties Trust administers the process of subdividing, servicing and marketing the lands to third party developers. UBC Properties Trust also develops and operates residential and commercial rental premises in the Development Areas.

Development sites are developed pursuant to the terms of a 99-year ground lease between UBC and the developer. The terms of the lease require that the developer construct the building in compliance with UBC's land use rules and governance requirements, which are municipal-like in structure and content (including requiring compliance with the B.C. Building Code). In addition, the lands on Campus are subject to property taxes at the rural tax rate. To ensure that there is no tax advantage to leasing land on Campus (compared to the City of Vancouver) and to provide funding for the municipal-like services provided in the Development Areas, the lease requires lessees to pay to UBC an additional amount, called the "services

levy". The amount of the services levy is such that a lessee on Campus will pay a comparable amount to what a person leasing land in the City of Vancouver would pay in property taxes.

UBC has an existing Academic District Energy System (ADES), which serves the academic section of Campus. UBC is completing a major conversion of its ADES from steam to hot water. UBC has added the Bioenergy Research and Demonstration Facility (BRDF) to the ADES and is now building a new gas-fired hot water plant.

### Musqueam First Nations and Block F

The Musqueam First Nation is currently seeking to rezone Block F with the University Endowment Lands (UEL) for a mixed used development. The UEL is the administration set up to administer all lands generally described as being situate in the areas east of Wesbrook Mall and north of Agronomy Road. Block F is located immediately east of UBC's Acadia East Neighbourhood and is owned by the Musqueam First Nations. Block F was contemplated in the pre-feasibility study and is currently being considered as part of the project plan.

### Neighbourhood District Energy System (NDES)

In 2011, UBC commissioned a pre-feasibility study of district energy as one tool for achieving its high environmental targets for development at Wesbrook Place. The pre-feasibility study found that a Neighbourhood District Energy System (NDES) using waste heat captured from TRIUMF cooling towers could be technically and economically viable, while providing large GHG reductions and other social and environmental benefits. TRIUMF is Canada's national laboratory for particle and nuclear physics and is owned and operated by a consortium of Canadian universities (including UBC). UBC subsequently commissioned a full feasibility study to assess the potential for a NDES serving the Development Areas and the Musqueam First Nations Block F lands. The full feasibility study considered an expanded scope (larger Development Area) and contains more detail than the pre-feasibility study.

After considering the results of the full feasibility study, UBC determined that a NDES utilizing waste heat from TRIUMF cooling towers (or comparable Alternate Energy Sources) would support its objectives for the target Development Areas as well as UBC's institutional GHG reduction targets. UBC sees considerable potential synergies between the NDES and ADES, along with other strategic benefits, including possible research and education opportunities, consistent with UBC's goal for the Campus as a Living Lab. After considering various ownership models, UBC opted to pursue a private sector partner to develop the core NDES infrastructure and deliver ongoing retail services to residents. This decision was made in part because of the commercial and regulated nature of district energy services to external residents and businesses, and in part because of UBC's capital constraints and other near-term capital priorities.

Based on the results of the full feasibility study on February 25, 2013, UBC issued a Request for Information (RFI) to identify a utility partner to complete due diligence on and to implement an NDES using Alternate (low-carbon) Energy Sources across the new Development Areas at UBC. Several respondents submitted responses to the RFI and based on its evaluation, on May 6, 2014 UBC issued a Supplementary Request for Information (SRFI) to the two leading respondents. Based on that competitive process, UBC awarded the project to Corix in August of 2013.

Corix completed final detailed due diligence and in March 2014 submitted the NDES Project Plan that proposes that the NDES approach be implemented in two phases, with Phase 1 being a temporary natural gas solution serving early loads and Phase 2 being the implementation of the Alternate Energy Source, which is currently contemplated to be waste heat recovery from TRIUMF. *Figure 5: Proposed NDES Service Area* outlines the overall project plan.

**Figure 5: Proposed NDES Service Area**

This CPCN application is for Phase 1. The Project Plan phases are generally described below:

- Phase 1 involves the construction of two separate district heating loops, one for Wesbrook Place and one for Acadia East and Block F, (with further extensions as required). The Wesbrook Place loop would be fed initially by two 6.0 MW temporary natural gas boiler plants, plus a portion of the Wesbrook EC/ETS (5MW Boiler) in 2022. The Acadia East/Block F would be fed from the ADES via an interconnection to the ADES peaking plant. Phase 1 includes each loop's energy supply capacity or connection, associated distribution piping and energy transfer stations;
- The trigger to initiate Phase 2 of the NDES is either or both of the following events:
    - the interconnection of the Wesbrook portion of the NDES and the ADES; and/or
    - the connection of a permanent Central Energy Plant (CEP) to an Alternate Energy Source

There are two unique features proposed for the NDES that provide long term benefits to NDES customers. The first is the Carbon Emissions Rider. It is proposed that during Phase 1, Corix will collect in rates a temporary rider called the Carbon Emissions Rider of $25 / tonne of GHG emissions. The rider is intended to ensure that initial customers served by temporary natural gas boilers contribute to the cost of future Alternate Energy Sources and to help mitigate potential changes in rates with the implementation of the Alternate Energy Sources. It is also intended to ensure that Corix has appropriate incentives to implement low carbon energy sources in the event natural gas prices stay low. The second unique feature is the Connection Credit, which is required to insure that early low-rise buildings in Wesbrook Place have the required hydronic systems to connect to the NDES. Securing these loads will result in lower rates for all customers, even after taking into account the Connection Credit. The Connection Credit is designed to reflect the incremental cost of in-suite hydronic heating systems, over electric baseboard heating, and decline over time, as it is expected that hydronic building systems will become standard as developers innovate and building codes evolve, thereby eliminating the premium. The Connection Credit will be in place until 2021.

The anticipated Alternate Energy Source is TRIUMF, which is located to the south of Wesbrook Place, in the South Campus. TRIUMF generates a substantial amount of waste heat for a very significant portion of the year from cooling requirements for their research equipment; currently, the waste heat is rejected to the atmosphere via cooling towers. TRIUMF waste heat recovery is anticipated to be implemented in 2024. UBC has been consulting with TRIUMF throughout the feasibility process and has a Letter of Intent (LOI) in place agreeing to jointly support the development, establishment and operation of a heat recovery and distribution system.

## 1.2 FINANCIAL AND TECHNICAL CAPACITY

### 1.2.1 Financial Capacity

Corix is a privately held Canadian corporation owned by the British Columbia Investment Management Corporation (bcIMC).

Based in Victoria, British Columbia, bcIMC is one of the largest institutional investors in Canada, with gross assets under management of more than $114.0 billion. In addition to core holdings such as Corix, bcIMC has an active direct infrastructure investment program including water utilities, electric and gas utilities, energy and power companies, liquids transportation pipelines, and rapid transit infrastructure. bcIMC is a corporation owned by the Province of British Columbia and is not rated by credit rating agencies.

The solid financial foundation provided by this large, stable and well-respected investment firm enables Corix to be a fully invested partner with our clients. Corix has a strong financial history of consistent growth, stable revenue generation and operating cash flow. Corix has experienced strong revenue growth over the past 5 years with an average annual increase of 11%. Over the same period, EBITDA has grown at an annual rate of 21%. Correspondingly, we have also increased our asset base through a number of key investments and our employee base has increased to provide appropriate support without adding undue costs to our operations. Corix currently has over 2,250 employees and in 2013 recorded revenues of $620.9 million and $1,486.6 million in assets. Corix has established term debt and a revolving loan facility with a syndicate of banks, led by TD Securities and HSBC Bank Canada.

Corix has borrowing capacity of $250 million through a $150 million revolving credit facility and a $100 million accordion to its credit facility. This capacity can be used to provide interim financing for projects. Additionally, Corix can also access interim financing from its shareholders and external partners. Corix's core businesses is the long-term investment of equity in capital infrastructure related businesses and projects and we have extensive experience in making equity investments.

### 1.2.2 Technical Capacity

Corix and its predecessor companies have over 70 years of combined experience designing, building, financing and managing utility infrastructure systems. Corix owns and operates district energy systems at UniverCity in Burnaby, BC and at Centretown Citizens Ottawa Corporation (CCOC) in Ottawa, Ontario. Corix is an investor and operator of Dockside Green biomass-based district energy system (DES) and community tertiary wastewater treatment plant in Victoria, the electric, gas and district energy systems at Fort Wainwright, Joint Base Elmendorf-Richardson and Fort Greely in Alaska, and multi-utility operations at Panorama, Sun Rivers, and Sonoma Pines. Other projects include a long-term contract to own and operate the GeoExchange community at Wills Creek in Surrey, BC and the Rise in Vernon, BC. In addition to these operations, Corix operates regulated and non-regulated utility systems throughout Western Canada, Ontario, and the US. Corix has significant in-house experience in the design, construction and operations of district energy systems.

Corix partnered with Kerr Wood Leidal throughout the competitive process and they are the lead technical consultant for the NDES project. Kerr Wood Leidal Associates (KWL) is a civil engineering firm specializing in infrastructure consulting services, including infrastructure planning, modelling, design, construction management, project management and survey services. Clients include all levels of government, heavy industry, utilities, mining, First Nations, and developers. KWL has completed a number of district energy projects including projects with UBC (steam to hot water conversion), the City of Surrey, City of New Westminster and the City of Vancouver. Other specialized firms will be retained as required through the project.

### 1.2.3 Name, Title and Address of Contact

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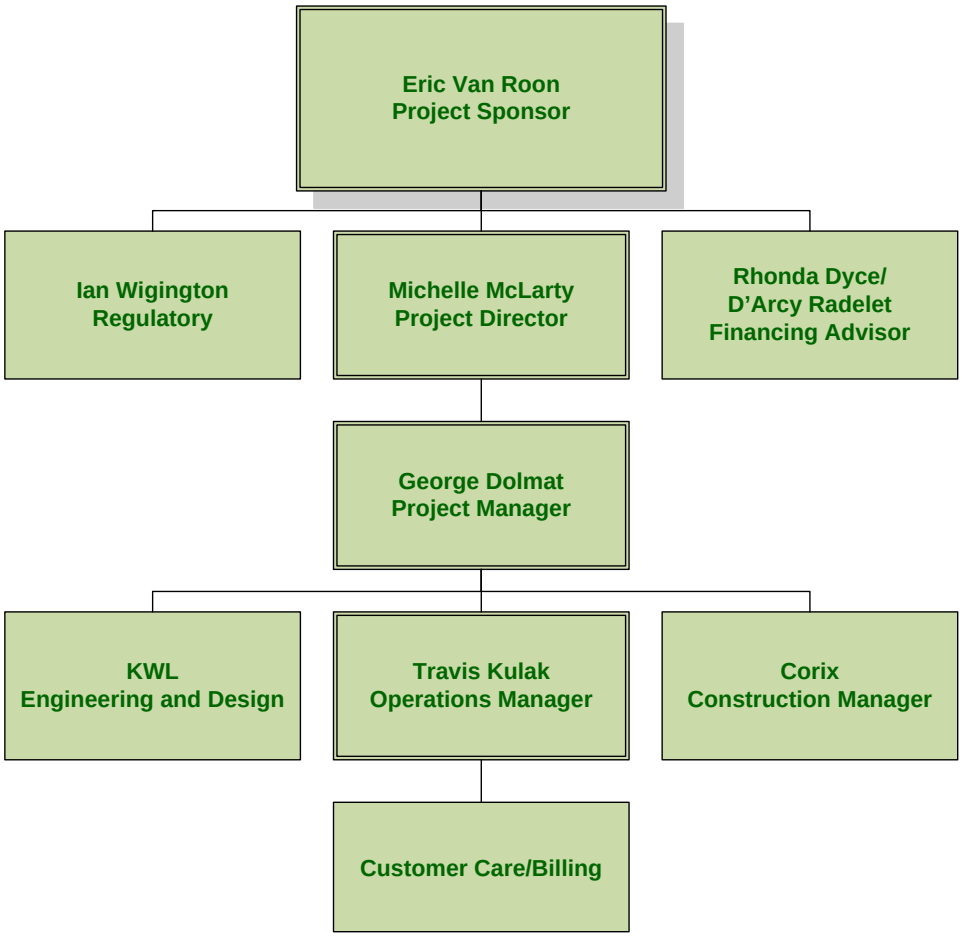
### 1.2.5 Project Team Organizational Chart

The project team comprises individuals within Corix who are experienced at successfully delivering projects of similar complexity as the proposed UBC NDES project and have extensive experience in designing and engineering district energy systems. Several team members have direct experience with the development of community based district energy systems in BC and Canada. The project team will also be supported by KWL Consulting Engineers who have experience in designing district energy heating and cooling systems in Canada and internationally. *Figure 6: Project Team Organizational Chart* outlines the project team.

**Figure 6: Project Team Organizational Chart**




## 1.3 REGULATORY PROCESS

In this Application, Corix is seeking approval of the indicative rate base, revenue requirements, rates and revenue deficiency deferral account (referred to as Residential Deferral Account in indicative model) associated with Phase 1 of the Project Plan, which is approximately the first 10 years of operation and includes the construction of distribution piping system (DPS) and energy transfer station (ETS) infrastructure, as well as two temporary energy centres and the nodal Wesbrook Energy Centre/ETS that will use natural gas as the interim fuel source to serve the initial development parcels in the Wesbrook Place neighbourhood. The long-term Project Plan, which includes the full expected DPS and ETS assets, boiler capacity, and the connection to TRIUMF for waste heat utilization, is presented as context for this Application, in particular as context for the proposed levelized rates, rate stabilization account and long-term benefits of the project. The Project Plan also forms part of the Infrastructure Agreement in Appendix 10 with UBC, which will guide the development of the NDES. The use of levelized rates is consistent with the approach used in other new district energy systems approved by the Commission including UniverCity, Dockside Green, and River District Energy. Corix intends to file a second CPCN Application for Phase 2 of the NDES development (currently forecasted to occur in 2024) when either or both of the following triggers occur:

- the interconnection of the Wesbrook portion of the NDES and the ADES; and/or
- and the connection of a permanent CEP to an Alternate Energy Source;

By submitting this application to the BCUC, Corix applies for:

1. A Certificate of Public Convenience and Necessity under Sections 45 of the Utilities Commission Act (the "Act") for the construction and operation for Phase 1 of the proposed community-based district energy system at UBC, Vancouver BC.
2. Approval under section 45(vii) of the Infrastructure Agreement between Corix and UBC, including endorsement of the proposed project plan.
3. Approval under sections 45 (i) 56, 60 and 61 of the Act of the indicative revenue requirements, indicative rate design and indicative rates as described in the application (a revised financial model showing final revenue requirements, rate design and rates will be filed in the spring of 2015):
    a. The rate base as provided in Section 2.7 of the Application.
    b. The indicative revenue requirement as provided in Section 2.9 and consistent with the recent Commission decision in the Phase 2 Generic Cost of Capital proceeding applicable to small thermal energy utilities:
        i. A deemed capital structure of 57.5% debt and 42.5% equity;
        ii. Long term debt financing costs estimated at 4.0%;
        iii. A return on equity (ROE) 9.5%, which is based on the current low risk benchmark equity return plus 75 basis points to account for the additional risk related to the development of the small scale alternative energy utility;
        iv. Operating costs as provided in Section 2.6.2; and
        v. The proposed 10-year levelized rate structure through which the company defers a portion of its annual revenue requirements in the early stages of development in order to provide affordable rates for customers.
    c. Approval of the accounting treatment of the following:
        i. A revenue deficiency deferral account which is used to record those portions of revenue requirements which are not recovered in the early stages of development, with the goal of complete recovery of the funds over the 20-year period; and
        ii. The proposed Connection Credit for low rise buildings connected prior to 2021;
        iii. The Carbon Emission Rider; and
        iv. The indicative rate design as provided in Section 2.10 of the Application

# 2 PROJECT NEED, ALTERNATIVES AND JUSTIFICATION

## 2.1 PROJECT HISTORY AND NEED

UBC's on-campus residential community currently houses approximately 8,500 residents in student accommodations and an additional 8,000 permanent community residents. UBC is targeting an additional 8,000+ student beds by 2030 in order to meet its goal for 50% of the full-time student enrolment. Meanwhile, neighbourhood build-out is projected to conclude by 2041 with a population of approximately 24,000 residents, requiring rapid building development. With these population targets and developments come increased sustainability challenges, such as increased greenhouse gas emissions on campus.

The Province of BC measures local governments' greenhouse gas (GHG) emissions in the Community Energy and Emissions Inventory (CEEI). Analysis determine that 51.5% of UBC's residential GHG emissions are due to building energy use, and almost entirely the result of fossil fuel use.

In 2011, UBC and the University Neighbourhoods Association (UNA) developed a Community Energy and Emissions Plan (CEEP) for UBC's residential community. The CEEP presents a comprehensive framework to achieve reductions in the use of energy, and to reduce GHG emissions within the community. In order to support its vision to advance a sustainable live-work-learn residential community, and to aid in achieving its greenhouse gas (GHG) emissions reduction targets of 18% by 2020 and 85% by 2050, UBC's CEEP recommends the implementation of a low carbon district energy (DE) system servicing all new buildings starting in 2015.

In June 2011, Stantec and Earth Voice Strategies completed a pre-feasibility study of a district energy system for Wesbrook Place for UBC with funding support from BC Hydro. Using preliminary, screening-level assumptions, the pre-feasibility study results suggested an NDES using waste heat capture from TRIUMF (Canada's national laboratory for particle and nuclear physics) was technically and potentially economically viable. Stantec recommended a full feasibility study be conducted.

In December 2011, UBC commissioned FVB and Compass Resource Management to prepare a full feasibility study to assess the potential for a NDES serving Wesbrook Place, as well as the Stadium Road, Acadia West, Acadia East, East Campus, and Block F (Musqueam) lands Development Areas. The study concluded that using waste heat from TRIUMF and/or biomass is technically feasible, with waste heat from TRIUMF being the preferred technology, and that on a lifecycle basis, customers' energy costs would be similar to current energy costs within the community.

Following the preliminary studies, in February 2013 UBC issued an RFI to identify a utility partner to complete due diligence for the potential implementation of a temporary district energy solution followed by the long term Alternate Energy Source solution to serve the neighbourhoods. Based on the RFI submissions, UBC released a Supplementary Request for Information (SRFI) and Corix responded with an initial due diligence report that analyzed the NDES alternatives for providing energy service to the UBC neighbourhood and confirming the viability of the NDES business case. Via this competitive bid process, Corix was named the lead proponent to finalize the due diligence and implement a BCUC regulated NDES. In January 2014, Corix completed a detailed technical and financial Due Diligence report that is the basis for this CPCN application.

In April 2014, Corix, along with a team representing the UBC Properties Trust, met with BCUC staff and presented an overview of the project scope of the new residential development underway at UBC and the proposed neighbourhood district energy system to serve that development.

## 2.2 SCREENING OF ALTERNATIVE TECHNOLOGIES

The UBC pre-feasibility study investigated a range of thermal energy sources with the following four energy supply alternatives being evaluated in more detail:

- Connection to the future medium temperature hot water system for the main Campus;
- Heat capture from the TRIUMF cooling facilities;
- Biomass combustion from a facility located on South Campus; and
- Sewer heat capture from South Campus sewer lines.

The pre-feasibility study results concluded that there are several technically feasible Alternate Energy Sources, that waste heat captured from TRIUMF and connection to the ADES are the preferred options, and the study recommended a full feasibility study to further refine the opportunity. In 2011, a full feasibility report was conducted by FVB Energy and Compass Resource Management, to develop the technical and business case for the NDES. The study generated the following conclusions:

- NDES serving UBC's Wesbrook, Stadium Road, Acadia East and potentially Block F Development Areas and using waste heat from TRIUMF and/or biomass is technically feasible. Waste heat could be captured from TRIUMF's cooling towers.
- The NDES would provide significant reductions in natural gas use and GHG emissions and moderate reductions in electricity use (at build out), both to the target Development Areas and to the Academic Campus. The NDES supports UBC's near-term GHG reduction targets. It also facilitates development of future Alternate Energy Sources to meet more aggressive significant long-term reduction targets. The system supports UBC's vision for a sustainable community with seamless integration to surrounding academic uses. There are also many teaching, research, and demonstration opportunities associated with the NDES (both in terms of technical and socio-economic aspects), which is consistent with UBC's vision of a living lab.
- Waste heat from TRIUMF is the preferable starting technology, but biomass offers an economically viable alternative to TRIUMF if agreements cannot be reached with TRIUMF to access waste heat and optimize system design. Biomass also offers a source of supplemental alternative energy in future phases of development.
- Under a set of conservative but realistic Reference Case assumptions and a variety of ownership scenarios, the NDES cost to residents would be equal to or lower than the benchmark cost based on 100% electric heat.

The full feasibility study uses the waste heat recovery from the TRIUMF cooling water system for the NDES Reference Case. Biomass combustion was considered as a supplemental source of alternative energy (for the NDES and the existing Academic District Energy System (ADES) in future phases if necessary, and also as an alternative to waste heat recovery from TRIUMF in sensitivity analyses. In all scenarios, peaking and back up for the NDES is provided by the ADES and/or dedicated gas-fired boilers.

## 2.3 THE SUSTAINABILITY OF WASTE HEAT FROM TRIUMF

The TRIUMF facility currently has two major cooling plants, with an additional plant expected to come online in 2014. An existing central cooling tower farm handles the cooling for the Accelerator Building and new Electron Hall, while an independent cooling tower serves the existing TRIUMF Isotope Separator and Accelerator (ISAC) facility, and a new cooling tower will serve The Advanced Rare Isotope Laboratory (ARIEL) facility, which is currently under construction. Stantec[1] prepared a Waste Energy Recovery Study that detailed the availability of waste heat and technical considerations for waste heat capture. The analysis conducted for Detailed Due Diligence is primarily based on that study and further analysis will be conducted

[1] TRIUMF – Waste Energy Recovery Study. Stantec, 2012.

as Phase 2 of the Project Plan is conceptually designed. At this time, Phase 2 of the Project Plan consists of the installation of a Permanent 10 MW CEP consisting of Four 2.5 MW heat pumps to feed Wesbrook Place, Stadium Road, Acadia East, East Campus (incl. Block F) and the ADES. Finally, the business case assumes that waste heat will be available from TRIUMF at no charge (beyond the costs of recovering this waste heat, which is currently vented to atmosphere). This is based on discussions between UBC and TRIUMF, supported by a Letter of Intent (LOI) between the two parties. Since the waste heat is currently released to the atmosphere, recovery by the NDES (at the NDES's cost) will lower operating costs for TRIUMF's existing cooling tower. TRIUMF will release heat to the NDES and therefore reduce the usage of its cooling towers. This will result in a reduction in operating costs: less power to operate the cooling towers pumps and fans; less wear and tear on the equipment. Moreover, making use of the waste heat recovery also represents an opportunity for TRIUMF to demonstrate goodwill towards the community within which it operates, and to contribute to its own sustainability performance.

## 2.4 PROJECT BUILD-OUT SCHEDULE, LOAD ANALYSIS AND ENERGY DEMAND FORECAST

The Corix team used development data provided by UBC Properties Trust, UBC and other sources to estimate thermal loads of the UBC NDES development. This information included the project build-out schedule, load analysis and energy demand forecast.

At build-out, the NDES will serve approximately 1,078,800 $m^2$ of built space, consisting of primarily residential units, with the possibility of having commercial and institutional customers in the Development Area.

The NDES will serve all new loads and district energy ready buildings (when existing systems reach the end of their current life) in the following neighbourhoods (collectively Development Areas):

- Wesbrook Place
- Stadium Road neighbourhood
- East Campus neighbourhood
- Acadia East neighbourhood
- Block F (potential)

Additional existing or new loads not in the current Project Plan may be added in future subject to a positive extension test.

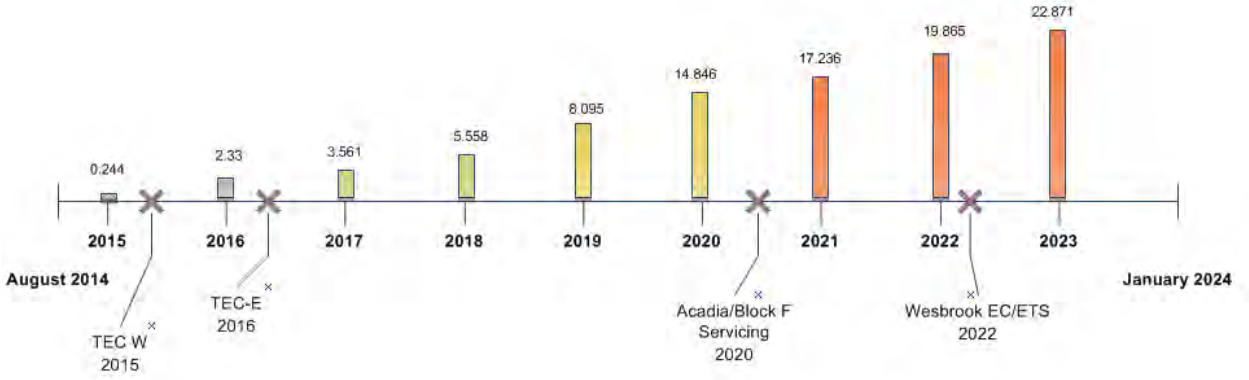
It is anticipated that there will be energy purchases from the Academic District Energy System (ADES) in Phases 1 and 2 to serve the Acadia East and Block F loads. Thermal energy sales from the NDES to the ADES are also contemplated in Phase 2 whereby the ADES may utilize surplus energy.

The Project Plan has been developed with the understanding that all new buildings constructed in the service area will connect to the NDES for all heating needs, including domestic hot water, ventilation air and space heating within suites. Under the Infrastructure Agreement, UBC has agreed to ensure that UBC Properties will require all developers who want to lease in the Development Areas to enter into a Community Energy Covenant with Corix. The Community Energy Covenants will require entry into an Energy Services Contract between developers and Corix, enforceable against future NDES customers. The Design Guide for Compatibility with District Energy, a set of guidelines for NDES-compliant design, will be attached as a schedule to each Energy Services Contract, enabling and ensuring Developer compliance with system design and connection requirements.

The current application for Phase 1 of the NDES Project Plan outlines how the NDES will provide thermal energy service to new buildings that are scheduled for completion between 2014 and 2023 in Wesbrook Place and between 2020 and 2023 in Acadia East and Block F. This comprises approximately 493,000 of floor area, or approximately half of projected load at build out.

A timeline of the anticipated Phase 1 developments is shown in *Figure 7: Anticipated Phase 1 Developments Timeline* with Cumulative Peak Load (MW) and milestones.

**Figure 7: Anticipated Phase 1 Developments Timeline**




### 2.4.1 Project Build-out Schedule

Development projections for the Wesbrook Place and Stadium Road neighbourhoods are based on information provided by UBC Properties Trust[2]. This information included projected occupancy dates and building floor area forecasts for planned developments by parcel. UBC Properties Trust did not provide floor area estimates for three lots (4/1, 3W and 11W) and two existing buildings (Sail and Academy) in Wesbrook Place, therefore the heated floor areas for these developments are based on the lot size and maximum Floor Area Ratio (FAR) allowed for in the Wesbrook Place Neighbourhood Plan. The floor areas of existing buildings were obtained from UBC Properties Trust's lists of properties published on their website, and complemented with as-built drawings and developer information (where available). *Table 1: Projected Building Gross Floor Area (m2) - Full Build Out* summarizes the expected gross heated floor areas in the four neighbourhoods. The load forecast for the Acadia East and Block F neighbourhoods is based on UBC's load analysis for NDES and cogeneration[3] and Block F's recent rezoning application package.

The load forecast for the Wesbrook Place and Stadium Road neighbourhoods is based on UBC's annual floor area projections for these neighbourhoods, updated as of May 2014[4]. In total, the Project Plan outlines that the new UBC development including Block F, will include approximately 1,078,800 $m^2$, and Phase 1 consists of approximately 493,000 $m^2$. *Table 1: Projected Building Gross Floor Area (m2) - Full Build Out* summarizes the projected building gross floor area. UBC's annual floor area projections for these neighbourhoods updated as of May 2014.

[2] Projected development map. Appendix One. June 2013.

[3] UBC NDES and Cogen schedules, received May, 2013

[4] Source Nick Maile, UBCPT email dated May 2nd, 2014.

**Table 1: Projected Building Gross Floor Area ($m^2$) - Full Build Out**

| NEIGHBOURHOOD | HIGH RISE EXISTING BUILDINGS | HIGH RISE NEW BUILDINGS | LOW RISE EXISTING BUILDINGS | LOW RISE NEW BUILDINGS | COMMERCIAL EXISTING BUILDINGS | COMMERCIAL NEW BUILDINGS | TOTAL GROSS FLOOR AREA |
|---|---|---|---|---|---|---|---|
| Wesbrook Place | 50,200 | 255,400 | 103,600 | 138,700 | 10,000 | 0 | 557,900 |
| Stadium Road | 0 | 0 | 0 | 75,900 | 0 | 0 | 75,900 |
| Acadia East and East Campus | 0 | 0 | 0 | 323,000 | 0 | 0 | 323,000 |
| Block F | 0 | 122,000 | 0 | 0 | 0 | 0 | 122,000 |
| Total Gross Floor Area | 50,200 | 377,400 | 103,600 | 537,600 | 10,000 | 0 | 1,078,800 |

### 2.4.2 Energy Use Intensity (EUI)

The EUIs summarized in *Table 2: EUI Summary* are based on the values used in the 2013 Feasibility Study[5] and projected EUIs provided from UBC, and validated by UBC in analyses of recently completed projects.[6]. The 2013 Feasibility Study applied a declining peak EUI over time, based on the assumption that energy efficiency requirements in the BC building code would result in lower peak energy consumption in the future. The peak demand EUIs applied in the Due Diligence Study are an area-weighted average of the declining EUI scheme. An annual EUI of 100 kWh/$m^2$ was applied to all buildings with full DES servicing; this is based on an annual Domestic Hot Water (DHW) EUI of 29 kWh/$m^2$ and a space heating EUI of 71 kWh/$m^2$. In buildings with partial hydronic servicing, the annual EUI is adjusted to account for reduced space heating provided through the DES. EUIs will be reviewed as buildings come online.

**Table 2: EUI Summary**

| BUILDING TYPE | PEAK HEATING EUI (W/$M^2$) | ANNUAL SPACE HEATING EUI (KWH/$M^2$) | ANNUAL DHW EUI (KWH/$M^2$) | TOTAL ANNUAL EUI (KWH/$M^2$) |
|---|---|---|---|---|
| High Rise | 47.5 | 71 | 29 | 100 |
| Low Rise | 46.5 | 71 | 29 | 100 |
| High Rise – Partial Hydronic Service | 15 | 37.5 | 29 | 66.5 |
| Low Rise – Partial Hydronic Service | 15 | 32.5 | 29 | 61.5 |
| Commercial | 29 | 34 | 13 | 47 |

The EUI assumptions are reasonably consistent with values used in other DES studies in the Lower Mainland. *Table 3: Energy Use Intensity Benchmark Data* shows a range of other published EUIs. As shown, the selected EUIs in this study are within the range of the published values.

[5] UBC NDES Technical Feasibility Study Report FVB Energy. March 20, 2013.

[6] Personal communication. Orion Henderson via email. December 5, 2013.

**Table 3: Energy Use Intensity Benchmark Data**

| PARAMETER | VALUE | SOURCE |
|---|---|---|
| Wesbrook Place-UBC[7] | 100-105 kwh/$m^2$ | UBC Campus Sustainability |
| Southeast False Creek NEU[8] | 109 kwh/ $m^2$ | City of Vancouver |
| Annual Space Heating – New High-Rise Residential (> 5 stories) | 84 kWh/$m^2$ | City of Vancouver Sustainable Large Site Rezoning Guidelines |
| | 60 kWh/$m^2$ to 140 kWh/$m^2$ (input basis) | "The Path toward Net-Zero High-Rise Residential Buildings: Lessons Learned from Current Practice"[9] |
| | 73 kWh/$m^2$ | River District Energy CPCN Application |
| Annual Space Heating – New Low-Rise Residential (5 stories or less) | 67 kWh/$m^2$ | City of Vancouver Sustainable Large Site Rezoning Guidelines |
| | 62 kWh/$m^2$ | River District Energy CPCN Application |
| Annual Domestic Hot Water – Residential | 24 kWh/$m^2$ | City of Vancouver Sustainable Large Site Rezoning Guidelines |
| | 30 kWh/$m^2$ | River District Energy CPCN Application |
| Total Heating – Residential | 118 kWh/$m^2$<br>102 kWh/$m^2$ | UBC REAP Gold minimum requirement (Version 3)<br>UBC REAP Gold Plus (Version 3) |
| Space Heating – Retail | 34 kWh/$m^2$ | River District Energy CPCN Application |

### 2.4.3 Load Analysis

The load forecast for Phase 1 of the NDES is illustrated on the following page in *Table 4: Expected Load Forecast Summary.* Details regarding the Energy Centres can be found in Section 4.3.1.

[7] Actual data for nine buildings based on BC Hydro and Fortis BC data

[8] Actual data

[9] Finch, Ricketts, Knowles. ASHRAE 2010.

**Table 4: Expected Load Forecast Summary**

| Year | Cumulative Connected Floor Space ($m^2$) | Cumulative Peak Load - Undiversified (kW) | Cumulative Peak Load - 85% Diversified (kW) | Cumulative Annual Energy Consumption (MWh/yr) | Cumulative # ETS | # Temporary Energy Centres | # Permanent Energy Centres | Cumulative Energy Capacity (kW) | Energy Centre Description (AEC supplies peaking to NDES after 2020) |
|---|---|---|---|---|---|---|---|---|---|
| 2015 | 16,295 | 244 | 208 | 1,002 | 1 | 1 | 0 | 5,858 | W-TEC |
| 2016 | 58,889 | 2,330 | 1,981 | 5,262 | 4 | 2 | 0 | 11,716 | W-TEC, E-TEC |
| 2017 | 84,916 | 3,561 | 3,027 | 7,864 | 7 | 2 | 0 | 11,716 | W-TEC, E-TEC |
| 2018 | 125,677 | 5,558 | 4,725 | 11,940 | 9 | 2 | 0 | 11,716 | W-TEC, E-TEC |
| 2019 | 179,197 | 8,095 | 6,881 | 17,292 | 12 | 2 | 0 | 11,716 | W-TEC, E-TEC |
| 2020 | 322,194 | 14,846 | 12,619 | 31,592 | 27 | 2 | 0 | 11,716 | W-TEC, E-TEC |
| 2021 | 372,209 | 17,236 | 14,651 | 36,594 | 31 | 2 | 0 | 11,716 | W-TEC, E-TEC, Wesbrook EC/ETS |
| 2022 | 426,662 | 19,865 | 16,885 | 42,039 | 34 | 2 | 1 | 16,716 | W-TEC, E-TEC, Wesbrook EC/ETS |
| 2023 | 493,050 | 22,871 | 19,440 | 48,678 | 38 | 2 | 1 | 16,716 | W-TEC, E-TEC, Wesbrook EC/ETS |

## 2.5 SUMMARY OF PREFERRED ALTERNATIVE

### 2.5.1 Phase 1: Project Plan and Description for Current CPCN Filing (2014-2024)

The NDES Project Plan proposes that the NDES approach be implemented in two phases. Phase 1 is contemplated as a natural gas solution serving early loads in Wesbrook Place, Acadia East and potentially Block F. Phase 2 is the implementation of the Alternate Energy Source, currently contemplated as waste heat recovery from TRIUMF, and/or the interconnection of the Wesbrook Place portion of the NDES and ADES, which is assumed to occur in 2024.

Corix is applying for Phase 1 of the NDES, which will provide service to new buildings in Wesbrook Place, Acadia East and Block F and is scheduled for completion between 2015 and 2023. Thermal energy for Wesbrook Place during Phase 1 will be provided by two natural gas temporary energy centres (TEC) located within Wesbrook Place, and potentially supplemented in 2022 by the installation of a section (one 5 MW natural gas boiler) of the nodal Energy Centre/ETS as described in section 4.3.4. Acadia East and Block F buildings will likely be fed from ADES through a direct connection to the ADES peaking plant. The installation of the Wesbrook EC/ETS and the supply of energy to Acadia East and Block F will not trigger another CPCN application, unless the triggers described in Section 2.5.2 occur.

Phase 1 includes each loop's energy supply capacity or connection, associated distribution piping and energy transfer stations. Drawing G002 in Appendix One depicts anticipated locations of the temporary and permanent energy centres as well as the interconnection to the ADES. Phase 1 is anticipated to be in place until 2024 based on the current Project Plan.

As the development of Wesbrook Place continues, there are two distinct areas to the far east and far west of Wesbrook Mall. The Project Plan anticipates that each area will initially be served independently, each by one temporary energy centre.

### 2.5.2 Phase 2: Long Term Project Plan

The trigger to initiate Phase 2 of the NDES is either or both of the following events:

- the interconnection of the Wesbrook portion of the NDES and the ADES; and/or
- the connection of a permanent CEP to an Alternate Energy Source

Phase 2 of the NDES Project Plan outlines the interconnection of Wesbrook Place, Stadium Road, the ADES and Acadia East/Block F with a main trunk supply-return pipeline. A permanent Central Energy Plant (CEP) will be constructed to the south of Wesbrook Place, as close as possible to the TRIUMF research facility. The Alternate Energy Source for the NDES will be provided by low-grade heat at 25ºC recovered from the TRIUMF cooling plant and upgraded by heat pumps in the CEP up to 80ºC. The heat pumps will be supplemented by natural gas boilers to raise the supply temperature to 90ºC during peak demand periods and to meet anticipated ADES temperatures. The supply temperature of the system will follow a reset strategy based on outside air temperature and whether heat is delivered to the ADES or not. Prior to the ADES connection, the NDES supply temperature will range from 65ºC for low demand periods in the summer to 90ºC for peak demand periods in the winter. After the ADES connection, the NDES supply temperature will be increased to 90ºC whenever heat can be sold to the ADES.

The long term servicing plan for Wesbrook Place, including the connection of existing buildings, is shown in the general arrangement Drawing G003, in Appendix One. Service to existing buildings will be provided by connecting the eastern and western branches at the northern end of the Wesbrook DPS, thus minimizing the required pipe sizes.

Alternate energy will be provided from the CEP to the ADES via the direct connection of the two district energy systems, the ADES and NDES. However, the load on the ADES is fundamentally different to the load on the NDES due to the fact that the majority of the buildings served by the ADES were originally designed to be heated with steam and the supply temperature on the ADES ranges between 80ºC and 117ºC. Therefore, during periods of peak demand when the ADES supply temperature exceeds 90ºC, the CEP will not supply any heat to the ADES and all thermal energy produced at the CEP will be supplied to the NDES. If the CEP is not feeding the ADES, it should not be necessary to run the CEP boilers unless additional peak heating capacity is needed.

The ADES return temperature ranges from 60-75ºC, which is higher than the required return temperature for the heat pumps at the CEP; therefore the Wesbrook and Stadium Road heating loads will be cascaded off of the hot return from the ADES via neighbourhood nodal energy transfer stations (ETS).

Each nodal ETS will also include local peaking boilers (i.e. Wesbrook EC/ETS and Stadium EC/ETS); this approach will enable the NDES to meet the higher supply temperatures required during peak demand periods.

## 2.6 FINANCIAL MODELING AND INPUTS

The principal objective of the financial analysis is to:

- Determine the requirements for long-term economic feasibility and financial viability of the project;
- Define the variables which will affect the viability of establishing and operating a district energy system at UBC;
- Develop a financial model to evaluate and optimize the project variables following a cost of service approach;
- Calculate the indicative rates for residential customers during Phase 1 of the development and compare the rates to conventional energy sources that would be used were it not for the DES; and
- Present a base case scenario (“Base Case”) and sensitivity analysis.

The Base Case assumes that the CEP will be constructed and in operation in year 2024, and before then all heat energy for Wesbrook Place will be provided to customers using the two temporary natural gas TECs and the Wesbrook EC/ETS until 2023. The Wesbrook EC/ETS will continue to be used for trimming the

hot water temperature once the permanent CEP is in operation. Loads in Acadia East and Block F in Phase 1 are contemplated to be served by the ADES. Phase 2 will involve interconnecting Wesbrook Place, Stadium, the ADES and Acadia East/Block F with a main trunk supply-return pipeline and additional peaking and boiler capacity in Wesbrook EC/ETS and Stadium EC/ETS.

As previous outlined, this application is for Phase 1 of the Project Plan, which is contemplated to be the first 10 years of the NDES. However, because the Base Case considers the full build-out of the UBC NDES project, all relevant capital costs, operating costs, and other facts and assumptions for the full 30-year project term will be presented where necessary in order to provide a complete picture of the long-term economic feasibility and financial viability of the project.

There are a number of assumptions regarding future prices and rates that have a global bearing on the results of the financial model. *Table 5: Escalation: Facts and Assumptions* below shows the commodity price and other cost escalation rates used in the model.

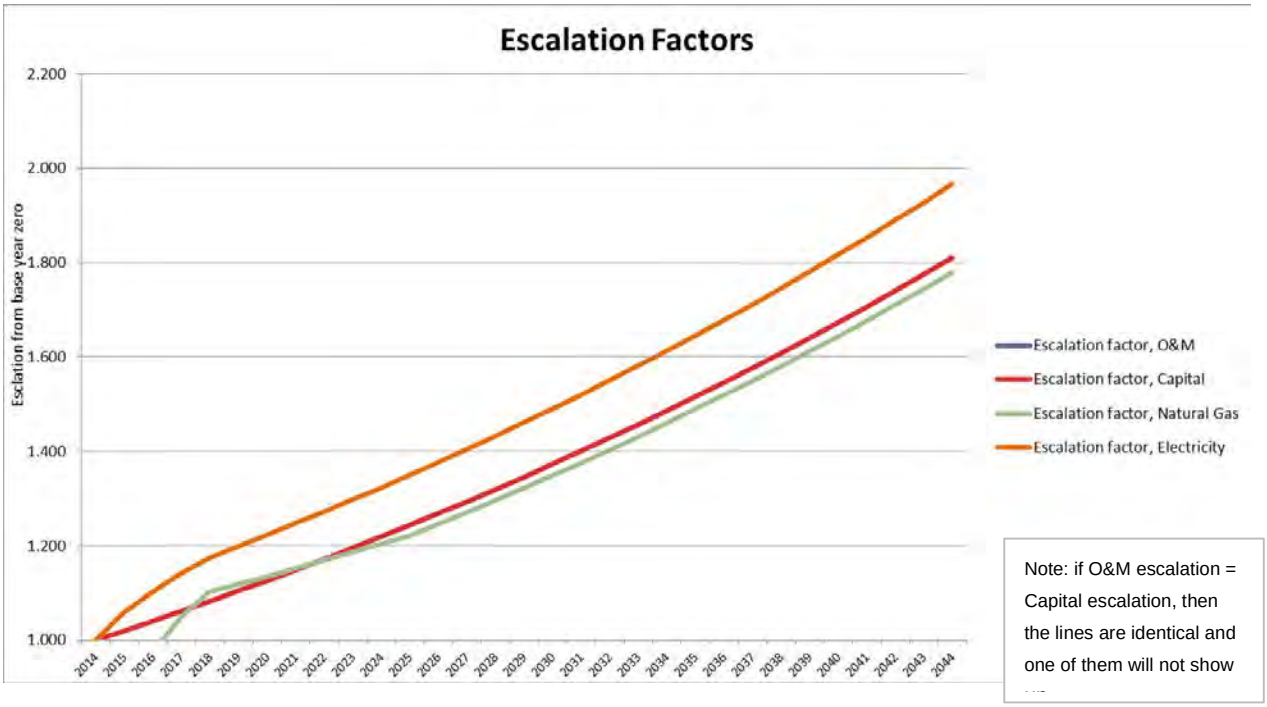
**Table 5: Escalation: Facts and Assumptions**

| ESCALATION (NOMINAL) | |
|---|---|
| Base year | 2014 |
| Forecast CPI (for O&M) | 2.0% |
| Capital costs | 2.0% |
| Natural gas | Sproule |
| Electricity (2014 to 2023) | Hydro |
| Electricity (2024 onwards) | 2.0% |
| Heat purchased from ADES | Sproule |
| Waste heat from TRIUMF | 0.0% |

Further information regarding the items in *Table 5* above:

- The base year for the model is 2014, although construction is not expected to commence until early 2015. The model also indicates a project year, with 2014 being year 0. No adjustment to the NPV calculations has been made for the short initial year because the costs incurred are proportionately small and no customer connections are made until the second quarter of 2015.
- Operating costs (non-fuel) and capital costs have been escalated at 2% per annum as an estimate of inflation. A sensitivity comparison for +/– 1% on this amount has been prepared and is shown in Section 2.10.3.
- The commodity cost of natural gas is assumed to escalate in proportion to the Sproule forecast for domestic natural gas at Huntington/Sumas. The commodity forecast used is as of June 30, 2014, and after two years of mild decline, followed by two years of increase moderately in excess of CPI, the forecast assumes 1.5% per annum escalation until 2024, which is the limit of the Sproule forecast. Thereafter, the financial model assumes that commodity cost of natural gas will escalate at 2% per annum, in line with the estimated CPI. Gas delivery and demand charges are assumed to escalate at CPI.
- The cost of electricity is assumed to escalate according to BC Hydro's most recent 10 year rate plan. The escalation factor used is moderately in excess of CPI until 2018, and thereafter is assumed to be 2% per annum, in line with the estimated CPI. *Figure 8: Escalation Factors* depicts all escalation factors.

**Figure 8: Escalation Factors**




### 2.6.1 Capital Costs

Detailed information about the compilation of capital costs and phasing of construction is found in Section 5.

For the purpose of the financial model, the capital costs are built up from a study of connected floor area and energy loads. *Table 6: Connected Floor Area* below shows the cumulative connected floor area during the first portion of Phase 1, as well as year 2024 when the CEP is expected to be constructed, and finally at year 2044, the completion of the 30 project life and forecast period.

**Table 6: Connected Floor Area**

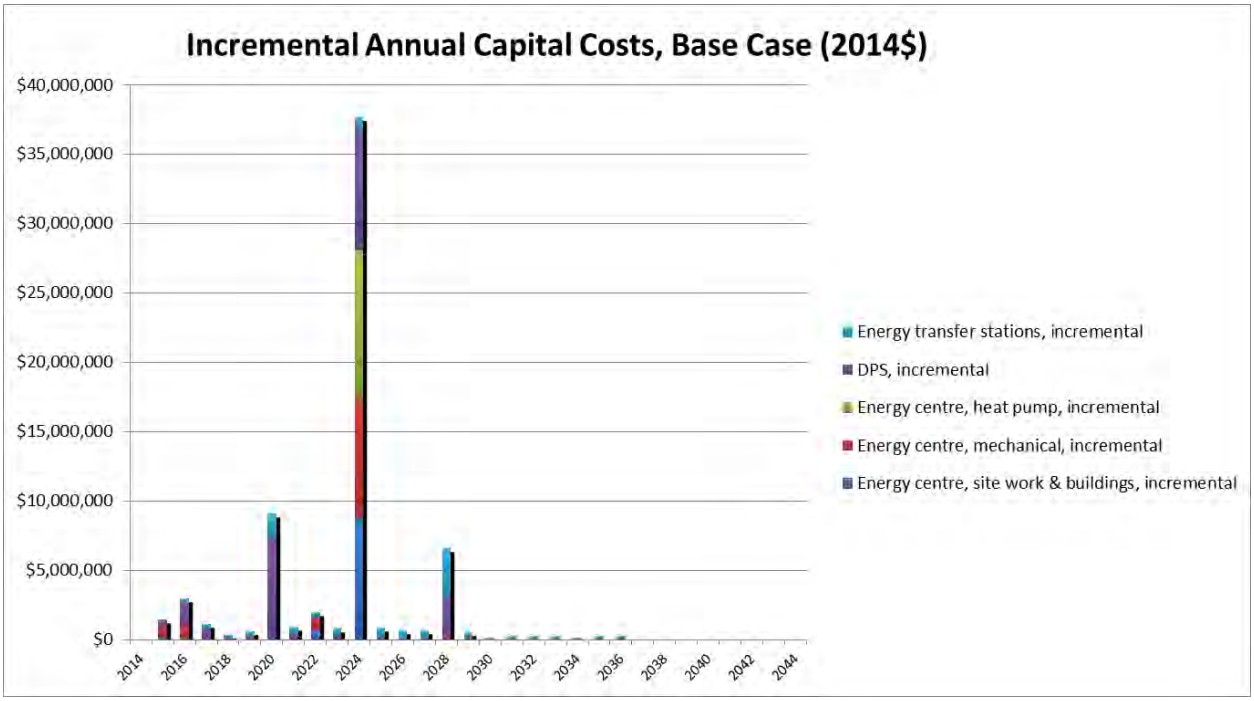
| Connected floor area, MWh's load, DPS length | At build-out | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Connected floor area, cumulative, square metres | 1,078,680 | 16,295 | 58,889 | 84,916 | 125,677 | 179,197 | 322,194 | 372,209 | 426,662 | 561,943 | 1,078,680 |
| Load, cumulative, MWh's | 113,204 | 1,002 | 5,262 | 7,864 | 11,940 | 17,292 | 31,592 | 36,594 | 42,039 | 74,497 | 113,204 |
| DPS length, cumulative, metres | 7,685 | 144 | 907 | 1,276 | 1,319 | 1,433 | 3,499 | 3,738 | 3,756 | 6,523 | 7,685 |

*Table 7: Incremental Capital Cost (thousands, 2014$)* below shows the incremental capital costs during Phase 1, which includes the connection of Acadia East in 2020 and the construction of the Wesbrook EC/ETS in 2022, and at 2024 (the connection of the CEP to an Alternative Energy Source), and at 2044 (the end of the forecasted period). *Table 8: Cumulative Capital Costs (thousands, 2014$)* shows the cumulative capital costs. The capital costs in *Table 7: Incremental Capital Cost (thousands, 2014$)* and *Table 8: Cumulative Capital Costs (thousands, 2014$)* are in current year dollars (i.e., real dollars). *Figure 9: Incremental Capital Costs (2014$)* and *Figure 10: Cumulative Capital Costs (2014$)* show the annual incremental capital costs and cumulative capital costs, segregated by asset category, in nominal dollars.

## Table 7: Incremental Capital Cost (thousands, 2014$)

| Incremental capital costs (thousands, 2014$) | Cumulative | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Energy centre, site work & buildings, incremental | 9,770 | 169 | 169 | 0 | 0 | 0 | 0 | 0 | 677 | 8,754 | 0 |
| Energy centre, mechanical, incremental | 11,398 | 812 | 812 | 0 | 0 | 0 | 0 | 0 | 868 | 8,615 | 0 |
| Energy centre, heat pump, incremental | 10,662 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10,662 | 0 |
| DPS, incremental | 24,082 | 391 | 1,653 | 826 | 120 | 267 | 7,438 | 484 | 120 | 8,824 | 0 |
| Energy transfer stations, incremental | 12,083 | 110 | 331 | 331 | 221 | 331 | 1,657 | 442 | 331 | 773 | 0 |
| Total, incremental | 67,994 | 1,483 | 2,966 | 1,158 | 341 | 599 | 9,094 | 926 | 1,997 | 37,629 | 0 |

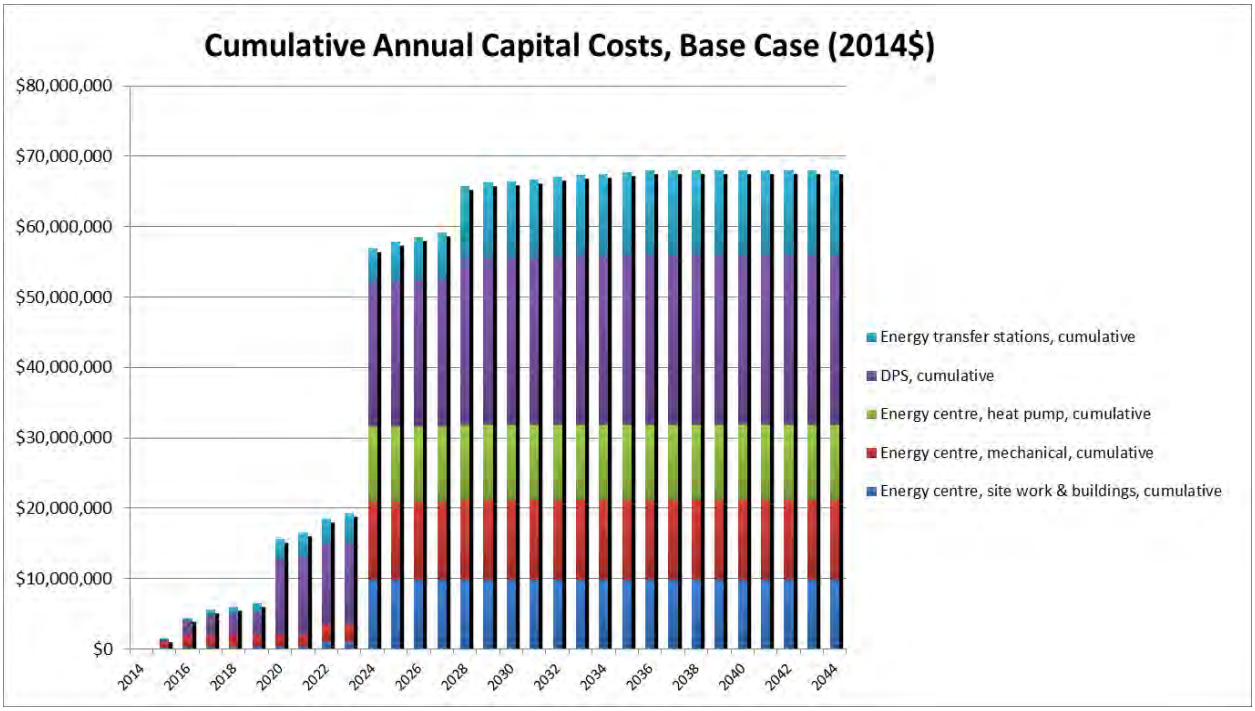
## Figure 9: Incremental Capital Costs (2014$)




## Table 8: Cumulative Capital Costs (thousands, 2014$)

| Cumulative capital costs (thousands, 2014$) | Cumulative | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Energy centre, site work & buildings, cumulative | 9,770 | 169 | 338 | 338 | 338 | 338 | 338 | 338 | 1,015 | 9,770 | 9,770 |
| Energy centre, mechanical, cumulative | 11,398 | 812 | 1,625 | 1,625 | 1,625 | 1,625 | 1,625 | 1,625 | 2,493 | 11,109 | 11,398 |
| Energy centre, heat pump, cumulative | 10,662 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10,662 | 10,662 |
| DPS, cumulative | 24,082 | 391 | 2,044 | 2,871 | 2,991 | 3,258 | 10,696 | 11,180 | 11,300 | 20,465 | 24,082 |
| Energy transfer stations, cumulative | 12,083 | 110 | 442 | 773 | 994 | 1,325 | 2,982 | 3,424 | 3,755 | 4,970 | 12,083 |
| Total, cumulative | 67,994 | 1,483 | 4,449 | 5,607 | 5,948 | 6,547 | 15,641 | 16,567 | 18,564 | 56,975 | 67,994 |

**Figure 10: Cumulative Capital Costs (2014$)**




#### 2.6.1.1 PST

Provincial sales tax of 7% has been added to the capital costs assuming a factor of approximately 45% hard-goods and 55% non-taxable labour.

#### 2.6.1.2 Project Development Costs

UBC and Corix have developed an Infrastructure Agreement to define the roles and responsibilities of relevant parties. As a part of the financial submission, Corix and UBC will submit each of their project development costs. These include engineering, financial, legal, consultation and regulatory costs spent by both to move the project to the implementation and construction stage. These project development costs are approximately 1.5% of total project capital costs. The project development costs have been capitalized and amortized over 30 years, being the contract term to which they relate. Corix is applying to have these costs included in rates AFUDC.

#### 2.6.1.3 AFDUC

Allowance for Funds Used During Construction is negligible in the current financial model, but will be calculated and added to the capital cost of the infrastructure once a specific construction timetable is available, and will reflect the same combined interest and return on equity cost as applied to the rate base amount at the particular time. Given small capital incremental capital expenditures in Phase 1, AFUDC is not expected to have a material impact on revenue requirement and rates.

#### 2.6.1.4 Grants and CIAC

Although no grants or other contributions in aid of construction have been assumed in the Base Case, Corix and UBC will cooperate to seek all grant and other capital contribution opportunities in order to provide the greatest possible benefit to the DES customers. The implementation of an Alternate Energy Source solution contemplated for Phase 2 in 2024 should allow Corix to apply for special environmental programs, such as NRCan federal funding, and this will be investigated and pursued.

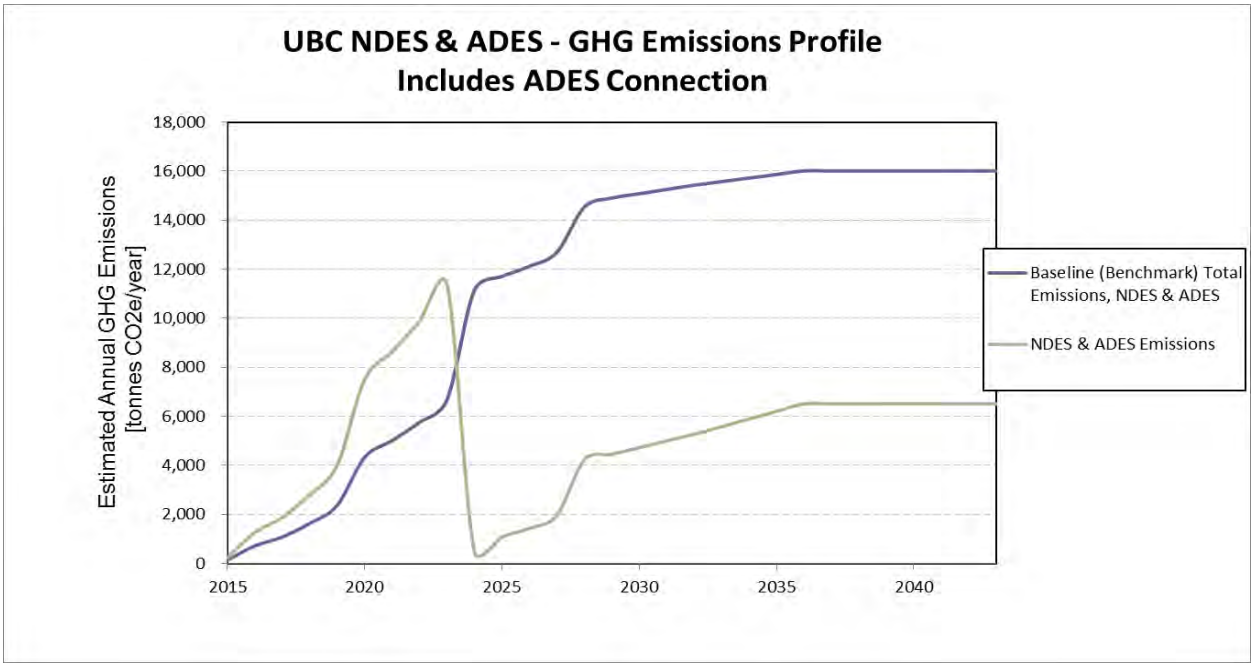
#### 2.6.1.5 Salvage Value

It is expected that the two temporary energy centres will be removed once Phase 2 begins. Corix will attempt to sell or otherwise re-deploy for value the temporary boilers, to the benefit of ratepayers, but recent experience indicates that the expected salvage value is sufficiently indeterminable that no estimate has been included in the financial model.

#### 2.6.1.6 Carbon Emissions Rider

Subject to BCUC approval, the Infrastructure Agreement provides that a temporary surcharge (the "Carbon Emissions Rider") will be applied to the monthly invoice for all NDES customers until the Alternate Energy Source is operational in 2024. The Carbon Emissions Rider will reflect a charge of $25 per tonne of carbon emissions resulting from the operation of natural gas boilers during Phase 1. The rider is intended to ensure that initial customers served by temporary natural gas boilers contribute to the cost of future Alternate Energy Sources and to help mitigate potential changes in rates with the implementation of the Alternate Energy Sources. It is also intended to ensure that Corix has appropriate incentives to implement low carbon energy sources in the event natural gas prices stay low. In the year that the Alternate Energy Source is utilized, the accumulated balance (with an interest amount in favour of the customers, reflecting Corix's after-tax weighted average cost of capital) of the Carbon Emissions Rider will be applied against the finished construction cost of the CEP in calculating the plant in service amount for rate-setting purposes. In the financial model, the accumulated balance of the Carbon Emissions Rider is expected to be about $0.9 million in 2024. It is intended that the revenues from the Carbon Emissions Rider will effectively be held in trust to be applied to a future low carbon energy source, or in the event a low carbon energy source is not available or feasible within the timeframe contemplated in the Project Plan, Corix may use the funds to acquire external offsets as necessary. *Figure 11* depicts the Carbon emissions profile.

**Figure 11: Carbon (GHG) Emissions Profile**




#### 2.6.1.7 Connection Credit

Subject to BCUC approval, the Infrastructure Agreement requires Corix to offer a connection incentive (the "Connection Credit") to identified developers of new low-rise buildings in Wesbrook Place to offset the incremental cost of fully hydronic-capable buildings over the benchmark approach of using electric baseboards for in-suite heating. As shown in *Table 10: Connection Credit*, the incentive will be at a rate of

$4.50 per square foot of completed floor space through 2017, and then declining by $0.90 per square foot each year thereafter (i.e., $nil by 2022). The accumulated amount of the Connection Credit will be added to rate base to permit Corix to earn its allowed return, and the balance will be amortized over a period of no less than 10 years. In the Base Case, the aggregate Connection Credit is expected to be approximately $2.9 million, which will have only a modest impact on the balance of rate base. The Connection Credit will be in place only until 2021. It is expected that developer innovation will drive the hydronic premium to zero by 2021. Innovation will be supplemented by potential changes in the building code that will make hydronic systems standard.

The magnitude of the proposed Connection Credit is based on an analysis by UBC of the net incremental costs of hydronic heating for a recent low rise project, and is also consistent with information from industry participants. No premium was found in high rise construction. The declining credit is intended to reflect expected cost reductions from developer learning, experience and innovation, as well as the effects of changes in building code and certification requirements that are expected to increase the prevalence of hydronic heating and also the value of future low carbon energy from the NDES.

In the absence of a Connection Credit, UBC was considering an exemption to hydronic systems for low rise construction. UBC has provided an exemption for a hydronic system to one building and has paid directly for hydronic systems for two projects, which shows the relevance of the Connection Credit. The Connection Credit has a small impact on levelized costs per MWh, of about 4.5%. The loss of low-rise loads would have an even larger impact on remaining customers, increasing levelized costs significantly. *Table 9: Connection Credit Scenarios* outlines how the connection credit versus low rise building exclusion impacts rates. The Connection Credit is essential to building load and lowering rates for all NDES customers.

**Table 9: Connection Credit Scenarios**

| Scenario | Levelized Cost |
|---|---|
| **No Connection Credit** | $130 |
| **With Connection Credit** | $133 |
| **Exclude low-rise buildings (considered for connection credit)from NDES** | $139 |

**Table 10: Connection Credit**

| CONNECTION CREDIT | | |
|---|---|---|
| Deferral a/c amortization, years | | 10 |
| Connection Credit per sq. foot | | |
| Year 2014 & 2015 | $ | 4.50 |
| Year 2016 | $ | 4.50 |
| Year 2017 | $ | 4.50 |
| Year 2018 | $ | 3.60 |
| Year 2019 | $ | 2.70 |
| Year 2020 | $ | 1.80 |
| Year 2021 | $ | 0.90 |

### 2.6.1.8 Capital Cost Summary

*Table 11: Plant in Service (thousands, nominal $)* below shows the cumulative plant in service cost for each asset category, as well as the aggregate accumulated depreciation balance and the net book value of the Project Development Costs and the Connection Credit.

**Table 11: Plant in Service (thousands, nominal $)**

| Plant in service (thousands, nominal $) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Original cost | | | | | | | | | | |
| Buildings | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10,236 | 10,236 |
| Renewable energy, plant | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19,720 | 19,720 |
| Non-renewable energy, plant | 1,033 | 2,086 | 2,086 | 2,086 | 2,086 | 2,086 | 2,086 | 3,135 | 6,840 | 7,233 |
| ADES distribution pipe | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,280 | 6,280 |
| ADES mechanical equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NDES distribution pipe | 412 | 2,186 | 3,090 | 3,225 | 3,529 | 12,169 | 12,743 | 12,887 | 18,117 | 23,068 |
| NDES mechanical equipment | 116 | 472 | 834 | 1,081 | 1,458 | 3,383 | 3,906 | 5,125 | 7,318 | 17,110 |
| Total cost | 1,560 | 4,743 | 6,010 | 6,392 | 7,073 | 17,638 | 18,735 | 21,148 | 68,510 | 83,647 |
| Accumulated depreciation | 0 | (41) | (150) | (284) | (427) | (587) | (933) | (1,304) | (2,209) | (38,788) |
| Net book value, PP&E | 1,560 | 4,703 | 5,860 | 6,107 | 6,646 | 17,051 | 17,801 | 19,844 | 66,301 | 44,859 |
| Net book value, project development costs | 880 | 851 | 821 | 792 | 763 | 733 | 704 | 675 | 616 | 29 |
| Net book value, lowrise connection credit account | 0 | 190 | 1,432 | 2,070 | 2,259 | 2,284 | 1,990 | 1,696 | 1,109 | 0 |
| Total, plant in service, net book value | 2,440 | 5,743 | 8,113 | 8,969 | 9,668 | 20,068 | 20,495 | 22,215 | 68,026 | 44,889 |

### 2.6.2 Operating Costs

NDES operating costs under the Base Case include all fuel, wages, maintenance, insurance, administration, land leases, water and sewer, UBC service levy, UBC franchise fee, property taxes and all other taxes, fees and levies. The temporary Carbon Emissions Rider charged to customers is added to the cost of fuel.

*Table 12: Fuel Prices (nominal $)* below shows the price for each category of fuel consumed.

**Table 12: Fuel Prices (nominal $)**

| Fuel prices (nominal $) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Renewable, waste heat (TRIUMF), $ / MWh | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Heat purchased from UBC, $ / MWh | $ - | $ - | $ - | $ - | $ - | $ 47.80 | $ 48.46 | $ 49.13 | $ 51.42 | $ 71.54 |
| Natural gas, commercial, fully-loaded cost + carbon tax, $ / GJ | $ 10.05 | $ 9.80 | $ 10.26 | $ 10.61 | $ 10.74 | $ 10.89 | $ 11.04 | $ 11.19 | $ 11.71 | $ 16.30 |
| Electricity, commercial, fully-loaded, $ / MWh | $ 78.33 | $ 79.92 | $ 82.80 | $ 85.36 | $ 87.11 | $ 94.34 | $ 95.28 | $ 97.20 | $ 102.49 | $ 150.84 |

Further information about the items in *Table 12* above:

- Based on current LOI and subject to agreement with TRIUMF, it is assumed that there will be no cost associated with waste heat captured at the TRIUMF facility.
- The cost of heat purchased from UBC to satisfy periodic NDES load requirements will be a function of the cost of natural gas (but minus the carbon offset amount otherwise included in the cost), being the FortisBC Large Commercial Service rate (i.e., Rate Schedule 3, as of April 1, 2014) including commodity, delivery, basic charge, riders and carbon tax.
- In the ordinary course of operations, the NDES will purchase natural gas from FortisBC at the Large Commercial Service rate (i.e., Rate Schedule 3, as of April 1, 2014) including commodity, delivery, basic charge, riders and carbon tax.
- Electricity will be purchased from UBC or BC Hydro at the Medium General Service Rate or Large General Service Rate as applicable according to the demand of the DES system as it grows (i.e., Schedule 1500 and 1600 respectively, although in the initial years the demand may be below the applicable demand for Schedule 1500; any difference in cost is nominal, however). The BC Hydro 5% Schedule 1901 Deferral Account Rate Rider is added to the cost of electricity each year and is assumed to continue indefinitely. Electricity consumption is modest until 2024 when the CEP heat pump is operational.

*Table 13: Fuel Consumption* on the following page shows the forecast consumption for each category of fuel.

### Table 13: Fuel Consumption

| Fuel consumption | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Renewable, waste heat (TRIUMF), MWh's | - | - | - | - | - | - | - | - | 52,459 | 54,731 |
| Heat purchased from UBC, MWh's | - | - | - | - | - | 11,211 | 12,502 | 13,793 | - | 6,367 |
| Natural gas, GJ's | 4,589 | 24,235 | 36,066 | 53,794 | 77,082 | 94,964 | 111,339 | 129,356 | 8,826 | 97,305 |
| Electricity, large general, MWh's | 94 | 126 | 124 | 122 | 121 | 171 | 187 | 186 | 24,335 | 25,336 |

*Table 14: Fuel Costs (nominal $)* shows the nominal dollar cost for each category of fuel on an annual and 30-year NPV basis. *Figure 12: Fuel Costs (nominal $)* also shows the fuel costs by category.

### Table 14: Fuel Costs (nominal $)

| Fuel costs (thousands, nominal $) | NPV, 30 yrs | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Renewable, waste heat (TRIUMF) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat purchased from UBC | 2,779 | 0 | 0 | 0 | 0 | 0 | 536 | 606 | 678 | 0 | 456 |
| Natural gas | 11,763 | 46 | 238 | 370 | 571 | 828 | 1,034 | 1,229 | 1,448 | 103 | 1,586 |
| Electricity | 20,824 | 7 | 10 | 10 | 10 | 11 | 16 | 18 | 18 | 2,494 | 3,822 |
| Carbon emissions rider | 586 | 6 | 32 | 47 | 70 | 100 | 123 | 145 | 168 | 0 | 0 |
| Total | 35,366 | 59 | 279 | 427 | 651 | 939 | 1,710 | 1,997 | 2,312 | 2,598 | 5,863 |

### Figure 12: Fuel Costs (nominal $)

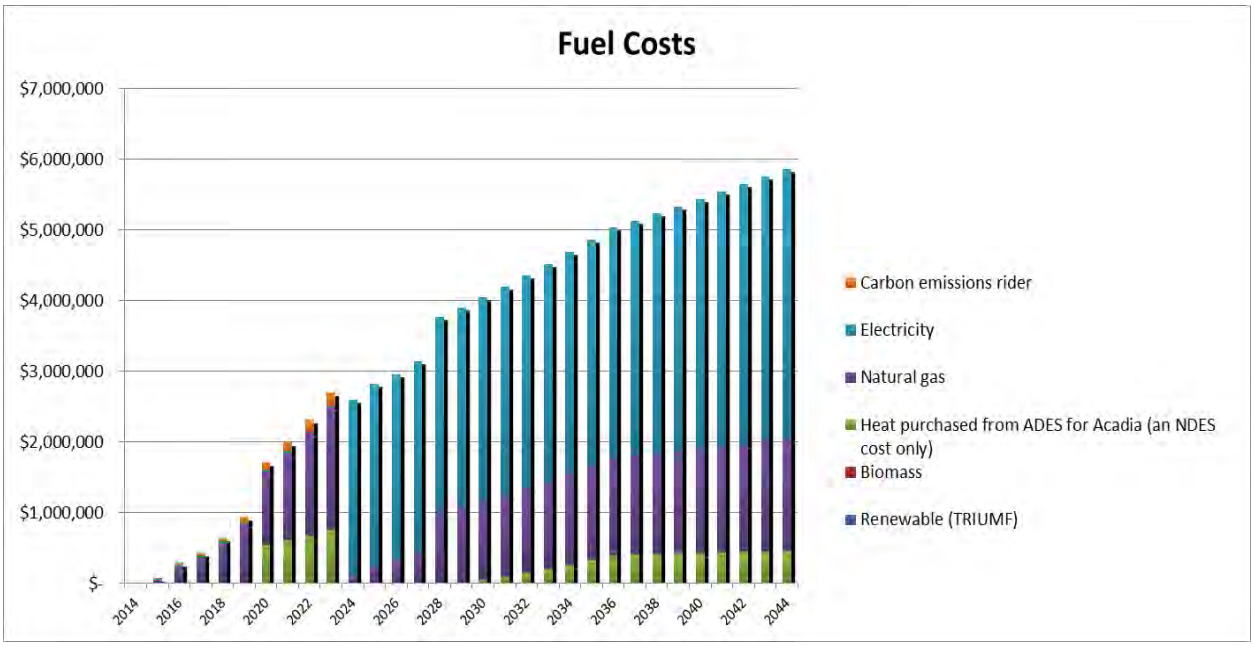



*Table 15: Direct Operating Costs (nominal $)* shows the operator cost and maintenance cost for the DES.

### Table 15: Direct Operating Costs (nominal $)

| Operator FTE's, operator cost, maintenance cost | At build-out | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Operator FTE's | 4.9 | 0.1 | 0.5 | 0.6 | 0.7 | 0.9 | 1.6 | 2.8 | 2.8 | 4.9 | 4.9 |
| Operator cost, thousands 2014$ | 490 | 10 | 45 | 60 | 70 | 85 | 160 | 280 | 280 | 490 | 490 |
| Maintenance cost, thousands 2014$ | 444 | 0 | 8 | 20 | 24 | 25 | 28 | 55 | 58 | 71 | 444 |

Further information about the items in *Table 15*: Direct Operating Costs (nominal $):

- Operator FTE's have been determined by KWL and Corix, with input from UBC. The Base Case assumes that less than 1 FTE is required to operate the two temporary energy centres and 4.9 FTE's will be required to operate the CEP when it is connected to the Alternative Energy Source in 2024.
- Each qualified operator FTE is assumed to cost $100,000 per annum in year 2014 dollars.
- Annual maintenance costs for each category of equipment have been estimated by KWL and Corix, with input from UBC, and are calculated as follows:
  - Mechanical, non-renewable energy equipment – 0.75% of cumulative capital
  - Site work and structures (civil) – 0.25% of cumulative capital
  - Mechanical, renewable energy equipment – 2.0% of cumulative capital
  - Distribution pipe system – 0.25% of cumulative capital
  - Energy transfer station – 0.50% of cumulative capital

*Table 16: Indirect Operating Costs (nominal $)* below shows the indirect operating costs for the NDES. There are assumptions about the allocation of indirect costs between the NDES and the ADES. For example, fees paid to UBC will be charged only to NDES customers. The details of these apportionment calculations are included in the financial model but only have an impact beginning in 2024 when the CEP becomes operational and the ADES receives heat energy. The costs shown in *Table 16: Indirect Operating Costs (nominal $)* are aggregate amounts and have not been apportioned between the NDES and ADES.

**Table 16: Indirect Operating Costs (nominal $)**

| Indirect operating costs (thousands, nominal $) | NPV, 30 yrs | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Insurance | 985 | 2 | 5 | 9 | 12 | 14 | 17 | 34 | 37 | 45 | 132 |
| Corix admin | 2,385 | 143 | 146 | 149 | 152 | 155 | 158 | 161 | 164 | 171 | 254 |
| Land leases | 901 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 111 | 165 |
| Water & sewer | 443 | 27 | 27 | 28 | 28 | 29 | 29 | 30 | 30 | 32 | 47 |
| UBC service levy | 3,308 | 0 | 3 | 14 | 19 | 20 | 22 | 75 | 79 | 82 | 439 |
| UBC franchise fee | 1,705 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 434 |
| Property tax on buildings, land and DPS | 2,284 | 0 | 2 | 9 | 13 | 14 | 15 | 52 | 54 | 57 | 303 |
| Total | 12,011 | 171 | 182 | 208 | 224 | 231 | 240 | 352 | 365 | 497 | 1,774 |

**Table 17: Indirect Costs: Facts and Assumptions**

| INDIRECT COSTS | | |
|---|---|---|
| Portion of capital costs attracting PST | | 45.0% |
| Rural property tax paid to Province (Metro Van.) | | 2.13% |
| Land value for property tax ($ per sq. metre) | $ | 560.00 |
| UBC service levy | | 3.09% |
| Insurance, owner ($ per $100 of nbv) | $ | 0.11 |
| Insurance, general commercial liability (% of rev.) | | 0.25% |
| Water & Sewer ($ annual) | $ | 26,000 |
| Corix admin (average year) | $ | 140,000 |
| UBC franchise fee (% of PY NDES rev.) | | 3.0% |
| UBC franchise fee to begin in project year | | 16 |
| UBC land lease rate per m2 | $ | 50.00 |

Further information about the items in *Table 16: Indirect Operating Costs (nominal $)* and *Table 17: Indirect Costs: Facts and Assumptions*

- Insurance includes an amount for (a) commercial general liability, and (b) operational insurance on the value of the property, being the buildings, pipe and equipment. General commercial liability insurance is assumed to be 0.25% per dollar of revenue, subject to a $2000 per annum minimum. Operational (property) insurance is assumed to be $0.11 per $100 of value, being the net book

value of the buildings and equipment, plus an estimated 20% of the cost of the pipe system. These estimates are based on internally provided information from Corix's insurance administrator. Construction insurance during construction and wrap-up is already included in KWL's capital cost estimates.

- Corix administration and overhead charge is an internal estimate based on Corix's broad experience operating similar district energy systems. The bundled charge of $140,000 per annum (in 2014 dollars) is for an average year and includes separately determined estimates for legal, accounting, regulatory, administration, human resources, I/T support and maintenance, telephones, office supplies, and vehicle costs. Corix makes every effort to minimize its administrative and overhead costs, but it is reasonable to assume that costs in the early phase of a project will be higher, if viewed on a per megawatt hour basis, than in later years.
- The CEP will be situated on land leased from UBC. Final site determination and the lease agreement have not been concluded, but provisional discussion between Corix and UBC indicates that the lease rate will be a market rate of approximately $50 per square meter. KWL has estimated that the CEP will require 1820 square meters of land.
- Annual water and sewer charges from UBC have been estimated based on provisional discussions between Corix and UBC.
- A Service Levy, intended to emulate a municipal tax, is charged by UBC at a rate of 3.09% (2014 rate) of the value of leased land, buildings and pipes. Property owners on UBC's campus pay a Rural Property Tax to the Province of BC (i.e., 2.13%, 2014 rate for jurisdiction 739 Lower Mainland Rural) and the Services Levy to UBC. The two added together are substantially the same as the City of Vancouver municipal tax due on a property with the same assessed value. Although property assessment will be determined by the BC Assessment Authority, for purposes of the calculation, land value has been estimated at an indicative market rate of $560 per square meter based on input from UBC, buildings have been valued at net book value, and the pipes at 20% of their capital cost.
- A UBC Franchise Fee on revenues has been agreed to between Corix and UBC and is included in the Infrastructure Agreement. The rate is 3% of revenue, but will not begin until after the 15th year of operation.

## 2.7 DEBT AND EQUITY FINANCING

The Base Case balance sheet used to calculate annual revenue requirement is shown in *Table 18: Balance Sheet (thousands, nominal $)*. Total depreciated rate base assets for this purpose include the residential revenue deferral account balance (see Section 2.10 below), and is net of the Carbon Emissions Rider account balance (see Section 2.6.1.7 above) that benefits the NDES customers and is expected to be used to offset the capital cost of the CEP in year 2024.

Ownership and operation of the NDES exposes Corix to business and financial risks that may exceed those allowed for in the Commission's recent Generic Cost of Capital (GCOC) decision for small thermal energy utilities. Corix proposes to set initial rates consistent with the GCOC Stage 2 "Minimum Default Capital Structure and Equity Risk Premium" for similar small thermal utilities to that contemplated for Phase 1 of the proposed NDES.

As indicated on the following page in *Table 19: Financing, Depreciation and Tax Assumptions*, Corix proposes a deemed capital structure of 57.5% debt and 42.5% equity and an equity risk premium of 75 basis points over the benchmark low risk utility. The Base Case annual revenue requirement includes interest expense and return on equity (ROE) calculated on the mid-year debt and equity balances on a forward test year basis.

The interest rate on debt financing was determined using the credit spread between BBB and BBB (low) rated debt and the 10 year Government of Canada bond yield, consistent with approach outlined for

calculating a "default debt" rate for TES utilities from the Commission's GCOC Decision (Stage 1) and confirmed in the Commission's Stage 2 decision[10]. The financing and tax assumptions applied are summarized in *Table 19: Financing, Depreciation and Tax Assumptions* below.

**Table 18: Balance Sheet (thousands, nominal $)**

| Balance sheet (thousands, nominal $) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Plant in service | 2,440 | 5,813 | 8,341 | 9,505 | 10,600 | 21,453 | 22,550 | 24,964 | 72,325 | 87,463 |
| Accumulated depreciation | 0 | (70) | (228) | (536) | (932) | (1,385) | (2,055) | (2,749) | (4,299) | (42,574) |
| Carbon emissions rider account owing to NDES | (6) | (37) | (84) | (154) | (254) | (378) | (523) | (691) | 0 | 0 |
| Residental deferral account | 220 | 549 | 1,090 | 1,722 | 2,234 | 2,422 | 3,096 | 3,503 | 3,160 | 0 |
| Total assets | 2,654 | 6,255 | 9,118 | 10,537 | 11,648 | 22,112 | 23,068 | 25,027 | 71,186 | 44,889 |
| | | | | | | | | | | |
| Debt | 1,526 | 3,597 | 5,243 | 6,059 | 6,697 | 12,714 | 13,264 | 14,391 | 40,932 | 25,811 |
| Equity | 1,128 | 2,658 | 3,875 | 4,478 | 4,950 | 9,398 | 9,804 | 10,636 | 30,254 | 19,078 |
| Total liabilities and equity | 2,654 | 6,255 | 9,118 | 10,537 | 11,648 | 22,112 | 23,068 | 25,027 | 71,186 | 44,889 |
| | | | | | | | | | | |
| Debt, mid-year | 763 | 2,561 | 4,420 | 5,651 | 6,378 | 9,706 | 12,989 | 13,827 | 27,681 | 26,370 |
| Equity, mid-year | 564 | 1,893 | 3,267 | 4,177 | 4,714 | 7,174 | 9,601 | 10,220 | 20,460 | 19,491 |
| Total liabilities and equity, mid-year | 1,327 | 4,455 | 7,687 | 9,828 | 11,092 | 16,880 | 22,590 | 24,048 | 48,141 | 45,861 |

**Table 19: Financing, Depreciation and Tax Assumptions**

| FINANCING & TAX | |
|---|---|
| Debt ratio | 57.5% |
| Equity ratio | 42.5% |
| Debt rate | 4.0% |
| Equity rate | 9.5% |
| Tax rate | 26.0% |
| Weighted after tax average cost of capital | 5.7% |
| Pre tax WACC | 6.3% |
| Depreciation - buildings | 1.5% |
| Depreciation - plant | 3.0% |
| Depreciation - distribution | 1.5% |
| Depreciation - ETS and other | 3.0% |
| CCA - buildings | 4.0% |
| CCA - natural gas | 8.0% |
| CCA - renewable energy (before 2020) | 50.0% |
| CCA - renewable energy (after 2019) | 30.0% |

### 2.7.1 Depreciation and Amortization

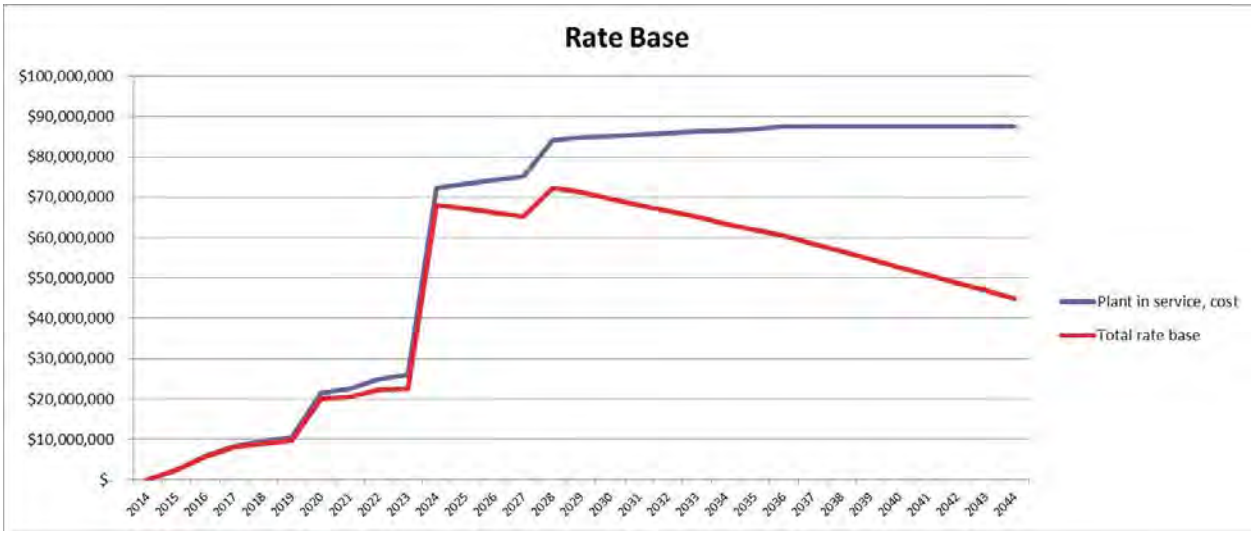
Depreciation charges are shown above in *Table 19: Financing, Depreciation and Tax Assumptions*. The charges reflect common DES utility accounting practice and estimated useful life of each asset group. The 30-year forecast period for the financial model is, on balance, in line with the end of the useful life of the plant and equipment, although it is reasonable that actual asset life will vary and replacement of plant and equipment might need to occur before the end of 30 years. (Also, the 30-year forecasted period was chosen because the terms of the Infrastructure Agreement allow UBC to purchase the NDES at that point.) Notwithstanding, the useful life assumptions for accounting depreciation, and the capital maintenance program is intended to allow plant, equipment and other infrastructure to meet or surpass the expected useful life.

*Figure 13: Plant in Service Coast Compared to Rate Base (nominal $)* below shows the depreciating balance of rate base over the 30-year forecast period compared to the original cost of the plant in service.

[10] BCUC Generic Cost of Capital Proceeding (Stage 2) Decision, March 25, 2014

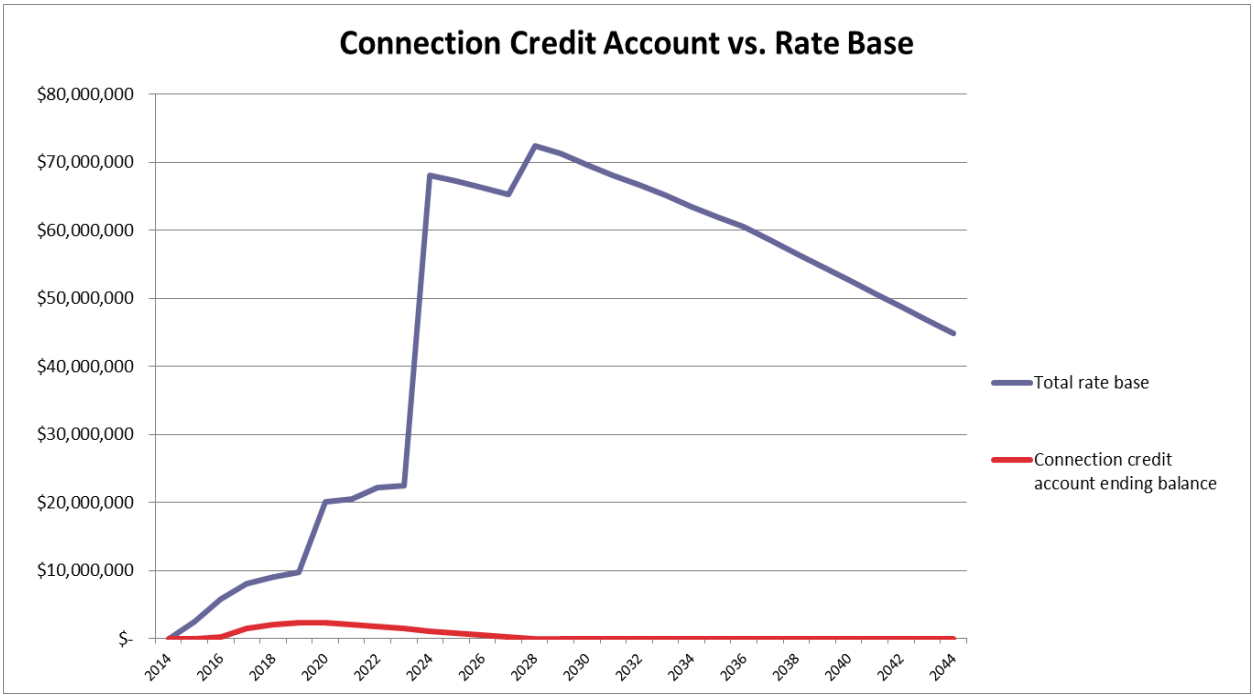
For this purpose, rate base excludes the residential Revenue Deferral Account and the Carbon Emissions Rider account.

**Figure 13: Plant in Service Coast Compared to Rate Base (nominal $)**




Subject to BCUC approval, the temporary Connection Credit account will be amortized over 10 years, which is considered a reasonable duration in order to smooth the impact on revenue requirement. The aggregate amount of the Connection Credit is forecast to be less than $3 million, as discussed above in Section 2.6.1.7. *Figure 14: Connection Credit Account Compared Rate Base (nominal $)* below shows the Connection Credit account balance in comparison to the depreciated rate base amount, which for this purpose excludes the residential Revenue Deferral Account and the Carbon Emissions Rider account.

**Figure 14: Connection Credit Account Compared Rate Base (nominal $)**



## 2.8 INCOME TAXES

Income tax assumptions are shown in *Table 19: Financing, Depreciation and Tax Assumptions*. The combined federal and provincial corporate tax rate on general income in British Columbia is 26%. The CEP is assumed to qualify for the UCC Class 43.1 renewable energy accelerated capital cost allowance rate of 30% (declining balance). In the Base Case, the CEP is not built until 2024, which is after the cut-off date for the enhanced UCC Class 43.2 50% CCA rate. Regardless, for purposes of calculating the Annual Revenue Requirement, the Base Case forecasts that tax will be not be payable in a material amount until year 2040. The Connection Credit and the Project Development Costs are each amortized for tax purposes as a Cumulative Eligible Capital amount (i.e., 75% of the incurred cost is added to the CEC account; 7% of CEC is annually deducted for tax).

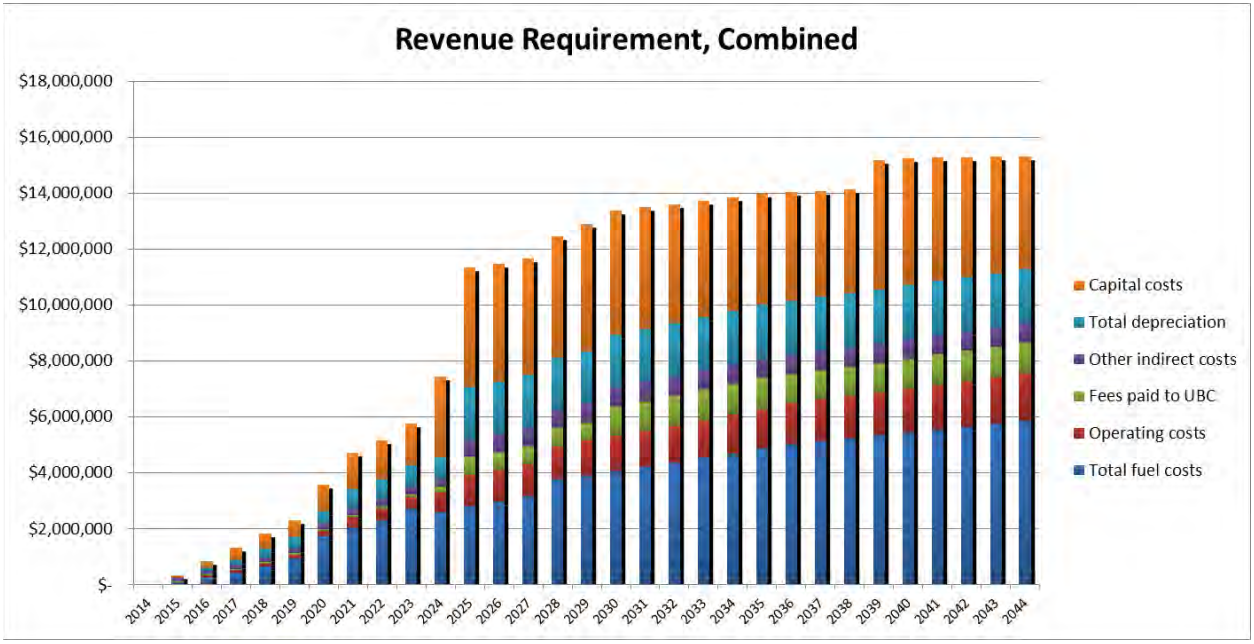
## 2.9 INDICATIVE REVENUE REQUIREMENTS

The forecasted annual revenue requirements until year 2022 (i.e., the year that the Wesbrook EC/ETS is in service), and thereafter as of 2024 (i.e., the year the CEP is constructed), and as of 2044 (i.e., the year in which UBC has an option to purchase the NDES from Corix under the terms of the Infrastructure Agreement), are shown below in *Table 20: Revenue Requirements (thousands, nominal $) and Figure 15: Revenue Requirement (nominal $)* on the following page.

**Table 20: Revenue Requirements (thousands, nominal $)**

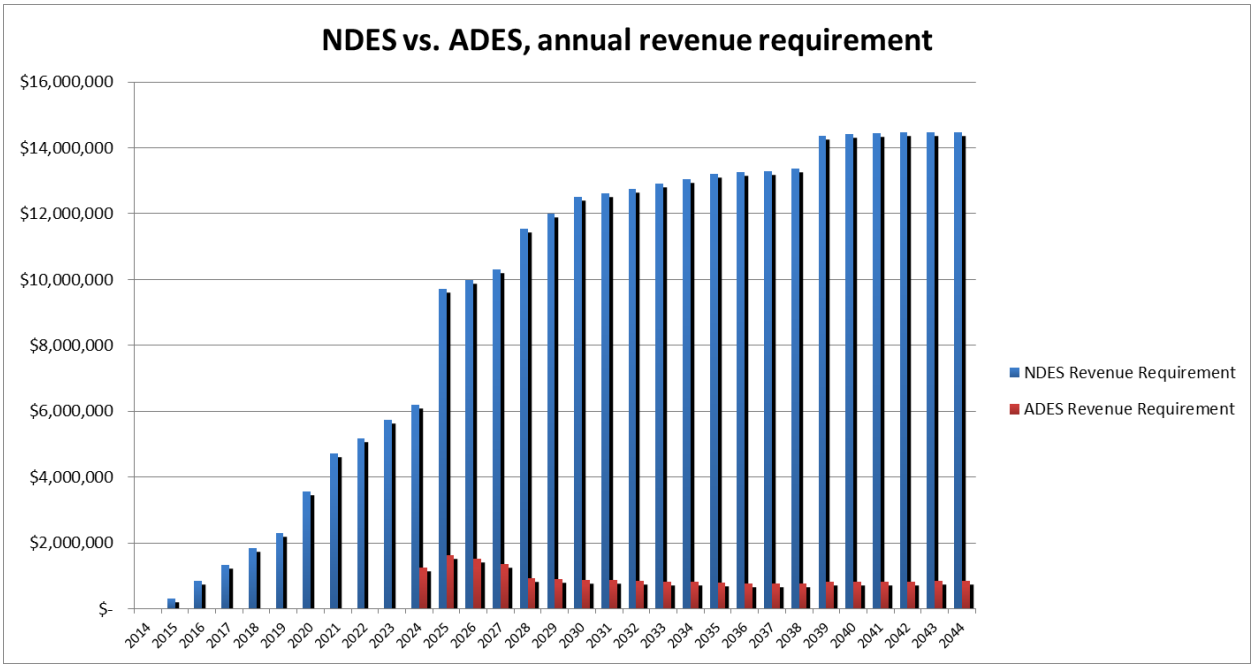
| Revenue requirements, indicative (thousands, nominal $) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Fuel costs | | | | | | | | | | |
| Renewable, waste heat (TRIUMF) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Heat purchased from UBC | 0 | 0 | 0 | 0 | 0 | 536 | 606 | 678 | 0 | 456 |
| Natural gas | 46 | 238 | 370 | 571 | 828 | 1,034 | 1,229 | 1,448 | 103 | 1,586 |
| Electricity | 7 | 10 | 10 | 10 | 11 | 16 | 18 | 18 | 2,494 | 3,822 |
| Carbon emissions rider | 6 | 32 | 47 | 70 | 100 | 123 | 145 | 168 | 0 | 0 |
| Total fuel costs | 59 | 279 | 427 | 651 | 939 | 1,710 | 1,997 | 2,312 | 2,598 | 5,863 |
| Operating costs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Indirect costs | 171 | 182 | 208 | 224 | 231 | 240 | 352 | 365 | 497 | 1,774 |
| Depreciation & amortization | 0 | 70 | 158 | 308 | 396 | 453 | 669 | 694 | 787 | 1,945 |
| Income tax | 0 | 0 | 0 | 0 | 9 | 10 | 27 | 41 | 0 | 1,135 |
| Interest | 28 | 94 | 159 | 196 | 214 | 342 | 466 | 491 | 1,040 | 1,055 |
| Return on equity | 49 | 165 | 280 | 345 | 376 | 600 | 819 | 862 | 1,826 | 1,852 |
| Total revenue requirement, indicative | 318 | 845 | 1,317 | 1,826 | 2,287 | 3,567 | 4,716 | 5,160 | 7,431 | 15,315 |

**Figure 15: Revenue Requirement (nominal $)**




Commencing in year 2024, it is assumed that UBC's Academic District Energy System (ADES) will begin to purchase energy that is produced by the CEP. At this point, certain capital and operating costs included in the annual revenue calculation will be allocated between the NDES and the ADES. Since this occurs after Phase 1, it does not directly impact the near-term NDES rate proposal expressed in this application, although it is discussed in general terms below and forms part of the long-term levelized cost comparisons. *Figure 16: NDES vs. ADES Annual Revenue Requirement (nominal $)* on the following page shows the allocated NDES and ADES annual revenue requirements.

**Figure 16: NDES vs. ADES Annual Revenue Requirement (nominal $)**




Apportionment of the annual revenue requirement between the NDES and the ADES for years 2024 and forward is based on a principled allocation of capital, fuel and operating costs. Costs that are solely attributable to the NDES are allocated solely to the NDES, while costs for shared plant (e.g., the TRIUMF waste heat recovery equipment and the ADES interconnection) are allocated based on relative use of energy between the NDES and ADES.

The apportionment of property, plant and equipment between the NDES and the ADES is shown in *Figure 17: Allocation of Property, Plant* and Equipment NBV between NDES and ADES below, and the apportionment of fuel costs based on annual relative energy load is shown in *Figure 18: NDES vs. ADES Share of Fuel Costs (%)* on the following page.

**Figure 17: Allocation of Property, Plant and Equipment NBV between NDES and ADES**

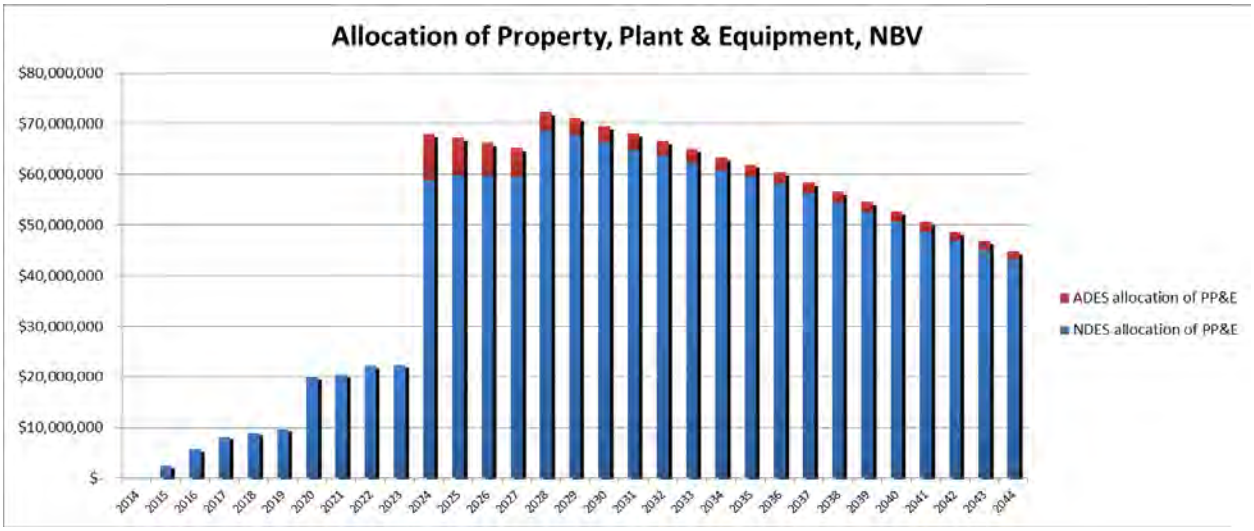
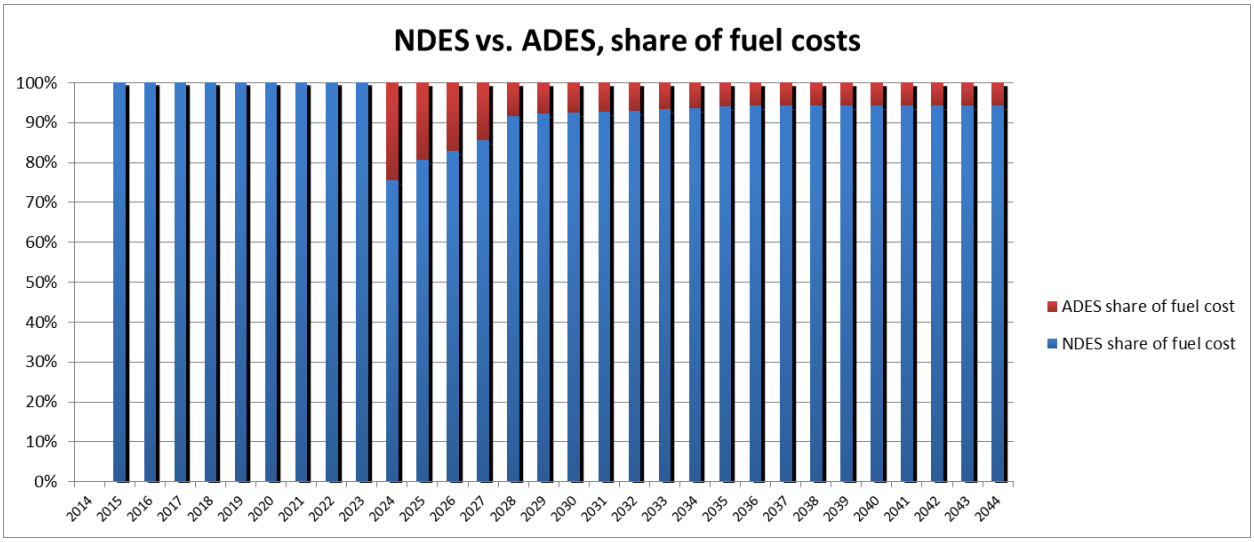


**Figure 18: NDES vs. ADES Share of Fuel Costs (%)**




## 2.10 LEVELIZED RATE PROPOSAL

The maximum sustained annual energy load occurs in project year 22 of the development (i.e., year 2036) at 102,835 MWh per annum. This is the result of 108 connections and 1,078,000 square meters of connected floor space. As shown previously in *Figure 9: Incremental Capital Costs (2014$)* and *Figure 10: Cumulative Capital Costs (2014$)* there is a very large, sudden increase in capital expenditures in project year 10 (i.e., year 2024) as a consequence of the CEP construction. To a lesser extent, because of a large increase in connected floor space in project year 6 that will result in a significant expansion of distribution piping, and the subsequent construction of the Wesbrook EC/ETS in project year 8, there is also a significant step-up in revenue requirement in project year 6 and then again in project year 10. As shown in *Figure 19: Annual Consumption (MWh)* the forecasted annual energy load in the Base Case lags these step changes in revenue requirement. The result is that annual revenue requirement per MWh of energy load increases suddenly in a manner that would be onerous to NDES customers, as shown in *Figure 20: NDES Annual Revenue Requirement per MWH (nominal $)*.

**Figure 19: Annual Consumption (MWh)**

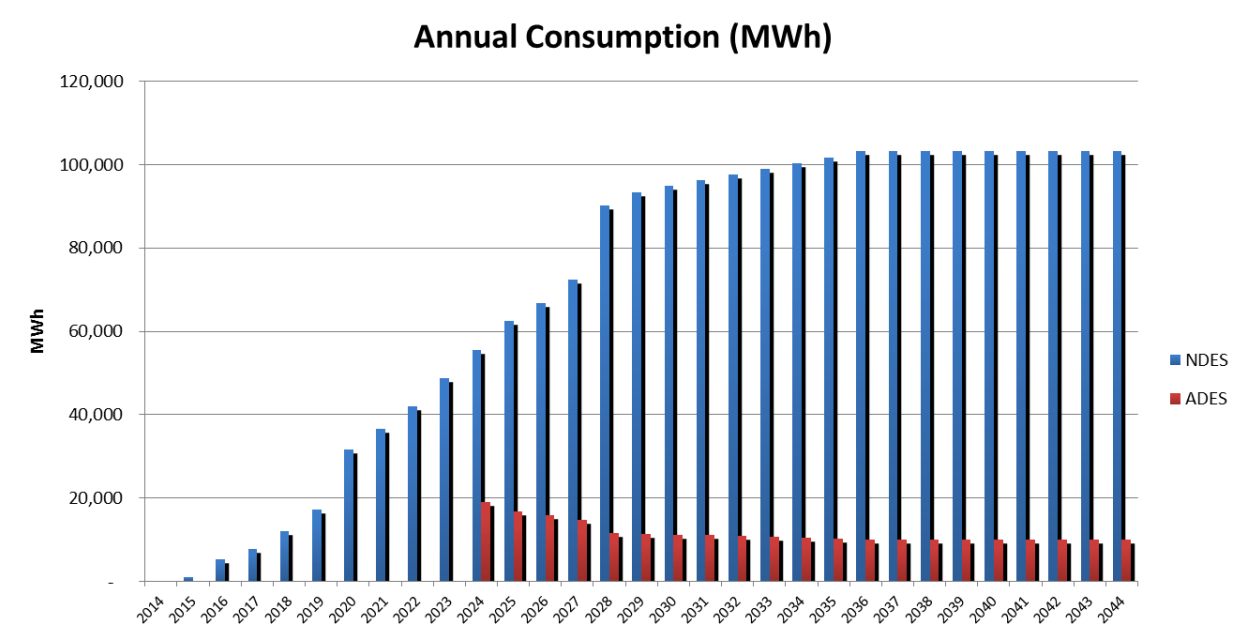
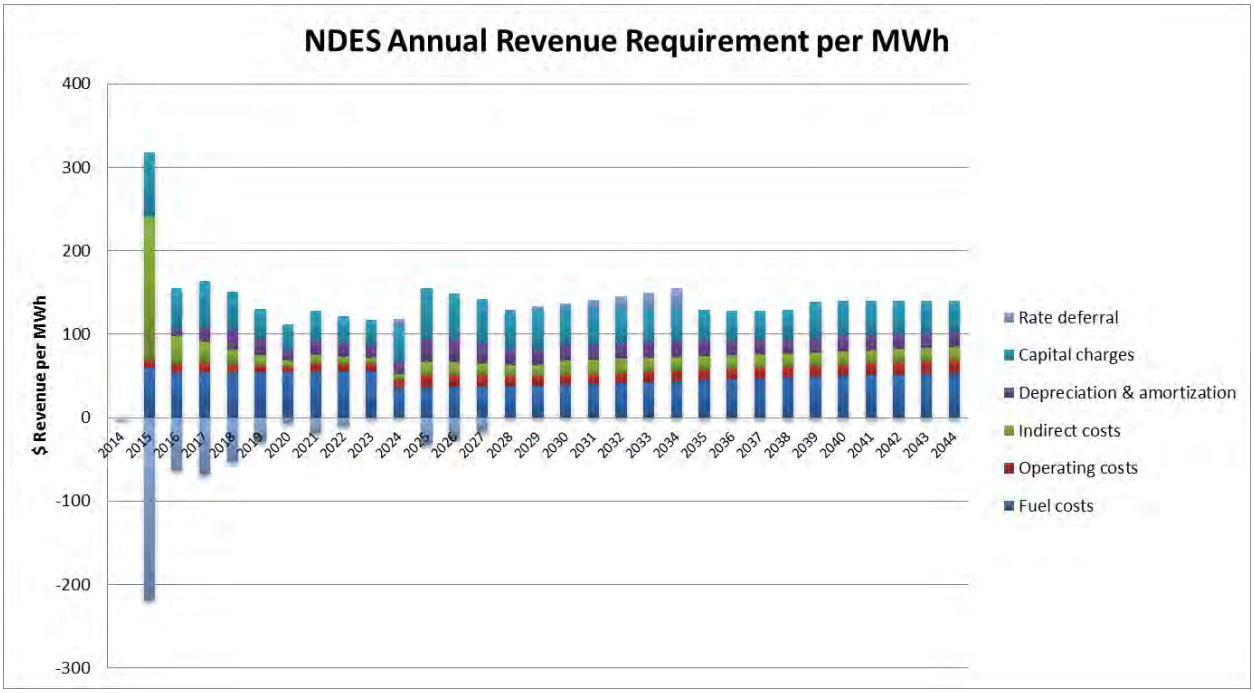



**Figure 20: NDES Annual Revenue Requirement per MWH (nominal $)**




Corix is proposing a levelized rate for the NDES, beginning upon initial energy load delivery and continuing until year 20, to allow recovery of accumulated deferred revenues without escalating annual rates much above CPI, and in line with other energy costs such as residential electricity. In the Base Case, the initial rate per MWh (i.e., including proportionally both fixed and variable components of annual revenue requirement) is $98.23 per MWh, escalating at 2.5% per annum. Including the remaining 10 years of the project term, the levelized cost on an NPV basis over 30 years is $133.28 per MWh. (For this purpose,

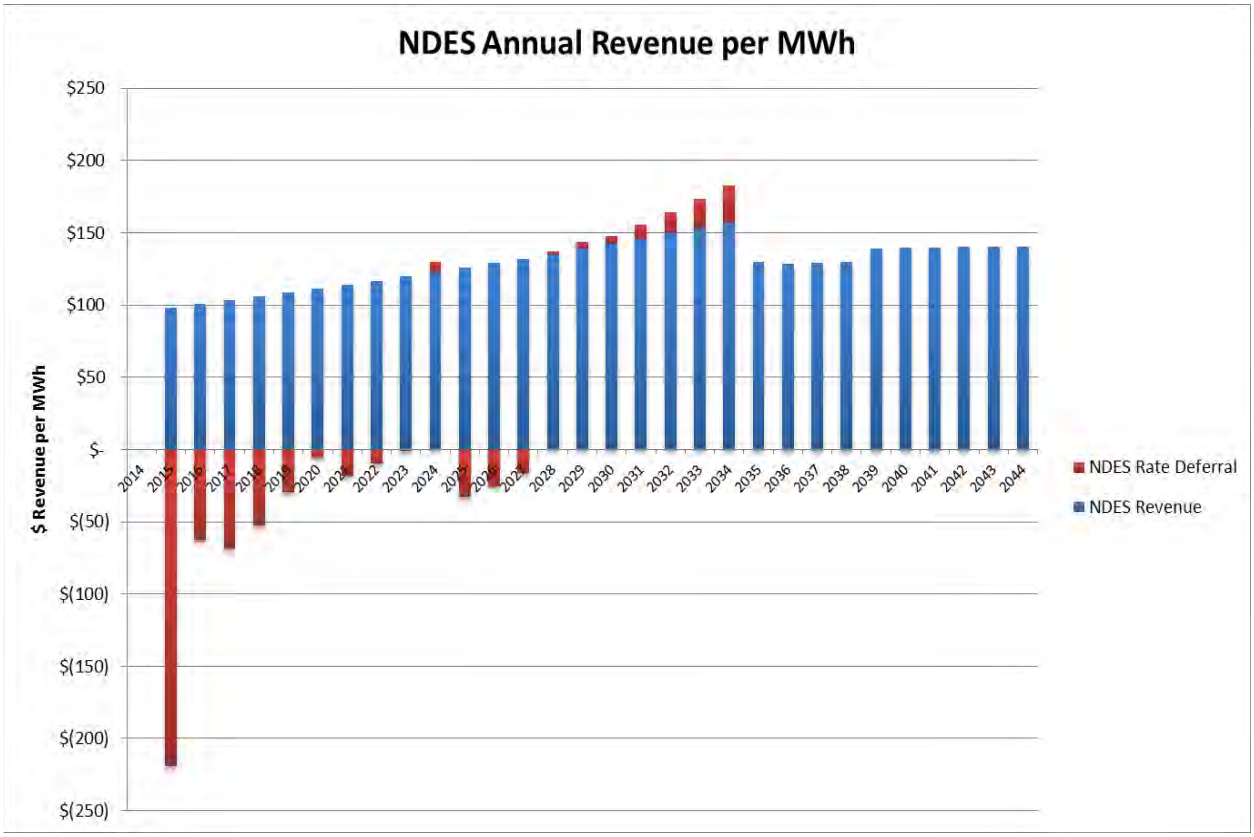
NPV is calculated using the after-tax WACC shown in *Table 19: Financing, Depreciation and Tax Assumptions)*. By comparison to a competitive carbon-neutral benchmark scenario assuming 100% residential electricity, the NDES levelized rate is about 10% lower and the initial rate is about equal, as shown below in *Table 21: NDES Rate Design*. Electricity is commonly cited by real estate developers as being a preferred heating alternative owing to the low cost of installing baseboard heaters.

**Table 21: NDES Rate Design**

| NDES rate design, indicative | | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| NDES | Levelized | | | | | | | | | | |
| Utility revenue (thousands, nominal $) | | 98 | 530 | 812 | 1,263 | 1,875 | 3,511 | 4,169 | 4,909 | 6,817 | 14,478 |
| Utility revenue per MWh ($) | $ 133.28 | $ 98.23 | $ 100.68 | $ 103.20 | $ 105.78 | $ 108.43 | $ 111.14 | $ 113.91 | $ 116.76 | $ 122.67 | $ 140.32 |
| Escalation | | | 2.50% | 2.50% | 2.50% | 2.50% | 2.50% | 2.50% | 2.50% | 2.50% | 0.06% |
| Square metres | | 16,295 | 58,889 | 84,916 | 125,677 | 179,197 | 322,194 | 372,209 | 426,662 | 561,943 | 1,078,680 |
| Annual basic charge per sq metre ($) | | $ 4.002 | $ 5.960 | $ 6.332 | $ 6.659 | $ 6.932 | $ 7.220 | $ 7.420 | $ 7.622 | $ 8.037 | $ 8.893 |
| Monthly basic charge per sq metre ($) | | $ 0.667 | $ 0.497 | $ 0.528 | $ 0.555 | $ 0.578 | $ 0.602 | $ 0.618 | $ 0.635 | $ 0.670 | $ 0.741 |
| Commodity charge per kWh ($) | | $ 0.033 | $ 0.034 | $ 0.035 | $ 0.036 | $ 0.037 | $ 0.038 | $ 0.038 | $ 0.039 | $ 0.041 | $ 0.047 |
| Carbon Neutral Benchmark, NDES | Levelized | | | | | | | | | | |
| Status quo electricity cost (thousands, nominal $) | | 99 | 550 | 855 | 1,344 | 2,005 | 3,736 | 4,414 | 5,172 | 7,112 | 19,624 |
| Status quo electric rates per MWh ($) | $ 147.69 | $ 98.65 | $ 104.57 | $ 108.75 | $ 112.56 | $ 115.93 | $ 118.25 | $ 120.62 | $ 123.03 | $ 128.00 | $ 190.20 |
| Escalation | | | 6.00% | 4.00% | 3.50% | 3.00% | 2.00% | 2.00% | 2.00% | 2.00% | 2.00% |

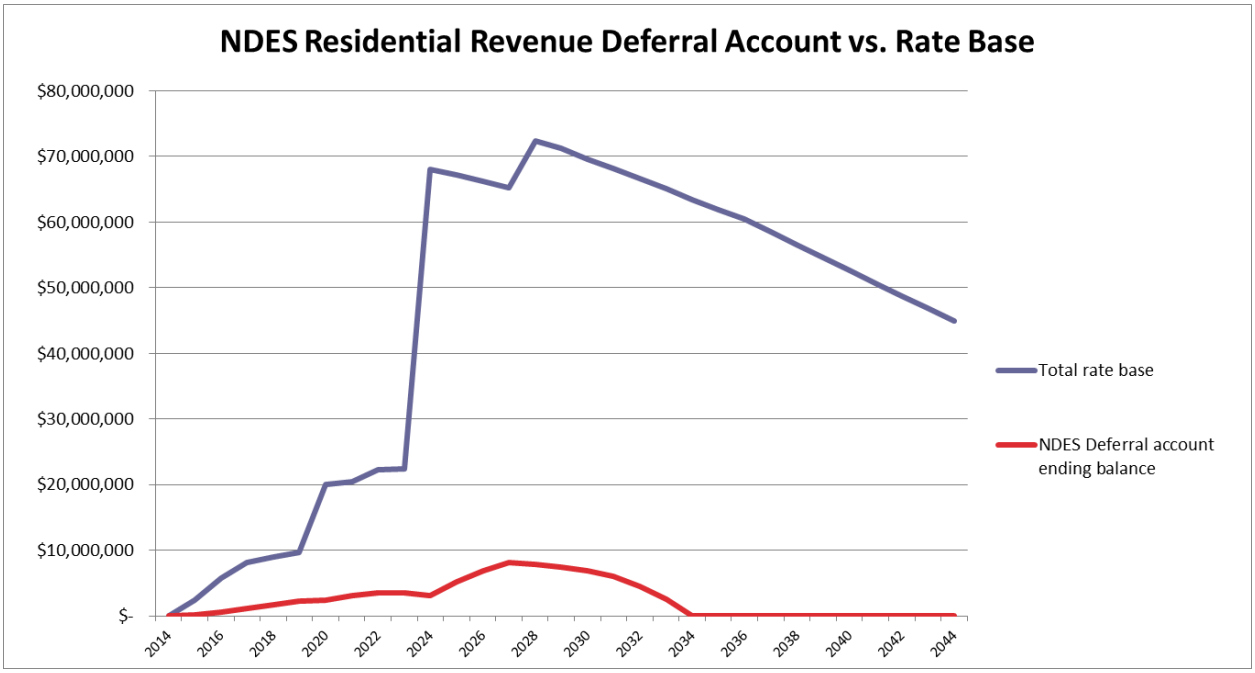
The levelized NDES rate is shown *in Figure 21: NDES Annual Rate per MWh (nominal $)* below, and the annual over or under recovery is shown as well. Note that the revenue deferral is bi-modal, with rates that under-recover annual revenue requirement in project years 1 to 5 and 11 to 13, while over-recovering in all other years up to project year 20.

**Figure 21: NDES Annual Rate per MWh (nominal $)**



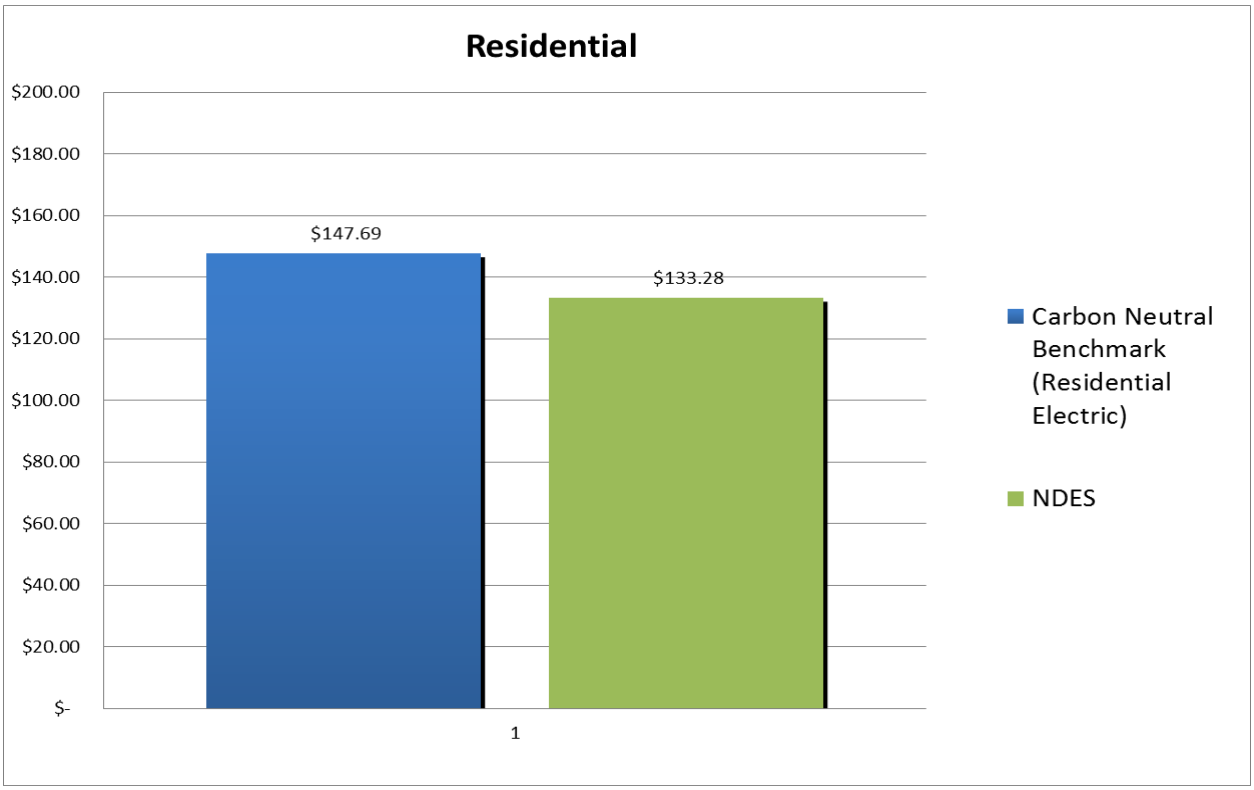
Corix proposes to accumulate the annual over or under recovery of revenue requirements in a Residential Revenue Deferral Account to be included in annual rate base, earning a return at the after-tax weighted average cost of capital. The Base Case intends that the Residential Revenue Deferral Account will be reduced to $nil by the end of 2034 (year 20), as shown in *Figure 22: NDES Residential Deferral Account Compared to Rate Base (nominal $) to Rate Base (nominal $)* below.

**Figure 22: NDES Residential Deferral Account Compared to Rate Base (nominal $) to Rate Base (nominal $)**



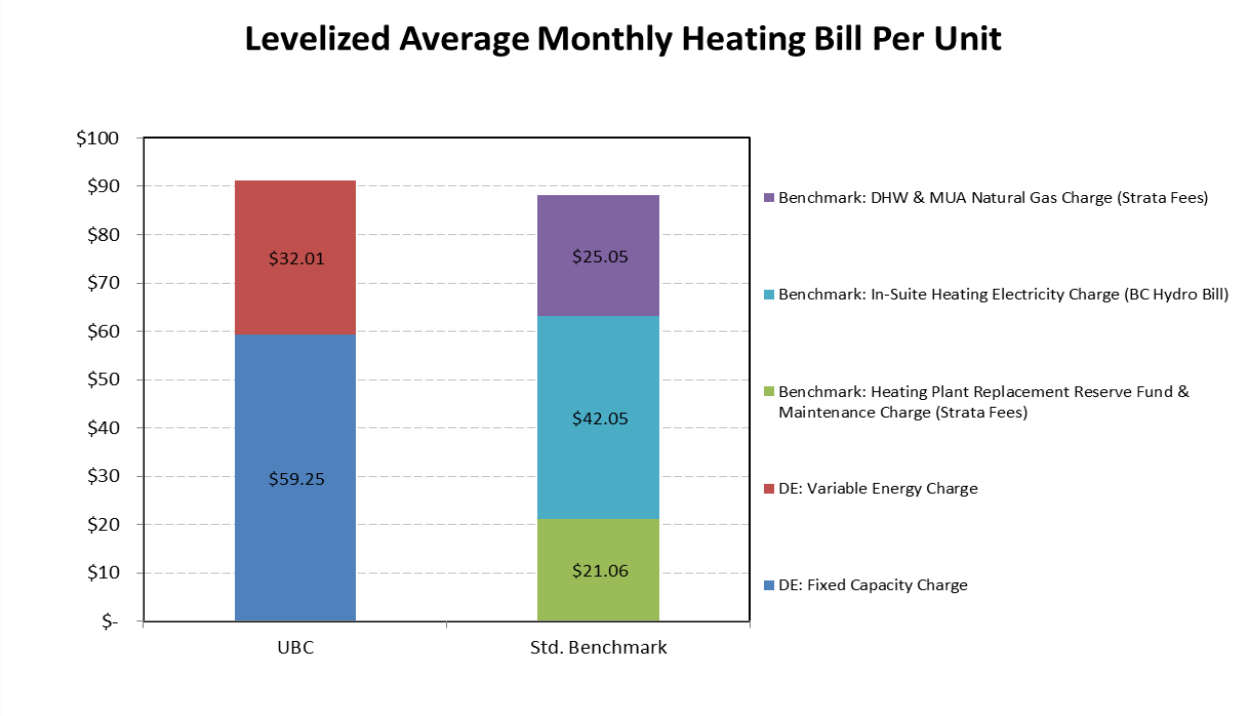

As stated above, the NDES competitive carbon neutral benchmark scenario reflects 100% electric energy, which is considered the cleanest energy source. On a net present value (NPV) basis, the NDES levelized cost over the 30-year forecast period is approximately $133, which is favourable to the competitive benchmark levelized cost of $147, as shown in *Figure 23: 30-year NPV Levelized NDES Coat vs. Competitive Carbon Neutral Benchmark* on the following page.

**Figure 23: 30-year NPV Levelized NDES Coat vs. Competitive Carbon Neutral Benchmark**




A comparison of the monthly heating bill for future residents is shown in *Figure 24: Monthly In-Suite Heating Bill.* The DE bill is on a suite level and is comprised of a capacity charge and variable charge. The standard benchmark bill consists of in-suite electric billed directly by BC Hydro, a heating plant reserve maintenance charge that would be in strata fees, plus the natural gas charge for domestic hot water and makeup air units, also billed in strata fees.

**Figure 24: Monthly In-Suite Heating Bill**




### 2.10.1 Fixed and Variable Charges

*Table 22: Residential Rate Design: Facts and Assumptions* below summarizes the principal facts and assumptions to determine the annual NDES rates per MWh and to allocate this rate between a fixed and variable (i.e., a Basic and Commodity) component.

**Table 22: Residential Rate Design: Facts and Assumptions**

| RESIDENTIAL RATE DESIGN, INDICATIVE | | |
|---|---|---|
| Annual escalation | | 2.50% |
| Rate per MWh (year 1) | $ | 98.23 |
| Levelized rate per MWh | $ | 133.28 |
| Basic charge % | | 66.3% |
| Commodity charge % | | 33.7% |
| Basic charge per sq. metre (partial year 1) | $ | 0.667 |
| Commodity charge per kWh (year 1) | $ | 0.033 |

Corix proposes an initial allocation of the annual NDES rate per MWh shown in *Table 22: Residential Rate Design: Facts and Assumptions* above based on 66.3% fixed charges and 33.7% variable charges. For this purpose, the fixed charges in the annual revenue requirement include all capital charges (i.e., depreciation, amortization, interest, return on equity and taxes) and all indirect charges (i.e., insurance, administration and overhead, land leases, water and sewer fees, UBC service levy, UBC franchise fee, and property tax) as well as operating costs (i.e., labour and maintenance). Variable charges include fuel. The 66.3% / 33.7% allocation is supported by the relative fixed versus variable charges included in the NDES portion of annual revenue requirement, calculated on an NPV basis over the 30-year forecast period. The calculated NPV proportions are 66.3% fixed and 33.7% variable. The annual rates, apportioned on a

monthly basis, will reflect a 66.3% basic charge expressed as an amount per square meter of floor space for each connected building, and a 33.7% commodity charge expressed as an amount per MWh of energy provided to the customer building.

### 2.10.2 Financial Projections

In addition to the forecast balance sheet presented in *Table 18: Balance Sheet (thousands, nominal $)*, and the forecast annual revenue requirement presented in *Table 20: Revenue Requirements (thousands, nominal $)* the forecast statement of earnings and the forecast cash flow statement are shown below in *Table 23: Statement of Earnings* and *Table 24: Cash Flow*.

**Table 23: Statement of Earnings**

| Earnings, indicative (thousands, nominal $) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Revenue | | | | | | | | | | |
| NDES basic charges | 65 | 351 | 538 | 837 | 1,242 | 2,326 | 2,762 | 3,252 | 4,516 | 9,592 |
| NDES commodity charges | 33 | 179 | 274 | 426 | 633 | 1,185 | 1,407 | 1,656 | 2,300 | 4,886 |
| Total residential charges | 98 | 530 | 812 | 1,263 | 1,875 | 3,511 | 4,169 | 4,909 | 6,817 | 14,478 |
| ADES basic charges | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 617 | 498 |
| ADES commodity charges | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 634 | 339 |
| Total campus charges | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,251 | 836 |
| Miscellaneous revenue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total revenue | 98 | 530 | 812 | 1,263 | 1,875 | 3,511 | 4,169 | 4,909 | 8,067 | 15,315 |
| Fuel | 59 | 279 | 427 | 651 | 939 | 1,710 | 1,997 | 2,312 | 2,598 | 5,863 |
| Operating costs | 10 | 55 | 85 | 102 | 122 | 211 | 384 | 396 | 684 | 1,691 |
| Indirect costs | 171 | 182 | 208 | 224 | 231 | 240 | 352 | 365 | 497 | 1,774 |
| Total operating expenses | 241 | 516 | 720 | 976 | 1,292 | 2,162 | 2,734 | 3,072 | 3,779 | 9,328 |
| Operating cash flow (EBITDA) | (143) | 14 | 92 | 287 | 583 | 1,349 | 1,435 | 1,836 | 4,288 | 5,986 |
| Depreciation & amortization | 0 | 70 | 158 | 308 | 396 | 453 | 669 | 694 | 787 | 1,945 |
| Interest (including deferral interest) | 28 | 99 | 172 | 222 | 254 | 393 | 522 | 562 | 1,122 | 1,055 |
| Earnings before tax | (171) | (155) | (238) | (243) | (67) | 503 | 243 | 580 | 2,380 | 2,987 |
| Income tax | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,135 |
| Earnings before deferral | (171) | (155) | (238) | (243) | (67) | 503 | 243 | 580 | 2,380 | 1,852 |
| Revenue deficiency deferral | 220 | 330 | 540 | 632 | 513 | 188 | 674 | 407 | (410) | 0 |
| Net earnings, indicative | 49 | 174 | 302 | 389 | 446 | 691 | 917 | 987 | 1,970 | 1,852 |
| ROE | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% | 9.50% |

**Table 24: Cash Flow**

| Cash flow (thousands, nominal $) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2024 | 2044 |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 30 |
| Operations | | | | | | | | | | |
| Net earnings | 49 | 174 | 302 | 389 | 446 | 691 | 917 | 987 | 1,970 | 1,852 |
| Depreciation & amortization | 0 | 70 | 158 | 308 | 396 | 453 | 669 | 694 | 787 | 1,945 |
| Carbon emissions rider collected (applied) | 6 | 32 | 47 | 70 | 100 | 123 | 145 | 168 | (889) | 0 |
| Revenue deficiency deferral | (220) | (330) | (540) | (632) | (513) | (188) | (674) | (407) | 410 | (0) |
| Cash from operations | (165) | (54) | (34) | 135 | 429 | 1,080 | 1,057 | 1,442 | 2,277 | 3,797 |
| Investments | | | | | | | | | | |
| Property, plant & equipment | (1,560) | (3,183) | (1,267) | (381) | (682) | (10,564) | (1,097) | (2,413) | (46,397) | 0 |
| Project development costs | (880) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lowrise connection credit account | 0 | (190) | (1,261) | (783) | (413) | (289) | 0 | 0 | 0 | 0 |
| Cash used for investments | (2,440) | (3,373) | (2,528) | (1,164) | (1,094) | (10,854) | (1,097) | (2,413) | (46,397) | 0 |
| Financing | | | | | | | | | | |
| Debt issue (repayment) | 1,526 | 2,070 | 1,646 | 815 | 639 | 6,017 | 550 | 1,126 | 26,502 | (1,118) |
| Equity issues | 1,079 | 1,356 | 915 | 214 | 26 | 3,757 | 0 | 0 | 17,618 | 0 |
| Equity distributions | 0 | 0 | 0 | 0 | 0 | 0 | (510) | (155) | 0 | (2,678) |
| Cash from financing | 2,605 | 3,427 | 2,561 | 1,029 | 665 | 9,774 | 40 | 971 | 44,120 | (3,797) |
| Net cash flow | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

### 2.10.3 Sensitivity Analysis

Although there are a number of variables that will have an unknown impact on future rates, the primary categories are capital cost, energy demand, inflation, and fuel costs. *Table 25: Sensitivities* below shows the impact on the Base Case levelized annual rate per MWh of variations in these keys categories. The results shown should be considered in light of the likelihood that there would be a corollary impact on the competitive benchmark case.

**Table 25: Sensitivities**

| SENSITIVITY, NDES LEVELIZED REVENUE | LOW | BASE | HIGH |
|---|---|---|---|
| Change in capital costs, –10% and +10% | $ 128 | $ 133 | $ 139 |
| Change in energy demand, +10% and –10% | $ 122 | $ 133 | $ 147 |
| Change in gas commodity$/GJ cost, –10% and +10% | $ 131 | $ 133 | $ 135 |
| Change in electricity $/KWh cost, –10% and +10% | $ 131 | $ 133 | $ 136 |
| Change in CPI, –1% and +1% | $ 124 | $ 133 | $ 144 |

## 2.11 PROJECT ALTERNATIVES COMPARISON

In 2011, UBC conducted a pre-feasibility study of a district energy system for Wesbrook Place. The study evaluated and screened Alternate Energy Sources to identify the most viable options for evaluation. The four energy supply options evaluated were:

- Connection to the future campus medium temperature hot water system
- Heat capture from the TRIUMF cooling facilities
- Biomass combustion from a facility located on South Campus
- Sewer heat capture from South Campus Sewer Lines

The pre-feasibility study concluded that there are several technically feasible Alternate Energy Sources, that waste heat captured from TRIUMF and connection to the ADES are preferred options, and the study recommended a full feasibility study to further refine the opportunity. Both studies are attached in Appendix Two, which details the justification for the project alternatives.

# 3 CONSULTATION

## 3.1 FIRST NATIONS CONSULTATION

Block F is a parcel of land owned by the Musqueam First Nations, and was considered in various scenarios in the feasibility study and due diligence process as a proposed future Development Area for the NDES. First Nations have been welcomed in the public consultation process. On September 3, 2013, Corix's Chairman of the Board met with the Musqueam Chief Nolan Charles. Subsequently Corix's Chief Operating Officer, Eric Van Roon met with Chief Nolan again on September 12, 2013. Development plans, including the prospect of a DES connection to Block F, were shared with the Musqueam. Chief Nolan indicated that the community is interested in the project and will review with key staff as the project moves forward. Chief Nolan and the Musqueam were invited to attend a stakeholder meeting on June 24, 2014 and will continue to be consulted during all phases of the project. The next meeting with the community is being scheduled for the fall with Corix's First Nations consultation team, Glen Ohs and Owen Matheson.

## 3.2 PUBLIC CONSULTATION

Prior to the selection of Corix as UBC's NDES partner, UBC engaged with a number of parties that were considered important stakeholders. These included the Musqueam First Nation, University Neighbourhoods Association, TRIUMF and the UBC Board of Governors.

- **Musqueam** – The Musqueam Capital Corporation were presented with the results of the Pre-Feasibility Study and requested that the proposed Musqueam Block F development be included in the NDES Feasibility Study.
- **University Neighbourhoods Association (UNA)** – The UNA and UBC jointly funded the development of a Community Energy and Emissions Plan (CEEP). Development of this plan included public consultation with the UNA community. The plan recommended a low carbon district energy system servicing all new residential buildings starting 2015. In 2013, the plan was presented to the UNA Board of Directors and a motion to implement the plan was approved. The results of the NDES Pre-Feasibility Study and Feasibility Studies were presented to the Operations and Sustainability Committee of the UNA.
- **TRIUMF** – TRIUMF were presented with the results of the NDES Pre-Feasibility Study and Feasibility Studies. In 2011, the former Director of TRIUMF, Nigel Lockyer, signed a Letter of Intent (LOI) between UBC and TRIUMF, agreeing that the NDES could capture and use the waste heat generated by TRIUMF operations. The LOI was extended by TRIUMF in 2014. TRIUMF carried out a separate Feasibility Study that evaluated how much waste heat could be made available to the NDES.
- **UBC Board of Governors** – The Board of Governors were presented with the results of the NDES Pre-Feasibility Study and Feasibility Studies and Due Diligence. In April 2014, the Board of Governors gave approval for staff to proceed with implementation of the NDES, including executing definitive agreements and supporting the application by Corix for a CPCN.

After Corix was selected as UBC's NDES partner, Corix and UBC included a stakeholder and public consultation as part of the project, understanding the importance of keeping the public informed about the progress and to enable the public to provide input or raise potential concerns before the project implementation. The public consultation is a vital component of the entire UBC NDES development, and UBC and Corix encouraged the residents and other stakeholders through open house meetings, small stakeholder meetings and online to provide their input or seek information about the NDES project.

Corix and UBC held two open-house sessions to address various important project milestones. Key stakeholders were identified in order to deliver the information presented to a broad audience and provide

communication tools to assist with information distribution to their networks. They included students, campus residents and student residences. Two stakeholder meetings were also held to provide information and address concerns of direct stakeholders, including developers and various University associations.

Notification of the events was provided through print advertisements and online channels, including the Vancouver Courier, the Ubyssey, the Campus Resident, myuna and UBC Properties Trust announcements, campus digital signage and NDES pages on the Campus + Community Planning (C+CP) website.

Samples and copies of the material related to the public consultation, including a stakeholder notification list, are provided in Appendix Three.

The following Public Meetings were organized by Corix and UBC:

1. November 2013 – the first public consultation was an Open House that was organized upon commencement of the feasibility study. The purpose of the first meeting was to provide the public with information about the project, feasibility study and future implementation process, and the NDES concept and its benefits.

   C+CP provided notification of the public consultation period to over **38,200** contacts through advertising, email, in-person meetings and stakeholder outreach. As a result of the outreach activities, there were:

   - A total of **12** people attended the first Open House held Tuesday, November 26, 2013.
   - **47** unique page views to the Neighbourhood District Energy System pages on C+CP website

2. June 2014 - a second public consultation focused on the next steps of the NDES development and impacts to the community, environment and stakeholders. A stakeholder meeting was held with members of the UBC community, which included an overview and status update of the project presented by UBC and Corix. The material presented at the stakeholder meeting was the same information provided in the second Open House display boards, and stakeholders were also given a handout with the same details. During the stakeholder meeting, there was an open Q+A/discussion session and attendees were given a feedback form and invited to the Open House. In addition to the stakeholder meeting, a public Open House was held. C+CP provided notification of this public consultation opportunity to **over 40,414** contacts through advertising and outreach activities. As a result of the outreach activities:

   - **9** invitees attended the stakeholder meeting held Tuesday, June 24, 2014.
   - A total of **15** people attended the second Open House held Wednesday, June 25, 2014.
   - **59** unique page views to the Neighbourhood District Energy System pages on C+CP website
   - **130** unique page views to the C+CP event calendar.

The information material was provided via presentation boards and hand-out brochures. As part of the online consultation, the C+CP website provided the same information that was available during the Public Open Houses. The web content was posted to the C+CP website, and the link to the online questionnaire was also posted to the Public Consultation page. The online questionnaire included links to the relevant supporting information on the Campus + Community Planning website. The online questionnaire included the same set of questions as those asked in the feedback forms provided at the Public Open House.

In terms of the material provided during the consultation phase, the vast majority of respondents felt the information gave them a better understanding of the NDES, the project goals, how district energy systems work and the associated benefits. The presentation material and information provided by Corix and UBC representatives were positively received. Attendees expressed their interest to learn more about the project as it progresses.

There was a request by a small number of respondents for more information on alternative sources and a business model, with the same respondents expressing concern for consideration of the future.

During the second consultation phase, the information most requested from the feedback forms was the costs of the project and comparisons to other systems, such as electric, ambient and solar and some respondents expressed concern about mandatory connection of future buildings to the NDES. Many respondents recognized the NDES as a tangible solution to reducing greenhouse gas emissions and meeting sustainability goals. Conversely, the same number of participants also responded that the benefits were unclear.

There was no unanimous agreement from participants on the appearance of the TEC, though the marginal preference was to blend it into the natural landscape.

Key themes from the stakeholder meeting include location of the TEC's and permanent facility, the opportunity for sub-metering, rate structure and comparison to the market, existing building compatibility for tie-in, and timing of connection to TRIUMF.

Consultation reports for both events can be found in Appendix Four.

Corix and UBC responded to specific questions and concerns raised in an email received from the University Neighbourhood Association, and also attended their board meeting to review the material presented during the latest consultation phase and subsequent Consultation Summary Report, and address any additional questions. This information was positively received.

On July 8, 2014, Corix, with UBC, gave a presentation to the University Neighbourhood Association Board Meeting outlining the NDES project. That presentation can be found in Appendix Five.

# 4 PROJECT DESCRIPTION

## 4.1 OVERALL PROJECT PLAN

This section provides a more detailed description of the NDES including an overview of the Project Plan, with a focus on Phase 1 for which this application is requesting approval.

Development of the NDES will be phased and is designed to coincide with growth of the new developments at UBC. The NDES Project Plan proposes that the NDES approach be implemented in two phases, with Phase 1 being a temporary natural gas solution serving early loads and Phase 2 being the implementation of the Alternate Energy Source, which is currently contemplated to be waste heat recovery from TRIUMF. The NDES will provide heating and domestic hot water to buildings located within the Development Areas at UBC.

Corix is applying for Phase 1 of the NDES which will provide DES service to new buildings in Wesbrook Place that are scheduled for completion between 2014 and 2023 and for Acadia East and Block F buildings to be built between 2020 and 2023. Thermal energy for Wesbrook Place will be provided by two natural gas temporary energy centres (TEC) located within Wesbrook Place. In 2022, it is anticipate that the boiler portion of the Wesbrook EC/ETS will be installed. The Wesbrook EC/ETS, which is a component of the permanent system, will provide an addition 5MW of thermal energy necessary prior to TRIUMF installation. Acadia East and Block F loads will be fed from the ADES through a direct connection to the ADES peaking plant.

Phase 2 is currently contemplated to occur in 2024 when thermal load can support the installation of the alternate energy source, which will be the utilization of waste heat from TRIUMF cooling towers. UBC has a Letter of Intent (LOI) with TRIUMF supporting the project.

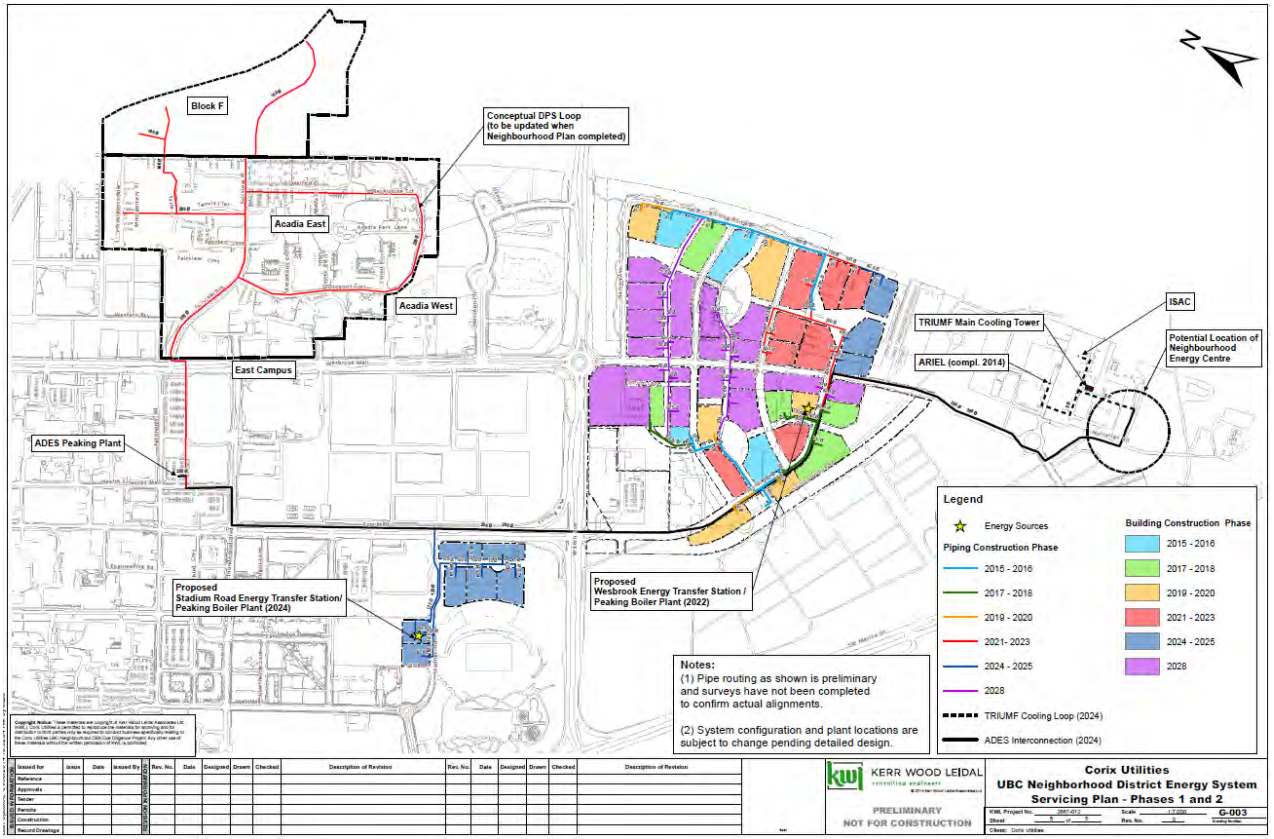
The trigger to initiate Phase 2 of the NDES is either or both of the following events:

- the interconnection of the Wesbrook portion of the NDES and the ADES; and/or
- the connection of a permanent CEP to an Alternate Energy Source

Phase 2 of the NDES Project Plan outlines the interconnection of Wesbrook Place, Stadium Road, the ADES and Acadia East/Block F with a main trunk supply-return pipeline. A permanent Central Energy Plant (CEP) will be constructed to the south of Wesbrook Place, as close as possible to the TRIUMF research facility.

*Figure 25: Project Plan Phasing* below summarizes both phases of the Project Plan. This diagram can also be found as Drawing G003 in Appendix One.

**Figure 25: Project Plan Phasing**




## 4.2 PHASE 1 PROJECT PLAN

Phase 1 involves the construction of two separate district heating loops, one for Wesbrook Place and one for Acadia East and Block F, with further extensions as required. The Wesbrook Place loop would be fed initially by two approximately 6.0 MW temporary gas boiler plants, supplemented with the installation of the Wesbrook EC/ETS (1- 5 MW boiler) in Wesbrook Place in 2022. The Acadia East/Block F loop would be fed from the ADES through a direct connection to the ADES peaking plant. Phase 1 includes each loop's energy supply capacity or connection, associated distribution piping and energy transfer stations.

The distribution piping system (DPS) is comprised of:

1. Main Trunk Distribution Pipes;
2. Branch Connections.

*Table 26: System Components Summary and Ownership* below summarizes the system components and the party responsible for the ownership, installation, operation and maintenance.

**Table 26: System Components Summary and Ownership**

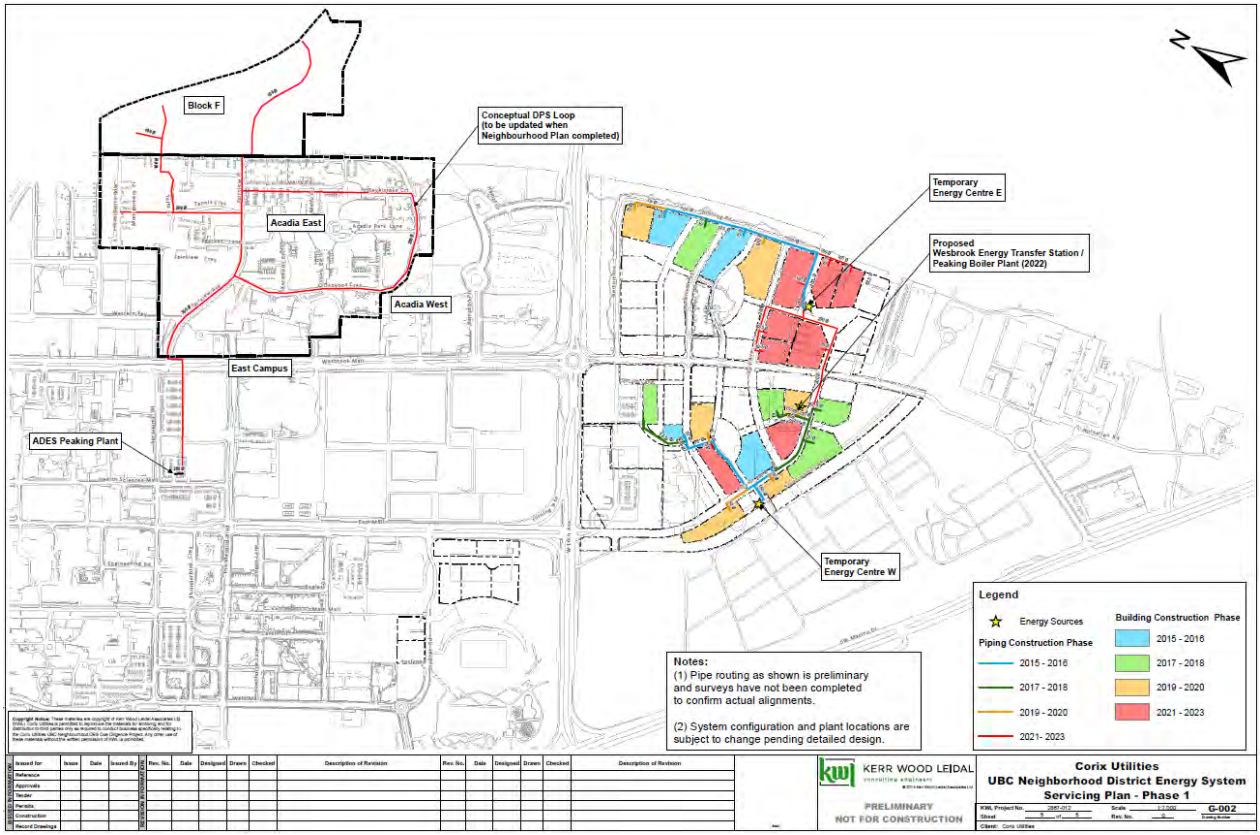
| System Component | Ownership |
|---|---|
| Temporary Energy Centres | NDES |
| Main trunk distribution lines | NDES |
| Permanent Gas Fired Plant | NDES |

| System Component | Ownership |
|---|---|
| Branch Connections | NDES |
| Energy Transfer Stations | NDES |
| Internal energy distribution systems within buildings | Building Owner |

### 4.2.1 Phase 1 Phasing

*Figure 26: Phase 1 Project Plan Summary* summarizes Phase 1 of the Project Plan. This figure can also be found as Drawing G002 in Appendix One.

**Figure 26: Phase 1 Project Plan Summary**




The Phase 1 TECs are labelled TEC-W and TEC-E. TEC-W will be the first natural gas plant and will be constructed to deliver energy to the first building (Prodigy) on the west side of Wesbrook Place in 2015. TEC-E will be constructed to serve new buildings beginning in 2016. Between 2016 and 2020, the two TECs will serve ongoing development as itemized in *Table 4: Expected Load Forecast Summary* (Load forecast summary and energy centre details). In 2020, the first buildings in the Acadia East and Block F development will be connected as NDES customers, however, until the CEP is built and the DPS extension to the ADES is made in 2024, it is contemplated that the NDES will purchase energy from the UBC ADES to serve the buildings in Acadia East and Block F.

In 2022, the peak demand in Wesbrook Place is forecasted to exceed the capacity of TEC-W and TEC-E. At this time, the two temporary energy systems will be connected together through an extension of the DPS, and a portion of the Wesbrook EC/ETS will come into service. Ultimately it is anticipated that the Wesbrook EC/ETS will comprise two 5 MW boilers which will be installed within the building on Lot #27. In 2022, only

1-5MW boiler will be installed to provide additional thermal energy for remaining Wesbrook Place development from 2021 to 2024 (the second boiler will be installed in Phase 2 in 2028). Subsequent to implementation of the alternate energy source (likely TRIUMF), the Wesbrook EC/ETS will have two functions: 1) transfer heat from the main transmission lines between permanent CEP and the ADES to the neighbourhoods, and 2) provide local peaking to the neighbourhood. In 2024, the ETS for the Wesbrook EC/ETS will be installed.

## 4.3 PHASE 1 SYSTEM COMPONENTS

### 4.3.1 Temporary Energy Centres

The TEC concept is shown on Drawing G002, and general arrangement drawings for the TEC-E and TEC-W locations are shown on Drawings C101 and C102, all in Appendix One. Each TEC consists of two 2.9 MW[11] non-condensing boilers housed within a standard 53 foot shipping container. In addition to the boilers, the TEC will house circulation pumps, an expansion tank and all necessary communications and controls.

The TECs will require a concrete pad for seismic anchoring and electrical and gas connections.

The temporary energy centre design is based on the following criteria:

- Peak heating loads of 4 MW in both the eastern and western branches of the Phase 1 NDES
- Required turndown ratio of 10:1 to meet base load conditions
- Minimum of 70% of peak load redundancy
- Containerized plant to be assembled off-site
- Supply temperatures of up to 90$^{o}$C
- Return temperatures as low as 50$^{o}$C
- Thermal efficiency of 84% and
- Maximum fireside heating surface area of less than 150 m$^2$ to allow for unsupervised operation.

### 4.3.2 Distribution Piping

Phase 1 of the NDES distribution piping system (DPS) is designed to accommodate the higher flow rates present at full build out demand of Wesbrook Place, including the connection of existing buildings later in Phase 2. However, the construction of the DPS will be phased to match the development in Wesbrook Place, Acadia East and Block F such that the DPS will reach new buildings just as they are reaching completion.

The DPS design is based on the following criteria:

- DPS routing is designed to follow roadways wherever possible and to avoid Wesbrook Mall, which has many existing underground utilities,
- Pipes are sized to meet projected diversified peak heating demand in the Project Plan with a supply temperature of 90$^{o}$C and a return temperature of 50$^{o}$C,
- During off-peak periods, the outdoor air temperature reset schedule will adjust the supply temperature and flow rate of the NDES to maximize overall system efficiency,
- Pipe sizes are based on a maximum head loss of 2.05 m/100 m and a maximum flow velocity of 3.4 m/s, and

[11] The current concept is based on a boiler selection at 2.9 MW, but this may vary (3 MW to 3.5 MW) depending upon final equipment selections.

- The DPS design pressure is 16 bar for Series 1 Logstor pre-insulated piping and components.

### 4.3.3 Energy Transfer Stations

Energy transfer stations in Phase 1 NDES will be designed based on the concept shown on Drawing M07 in Appendix Six. Generally, there will be one ETS per building consisting of one space heating heat exchanger and one domestic hot water heat exchanger, however the exact number of heat exchangers will depend on the individual building load.

The ETS design will be based on the following criteria:

- Building heating systems return temperature of 45°C to enable low return temperatures to the energy centre. This is an important design requirement that must be met in Phase 1 so that buildings provide suitable return temperatures for the heat pumps in the CEP in Phase 2.
- Domestic hot water may be cascaded with the return on the space heating heat exchanger in buildings if needed to meet required return temperatures to the energy centre. The design of the ETS will be done on a building by building basis, including whether or not to use cascading.

Additional considerations for designing buildings to be connected to the NDES are provided as part of the DES Compatibility Guide in Appendix Seven.

### 4.3.4 Nodal Energy Centre/Energy Transfer Stations

The energy centres/energy transfer stations (EC/ETS) at Wesbrook Place and Stadium Road perform two functions; they transfer heat from the main transmission lines between the CEP and the ADES to the neighbourhoods, and they provide local peaking to the neighbourhoods.

Between 2022 and 2024, the nodal Wesbrook EC/ETS peaking plant provides addition thermal energy to the Wesbrook DES loop via one 5 MW natural gas boilers. This boiler is required to meet the heat demand in the Wesbrook Place neighbourhood, in excess of what the two temporary energy centres are able to provide. A second 5 MW natural gas boiler will be added in Phase 2 to serve additional loads.

In 2024 it is planned that the CEP at TRIUMF will be commissioned and the Wesbrook EC/ETS will begin to function also as an ETS, transferring base load alternative energy from the CEP to Wesbrook Place via the heat exchangers in the nodal ETS. The two 5 MW natural gas boilers in the Wesbrook EC/ETS will continue to provide peaking and backup energy to the Wesbrook Place neighbourhood. While the primary function of the heat exchangers in the Wesbrook EC/ETS is to transfer heat from the main transmission line and the neighbourhood, they also serve to isolate the Wesbrook peaking boilers from the CEP boilers, thus reducing the plant supervision requirements of the boilers in the Wesbrook EC/ETS.

The design of the nodal Wesbrook EC/ETS is based on the following criteria at full build-out, in Phase 2:

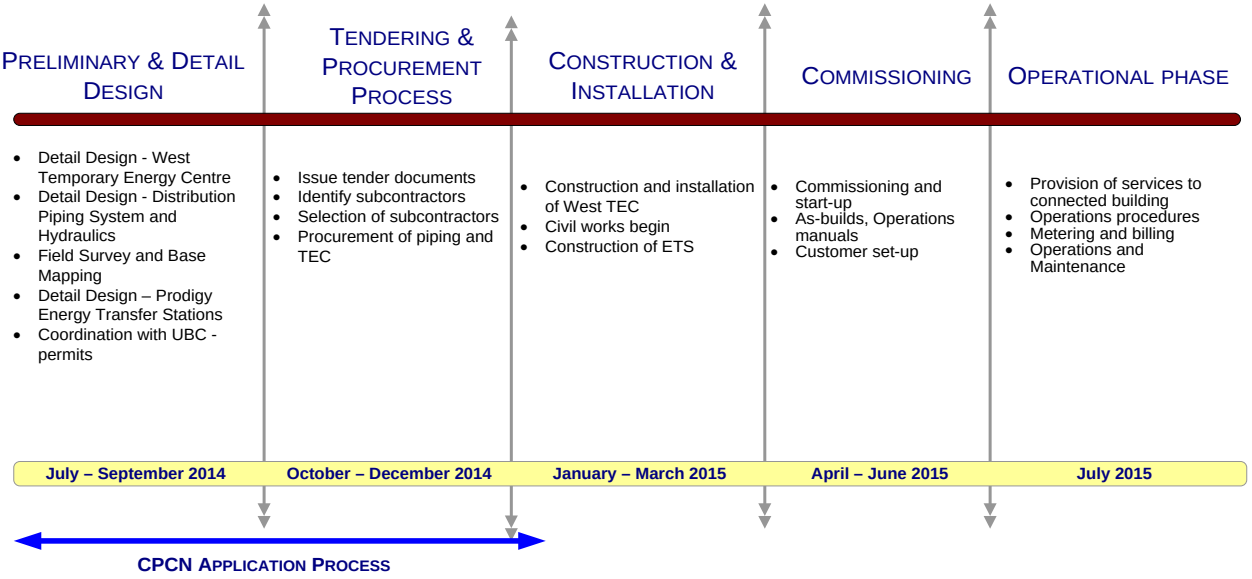
- Heat Exchanger Capacity of 15.8 MW
- Gas Boiler capacity of 10 MW
- Wesbrook peaking boiler capacity combined with CEP boiler capacity to provide 70% of Wesbrook peak demand or 15.8 MW at 90°C
- Wesbrook DPS pumps selected to provide peak heating flows to the neighbourhood and

In Phase 2, a similar nodal EC/ETS will be constructed for the Stadium Road neighbourhood.

## 4.4 IMPLEMENTATION SCHEDULE

The implementation schedule for the project including design and engineering, and construction and commissioning of the TEC-W, DPS and Prodigy ETS through to December 2015 is provided in Appendix Eight. *Figure 27: Initial Development Schedule* below shows the estimated timing, through the summer of 2015, of the next steps required in developing the NDES, including the CPCN filing and review process.

**Figure 27: Initial Development Schedule**




### 4.4.1 Construction Issues and Public Works

The construction of the TEC-W will have a minimal impact on public works as it will be constructed on the unused South Campus Road right-of-way. The DPS will be installed in existing roadways and the neighbourhood 'Green Streets', and leasehold parcels will be avoided. Surveys will be completed prior to design to identify the specific pipe alignments and avoid conflicts with existing and future utilities. Corix will coordinate with UBC Utilities, BC Hydro and FortisBC if there are any requirements for relocating existing utilities to accommodate the DPS.

Connection branch lines will extend to the buildings along the right-of-way frontage. The connections will be installed concurrently with other service connection for the new buildings. The DPS will be installed on a "just in time" basis and in smaller sections that will be completed in a timely manner and following UBC's construction requirements. DPS connections will be coordinated with the building developers to ensure the installation does not conflict with other building services.

## 4.5 HUMAN RESOURCES REQUIREMENT

The project's work force requirement varies for each stage of the project implementation. The project will have a dedicated project manager who will be responsible for overall project coordination, budget functions and scheduling, as well as liaison with the subcontractors, client, developers and other project stakeholders to ensure the successful project delivery. An assigned project sponsor will provide strategic direction and ensure that the project manager has the necessary resources to execute the project efficiently and effectively.

Corix will subcontract the design and engineering of the NDES components to KWL, the company that will also provide construction supervision and will support Corix in issuing and evaluation of the tender document for the supply and installation of the various components of the work.

Corix will employ a competitive tendering process for construction and installation components of the project. Upon commissioning of the temporary solution, the operations and maintenance requirements will be covered by a subcontractor until the full-time personnel are required for the project.

The staffing requirements for the temporary and permanent energy centres are based on needs and regulations. Corix estimates that the staffing requirements for all operation and maintenance services will range from 0.1 FTE in 2015 to 4.9 FTE in 2024 (the year the CEP is connected).

The BC Safety Authority has regulations governing the requirements for energy centres. For staffing requirements, the appropriate regulation is the Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation. The key factors determining plant classification and hence staffing requirements are fluid temperatures and pressures plus surface area of boiler installed, for boiler plants, and prime mover (i.e., compressor) nameplate capacities connected to the same header, for heat pumps.

Based on our interpretation of the current regulation and the concept proposed, the temporary energy centres, while on separate heating loops, will have less than 150 $m^2$ of heating surface area each, and will be exempt from supervision requirements under section 6 of the regulation. Once the two temporary plants are connected together via the DPS, they will become 5th Class Low Pressure Fluid Plants under 500 $m^2$ boiler surface area, and therefore would be eligible for general supervision status. General supervision requires the supervision of a qualified engineer 7 hours per day, 7 days a week, rather than 24-hour supervision, which is key to a viable business case for this scale of system.

The heat pumps in the proposed CEP concept combine 2,800 kW of prime mover nameplate capacity (to be confirmed once equipment is selected). As a result, under the current regulation the CEP would require continuous supervision. The regulation states that a Refrigeration or Power Engineer with a 4th Class or higher certification would be required to be in charge of the plant, 24 hours per day, 7 days per week.

Note that final rulings on plant status are determined solely by the BC Safety Authority.

The billing and customer care functions will be provided by Corix Customer Care Centre.

## 4.6 RISK ANALYSIS

Corix will strive to minimize risk to the NDES and its customers. Corix has successfully implemented the district energy system serving UniverCity and will apply experience from that project as well as our utility operations in other jurisdictions. *Table 25: Sensitivities* summarizes sensitivity effects of changes to key elements in the project plan.

### 4.6.1 Development Risk

#### 4.6.1.1 Timing of Development is Delayed

There is a risk that development does not occur as forecasted.

*Mitigating Factors:*

1. The Project Plan has been designed with two phases to address development timing. If development is delayed, the temporary plants can be utilized until the load is sufficient to implement Phase 2.
2. Phased approach to capital deployment. The TEC's will be installed as required, and there is a possibility to reduce the size of boilers within East TEC to reduce capital. Also, installation of the distribution system will be done just in time, to match development construction.

3. Corix will pursue capital grants for future phases. If successful, these grants will service to reduce customer rates
4. Corix is in discussion with Musqueam to determine a plan for having Block F tie into the system. If this does not occur, it is possible to reduce the size of the permanent system that serves only the UBC development lands

#### 4.6.1.2 Developer Connection to NDES

UBC has a mandatory connection requirement. However, the early load consists of low-rise buildings that may have a cost premium to install hydronic systems for DE connection.

*Mitigating Factors*

1. Connection credit for early buildings that will support installation of the hydronic system.

#### 4.6.1.3 Unable to secure agreement with TRIUMF

There is a risk that an energy supply agreement with TRIUMF cannot be obtained. Although waste heat from TRIUMF is not utilized in Phase 1, there may be risk to the overall intent of the Project Plan.

*Mitigating Factors*

1. UBC has been in discussions with TRIUMF since the beginning of the project and has an LOI in place. Please refer to Appendix Nine for reference.
2. The system will be designed and constructed to operate on natural gas from a temporary energy source. As the system develops, Corix will work with TRIUMF to negotiate terms. If it is determined that an agreement cannot be negotiated, the system can continue to run on natural gas while the Alternate Energy Source is identified.
3. During the feasibility and final due diligence, a biomass system was screened and found to be viable. If there is a risk to TRIUMF implementation, more detailed analysis will be completed for biomass in advance of the Phase 2 CPCN application.

#### 4.6.1.4 Performance Risk

There is a risk that the system does not perform as designed, constructed and operated.

*Mitigating Factors*

1. Corix has implemented similar systems and will continue to apply learnings as the NDES is developed.
2. Corix has retained recognized experts with local experience to design the system and will continue to do this throughout the entire project.

#### 4.6.1.5 Construction Cost Risk

There is a risk that construction and equipment costs may be higher than projected.

1. Corix has implemented similar systems and will continue to apply best practices as the NDES is developed.
2. Corix has retained recognized experts with local experience to design the system and will continue to do this throughout the entire project. KWL, Corix's technical partner, is currently working at UBC for the steam to hot water conversion, and will apply any learnings from that project.
3. Corix will work closely with the UBC Campus Planning group to ensure that all permits and construction rules are followed.
4. There will be a competitive tendering process for third-party suppliers, including all plant materials, piping, and services.
5. A defined tendering process, with appropriated contract structures will be pursued to control price risk.

#### 4.6.1.6 Public Acceptance

There may be a concern with the system construction and operation. Furthermore, there may be concerns with the use of TRIUMF waste heat.

*Mitigating Factor*

1. A Community Energy and Emissions Plan (CEEP) was completed in consultation with the residential community.
2. UBC has been communicating with the University Neighbourhood Association (UNA) through the entire process.
3. A public consultation process has been undertaken for this project and to date there have been no significant concerns regarding the project.

## 4.7 PHYSICAL, BIOLOGICAL AND SOCIAL IMPACTS

Once the CEP is commissioned and waste heat is being utilized from TRIUMF, the NDES will result in substantial reductions in greenhouse gas (GHG) emissions as compared to typical building-scale thermal energy systems. At build-out, a target of 60% of total energy requirements will be supplied using the Alternate Energy Source. *Figure 28: GHG Emissions Profile*, outlines the GHG emissions over the duration of the Project Plan and compares it to standard benchmark. Phase 1 of the Project Plan has 100% of the NDES energy supplied by natural gas, therefore there will be higher GHG emissions during this phase.

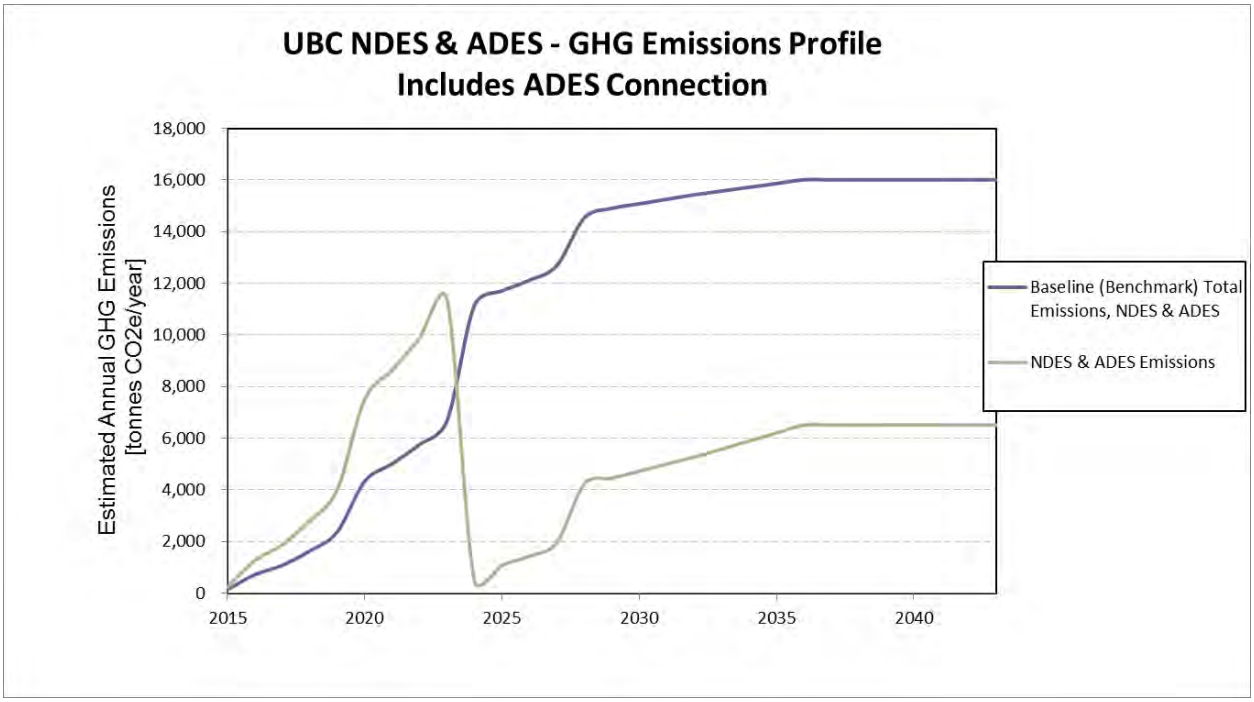
The temporary energy centres will be located in areas that have minimal impact on the neighbourhood. TEC-W will be located in an abandoned roadway, adjacent to the UBC Farm that will ultimately become a pedestrian greenway.

TEC-E is currently planned to be on a future green street bordered by BCR1, BCR2 and BCR7. Alternatively, it is possible to build the temporary plant in a building mechanical room of the future building in Lot 6 (Binning Tower) and discussion with developer has been initiated.

Wesbrook EC/ETS is currently planned to be installed within a building on Lot #27, within a designed mechanical room, thereby minimizing neighbourhood impact.

The permanent CEP is currently planned to have a site footprint of up to 0.5 ha. Based on the current Project Plan, this is likely to be a brownfield site. The redevelopment of the site will provide an opportunity to improve storm water management and landscaping.

**Figure 28: GHG Emissions Profile**




## 4.8 CUSTOMERS

Customers served in Phase 1 by the NDES will primarily be residential customers in Wesbrook Place, with some later residential customers in Acadia East and Block F. The overall Project Plan contemplates customers that are considered residential or mixed use, commercial, institutional for academic Buildings and an ADES class of customer for provision of Energy Services to the ADES.

Customers will reside in Wesbrook Place, Stadium Road, and Acadia East and potentially within the Musqueam First Nation's Block F parcel in the UEL. *Figure 29: Geographic Area* on the following page, outlines the geographic area.

**Figure 29: Geographic Area**

## 4.9 PERMITS AND APPROVALS

The NDES will require a CPCN to operate.

Development and Streets and Landscape permits will be required through UBC to construct the temporary energy centres.

Approval and determination of staffing requirements by the BC Safety Authority will be required prior to operation of the temporary and permanent energy centres.

An air quality permit is not currently required under the base Project Plan.

SRWs will need to be obtained through the province for pipeline crossings of certain roadways. UBC will support Corix in this process.

# 5 PROJECT COSTS

## 5.1 CAPITAL COST ASSUMPTIONS

### 5.1.1 Capital Cost Estimate

#### 5.1.1.1 Project Cost Assumptions

##### 5.1.1.1.1 General Assumptions

The overall cost estimate of the UBC Neighbourhood District Energy System (NDES) is a Class C estimate, which the Association of Consulting Engineering Companies British Columbia (ACEC-BC) defines in the following way:

> "An estimate prepared with limited site information, based on probable conditions affecting the project. It represents the summation of all identifiable project elemental costs and is used for program planning, to establish a more specific definition of client needs and to obtain preliminary project approval. Class C estimates typically have an accuracy of +/- 25-40%."

However, some elements of this cost estimate have a higher degree of accuracy and can be classified as Class B, defined by ACEC-BC in the following way:

> "Class B estimate (+/- 15-25%): this is prepared after site investigations and studies have been completed and the major systems defined. It is based on a project brief and preliminary design."

##### 5.1.1.1.2 Temporary Energy Centres Containerized Plants – Class B

The cost estimate for the TEC is based on 2014 tender pricing received for a similar containerized boiler plant for another lower mainland district energy project that KWL is leading. The tender price was for two (2) (2.5 MW) non-condensing boilers installed inside a 53' shipping container complete with expansion tanks, piping, valves, pumps, controls and a 58 kW boiler for meeting turndown requirements in the early years of the DES.

The price has been adjusted to allow for higher capacity boilers by the same manufacturer (2.9 MW), and the feasibility of installing larger boilers within the same layout has been confirmed with the contractor.

General conditions have been estimated at 4.5% of the contract value.

Engineering costs have been estimated at 6% of the contract value (for design and specifications, tendering, contract administration and construction support).

A contingency of 10% has been applied to the TEC cost estimate, given that the estimate is based on recent tender pricing.

##### 5.1.1.1.3 Temporary Energy Centre Installation – Class C

The cost estimate for the TEC installation is based on averaged unit pricing received for the installation of similar containerized plants in the Lower Mainland.

The installation cost of the TEC includes the following:

- reinforced concrete foundation and seismic anchoring of the container;
- sanitary sewer connection;

- water service connection;
- gas service connection;
- electrical service connection; and
- supply and return piping for the district energy system.

TEC locations have not been finalized, but will be under the UBC permit process. Storm sewer connections have not been included in the estimates as the TEC-W is expected to be installed on an existing asphalt surface, and runoff for the TEC-E can likely be infiltrated on-site.

The cost to tie the TEC into the distribution piping system (DPS) was also based on averaged tender pricing on recent projects administered by KWL.

Service agreements, including any connection costs have not been finalized with BC Hydro, FortisBC or UBC Utilities. An allowance of $25,000 has been made for the electrical and gas service connections. The cost estimate for the water and sanitary service connections are based on averaged unit rate pricing for similar work. It was assumed that 20 m of pipe would be required to tie into the water and sanitary mains in Wesbrook Place.

Demolition and site restoration costs for the TECs are included in the estimate at $25,000 per TEC.

General conditions were estimated at 7% of capital cost, engineering at 15% and a contingency of 20% has been added.

#### 5.1.1.1.4 Central Energy Plant – Class C

The cost estimates of the CEP are based on the following:

- 2013 supplier quotations for 4 x 2.5 MW Heat Recovery Heat Pumps and 3.4 MW Non-condensing Natural Gas Boiler;
- Electrical consultant estimate for the Electrical Balance of Plant;
- KWL expertise for the Mechanical Balance of Plant; and
- Scaling of the 85% design cost estimate of the UBC Combined Heat and Power Plant for Mechanical and Electrical Services as well as Building, Structure and Site Work.

General conditions have been estimated between 3% and 7% of capital costs, engineering between 10% and 15%, and contingency between 10% and 20%, depending on the level of detail and uncertainty of the associated capital cost. The higher rates apply to all Building, Structure and Site Work costs, since the location for the CEP has not been finalized.

Site Work costs include 250 m of supply and return HDPE piping to connect the TRIUMF Cooling Towers to the CEP.

#### 5.1.1.1.5 Nodal Energy Centres / Energy Transfer Stations & Pump Station– Class C

The cost estimates of the Wesbrook and Stadium Road EC's and of the Heat Pump Station are based on the following:

- 2013 supplier quotation for the 5 MW Non-condensing Natural Gas Boiler;
- Recent tender unit pricing for similar projects for Electrical & Control; and
- KWL expertise for the Mechanical Balance of Plant and the Heat Pump Station.

It is assumed that the Wesbrook EC/ETS and the Stadium EC/ETS will be integrated into future residential buildings (i.e., they will not be in standalone buildings). As a result, the cost estimate does not include building costs, but only space allowance provisions.

The locations of the plants have not been finalized. General conditions have been estimated at 3% of Mechanical, Electrical and Equipment capital costs and 7% of Building, Structure and Site Work costs; engineering at 15%; and contingency at 20%.

#### 5.1.1.1.6 Distribution Piping System – Class C

KWL has extensive experience with the design and installation of pre-insulated piping for hot water district energy systems in the Lower Mainland, particularly at UBC. The per-linear-meter cost factors for individual pipe diameters are based on actual installed costs of DPS in the Lower Mainland. The quantities and sizing of pipe in the cost estimate are based on the DPS layout shown in drawing G-002, which was developed using a WaterCAD model to optimize the pipe sizing and the pipe lengths were determined using GIS.

DPS alignments and locations have not been finalized. General routing has been identified, however major utility conflicts have not been identified or included in the cost estimates.

DPS service connection allowances are included for all building and energy centre connections.

General conditions were estimated at 7% of capital cost, engineering at 15%, and a contingency of 20% of capital has been added.

#### 5.1.1.1.7 Energy Transfer Stations – Class C

KWL has extensive experience with the design and installation of energy transfer stations (ETS) in both new and existing buildings in the Lower Mainland. In KWL's experience, an ETS installed in a new high-rise or low-rise building will cost approximately $115,000, including general conditions, engineering and contingencies. KWL has found that the design capacity of the ETS is a relatively insignificant factor in the overall cost of an ETS for Multi-Unit Residential Buildings in the Lower Mainland.

The ETS cost for existing buildings is generally higher than that of new buildings because of additional constraints and demolition costs in existing mechanical rooms. In KWL's experience, an ETS installed in an existing high-rise or low-rise residential building will cost approximately $155,000, including general conditions, engineering and contingencies, and the cost of an ETS in an existing commercial building $65,000.

General conditions have been estimated at 3% of total capital cost for the ETS, while engineering has been estimated at 6% for design, specification, tendering and construction support. A contingency of 10% has been added to the capital cost.

#### 5.1.1.1.8 Exclusions

The following specific items are excluded from the cost estimates:

- Land acquisition costs associated with the temporary and permanent energy facilities, including the TECs, Wesbrook and Stadium EC/ETSs, CEP, DPS and ETSs.
- Geotechnical work required to assess foundation requirements for any buildings or structures;
- Contaminated site investigations or remediation;
- Environmental impact mitigation;
- Allowances for utility conflicts;
- Cost premiums due to critical shortages of labour and/or materials; and Goods and Services Tax (GST).

#### 5.1.1.2 Project Capital Cost and Budget

**Table 27: Project Capital Cost and Budget**

| NDES Element | Base Cost | General Conditions, Engineering | Total |
|---|---|---|---|
| **Temporary Energy Centres (W-TEC & E-TEC)** | $1,636,460 | $397,394 | **$2,033,854** |
| **Wesbrook EC/ETS** | $1,968,000 | $766,920 | **$2,734,920** |
| **Stadium EC/ETS** | $721,800 | $282,684 | **$1,004,484** |
| **Central Energy Plant (CEP)** | $20,108,233 | $5,947,794 | **$26,056,027** |
| **Distribution Piping System (DPS)** | $16,959,427 | $7,122,959 | **$24,082,386** |
| ***DPS Unit Cost ( $/per trench meter)*** | *$2,207* | *$927* | ***$3,134*** |
| DPS 2015 - 2023 | $8,197,783 | $3,443,069 | **$11,640,852** |
| *2015-2023 DPS Unit Cost* | *$2,108* | *$886* | ***$2,994*** |
| DPS 2023 - 2044 | $8,761,644 | $3,679,890 | **$12,441,534** |
| *2024 - 2044 DPS Unit Cost* | *$2,308* | *$969* | ***$3,277*** |
| **Energy Transfer Stations (ETS)** | $10,153,462 | $1,929,158 | **$12,082,620** |
| **No. of ETS** | 103 | n/a | n/a |
| *2015-2023 No. of ETS* | *38* | *n/a* | *n/a* |
| *2024-2044 No. of ETS* | *65* | *n/a* | *n/a* |
| ***ETS Unit Cost*** | *$98,577* | *$18,730* | ***$117,307*** |
| **Total** | **$51,547,383** | **$16,446,909** | **$67,994,292** |

# 6 PROVINCIAL GOVERNMENT ENERGY OBJECTIVES AND POLICY CONSIDERATIONS

The UBC NDES Project aligns with several provincial government objectives under the 2007 *BC Energy Plan* and the *Clean Energy Act*.

1. The Province has set ambitious goals to reduce the growth in electricity demand so that, by 2020, 10,000 GWh of currently forecast needs will be met through demand reduction measures. By implementing hydronic heating systems in buildings there will be a reduction in the direct use of electricity for space heating when compared to benchmark. Considering that 40% of annual energy is used for space heating, it is estimated that implementation of the NDES will provide direct energy savings of 25,300 MWh/year, approximately 40% lower than the competitive benchmark.
2. The utilization of waste heat recovered from TRIUMF in Phase 2 will reduce overall GHG emissions as depicted in *Figure 28: GHG Emissions Profile*. 60% of total energy demand will be supplied by an Alternate Energy Source. The project will reduces GHG emissions by 4,800 tonnes/year approximately 64% less than the competitive benchmark.

# 7 NEW SERVICE AREAS

The NDES will be a new utility at UBC, providing space heating and domestic hot water services to the new residents in the Development Areas.

Corix will be responsible for operation of the utility as well as emergency response, billing and customer care.

In the initial phase of operation, before the CEP is developed, the TECs will provide energy service. This facility will be remotely monitored with regular visits by Corix personnel.

An emergency response phone number will be set-up prior to the start-up of the NDES. Customer bills will include emergency contact information as well as contact information for customers having any questions and concerns regarding billing and customer care. The emergency contact information will be also posted at the central energy plant. The TECs and ETSs will be equipped with a remote monitoring system that will automatically contact Corix operations personnel in the event of any unusual situation or problem with system performance.

Once the permanent facility is built, a dedicated Operations Manager and full-time Plant Operators will be assigned to the project. Any additional operating staff will be available from Corix to address any immediate needs. Corix has a pool of 50 certified operators and operates several DES across North America with the closest being the UniverCity Neighbourhood Utility System on Burnaby Mountain and the Dockside Green Energy system in Victoria.

A review of potential customers outside of the proposed service areas for the UBC NDES has identified the following opportunities. These other customers -may be considered in future through individual extension tests.

- University Endowment Lands
- Connection to UBC's Academic District Energy System
- Other "non-district energy ready" buildings located in other UBC neighbourhoods such as Hawthorn Place, Chancellor Place and Hampton Place (likely only domestic hot water and common-space)

Corix will undertake all extensions consistent with the capital plan and rates in the Project Plan, as approved by the BCUC. Where an extension of the Infrastructure deviates significantly from the capital plan and such extensions would increase rates beyond the rates contemplated in the Project Plan and approved by the BCUC, Corix will notify UBC and seek approval from the BCUC accordingly. In such cases, Corix may still seek such extensions if they can be deemed in the public interest, including the development objectives set out by UBC and/or undertake the extensions with an appropriate contribution in aid of construction from UBC and/or loads. The Project Plan notwithstanding, Corix will continue, as reasonable, to seek out and implement viable strategies that reduce rates and/or increase GHG savings relative to the approved Project Plan.

# APPENDIX ONE: DRAWINGS

Please find attached in this Appendix:

- Drawing C101: West Temporary Energy Centre
- Drawing C102: East Temporary Energy Centre
- Drawing G002: Servicing Plan – Phase 1
- Drawing G003: Servicing Plan – Phases 1-2

# APPENDIX TWO: PRE-FEASIBILITY STUDY AND FEASIBILITY STUDY

Please find included in this Appendix:

- Final Report for the District Energy Pre-Feasibility Study for Wesbrook Place (South Campus) as prepared by Stantec Consulting Ltd., dated June 24, 2011
- Feasibility Study for the Neighbourhood District Energy System for UBC Expansion Areas as prepared by Compass Resource Management Ltd. In Association with FVB Energy, dated November 30, 2012

# APPENDIX THREE: PUBLIC CONSULTATION OPEN HOUSE AND FEEDBACK

Please find included in this Appendix:

- First Public Consultation
- First Public Open House Feedback Form
- Second Public Consultation
- Second Public Open House Feedback Form

# APPENDIX FOUR: PUBLIC CONSULTATION SUMMARY REPORTS

Please find attached in this Appendix:

- UBC NDES First Public Consultation Summary Report from November 2013
- UBC NDES Second Public Consultation Summary Report from June 2014

# APPENDIX FIVE: UNA BOARD PRESENTATION

Please find enclosed in this Appendix:

- UNA Board Presentation dated July 8, 2014

# APPENDIX SIX: PROCESS SCHEMATIC

Please find included in this Appendix:

- Process Schematic for the Energy Transfer Station

# APPENDIX SEVEN: UBC DISTRICT ENERGY COMPATIBILITY GUIDE

Please find included in this Appendix:

- UBC District Energy Compatibility Guide

# APPENDIX EIGHT: 2014-2015 PROJECT SCHEDULE

Please find included in this Appendix:

- BCUC Application – 2014-2015 Project Schedule

# APPENDIX NINE: UBC TRIUMF LETTER OF INTENT

Please find enclosed in this Appendix:

- UBC-TRIUMF LOI Executed
- UBC-TRIUMF LOI Extension - Oct 31-2014_signed

# APPENDIX TEN: INFRASTRUCTURE AGREEMENT

Please find enclosed in this Appendix:

- Infrastructure Agreement